APPENDIX B

ENGINEERING INFORMATION

APPENDIX B.1

CIVIL ENGINEERING DESIGN CRITERIA

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CIVIL ENGINEERING DESIGN CRITERIA AND CIVIL DESIGN CRITERIA

1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the Project will be completed in accordance with various predetermined standard practices and project- specific practices. An orderly sequence of events for the implementation of the Project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Startup, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the Project. The general foundation and civil engineering design criteria defined herein form the basis of the design for the foundation and civil systems of the Project. More specific design information will be developed during preliminary and detailed design to support equipment procurement and construction specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes, standards laws and ordinances and Section 3.0 includes the general criteria for foundations, design loads, and, general site information.

2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

The design and specification of work will be in accordance with all applicable laws and regulations of the federal government, the State of California, and with the applicable local codes and ordinances. The following laws, ordinances, codes, and standards have been identified as applying to civil engineering design and construction.

The edition and/or addenda to a law, ordinance, code, or standard that has been adopted and is in place at time of plant design and construction will apply to work performed for this Facility.

A California-registered Professional Engineer stamp is required on design documents.

2.1 State and Local Building Codes, Standards and Ordinances

- Code, Rules and Regulations of the State of California
- International Building Code (IBC)

- California Building Standards Code (CBSC)
- California Electrical Code
- California Fire Code
- California OSHA (CALOSHA)
- Local ordinances, regulations, and requirements

2.2 U.S. Government Codes, Ordinances, and Standards

- Occupational Safety and Health Act (OSHA)—29 CFR 1910, 1926
- Federal Aviation Agency (FAA)— Obstruction Marking and Lighting AC No. 70/7460-IJ) 14CFR 77
- Environmental Protection Agency (EPA) —40 CFR 423, 40 CFR 60, 40 CFR 72, 40 CFR 75,
- Spill Prevention, Control and Countermeasures Regulation, 40 CFR 112
- Appendix A to Part 36, "American Disability Act Accessibility Guidelines for Buildings and Facilities (applicable only to administrative and control room areas).

2.3 American National Standards Institute

The following standards of the American National Standards Institute (ANSI) will be followed:

- B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- B16.5 Steel Pipe, Flanges, and Fittings
- B16.34 Steel Valves
- B30.17 Overhead and Gantry Cranes

2.4 Industry Standards

Applicable standards issued by the following industry organizations:

- American Association of State Highway and Transportation Officials (AASHTO)
- American Concrete Institute (ACI)
- American Gas Association (AGA)
- American Institute of Steel Construction (AISC)
- American Iron and Steel Institute (AISI)
- American Petroleum Institute (API)
- American Society for Nondestructive Testing (ASNT)
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- Crane Equipment Manufacturer's Association of America (CMMA)

- Metal Building Manufacturers Association (MBMA)
- National Association of Corrosion Engineers (NACE)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Steel Structures Painting Council (SSPC)
- Thermal Insulation Manufacturers Association (TIMA)
- Welding Research Council (WRC)

3.0 DESIGN CRITERIA

3.1 Site Preparation

Site preparation will consist of clearing and grubbing and the placing and compaction of fill with slopes and embankments designed in such a fashion as to be stable and capable of carrying anticipated loads from either equipment or structures constituting part of the Project.

Materials from clearing and grubbing operations will either be removed from the jobsite and properly disposed of or, if suitable, reused on site.

Erosion and sediment control measures will be taken to prevent or minimize erosion and sediment transportation associated with the new construction. Measures will be in accordance with Applicable Laws.

Root mats will be removed to a depth of not less than 6 inches below existing grade, and holes will be refilled with material suitable for embankment and compacted.

3.2 Geotechnical Investigations

A detailed soils investigation, which will be the basis for plant foundation work, will be performed. The results of the investigation and recommendations will be documented in an engineering report certified by a licensed, California Geotechnical Engineer who is familiar with the various types of soils that exist in the area of the Project, including the geologic and seismic conditions.

The site preparation work and foundation selection will be engineered to mitigate any effects of soil shrinkage and expansion and settlements. If necessary, soil stabilization, remediation, and/or piles will be provided in the engine hall areas and other areas as required to ensure settlements, and differential settlements are acceptable with respect to all settlement sensitive equipment including, but not limited to, the engines.

The resistivity testing conducted during the preliminary geotechnical investigation (Petra 2011) identified very low resistivity results indicative of soils that maybe severely corrosive to exposed metals. An additional soils investigation and corrosivity study will be conducted to provide further details about the corrosive nature of the soils to buried ferrous metals. The Project will include appropriate corrosion protection for all buried pipes in accordance with good engineering practice and this specification.

3.3 Surveying

An American Land Title Association/American Congress on Surveying and Mapping (ALTA/ASCM) Land Title Survey was performed by RBF Consulting in April 2011.This survey indicates property boundaries, easements, right of ways, existing features, known underground utilities, wetlands delineation, and site topography will be developed. Future surveys will include the establishment of permanent benchmarks for construction of the Project.

3.4 Site Development and Earthwork

The site will be developed as required for both the initial construction and the final operating conditions of the Project. The initial earthwork services will be performed based on the results of the geotechnical investigations and topographical surveys. However, the final site work will meet all minimum requirements of the detailed plant layout. Site preparation will consist of clearing and grubbing and the placing and compaction of fill with slopes and embankments designed in such a fashion as to be stable and capable of carrying anticipated loads from equipment or structures.

3.5 Temporary Construction Facilities

Temporary facilities required to construct the Project, as noted below, will be provided. All temporary facilities will be removed as required or upgraded to meet the final plant requirements.

- Installation and maintenance of construction parking and construction laydown areas
- Construction trailers and facilities as required by construction, testing, inspection, engineering, supervision, management, and other personnel
- Improvements to existing roads to transport equipment to the site, either temporary for construction purposes or permanent to support plant maintenance and operation activities.
- Construction of temporary drainage facilities
- Providing temporary erosion control during earthwork
- Final grading and cleanup after the Project is essentially complete
- Providing portable toilets at the Project site during all construction activities

Restoration of all areas affected by the construction of access road, parking, and laydown areas will be conducted following project completion. Adequate space will be provided for temporary trailer(s) for construction and operation staff. Trailers will be equipped with temporary furnishings, HVAC, and set up for phone and high-speed internet access during plant construction and commissioning until Substantial Completion. The trailers will be located on-site, in close proximity to the Project construction.

3.6 Project Grading

Project grading will include the following items:

- Shape the natural grade as required to accommodate permanent Project equipment and construction facilities while minimizing earthwork.

- Obtain proper cross section, longitudinal slopes, and curvature for roads.
- The 100-year runoff from uphill drainage areas will be diverted around the Project and returned to the natural drainage course in a manner acceptable to the permitting agency.
- To the extent practical, runoff from the uphill drainage areas will be maintained in the same watershed following construction.
- Construct adequate in-plant surface drainage to discharge the 10-year runoff without flooding roads and the 50-year runoff without flooding plant facilities.
- Obtain proper area slopes to provide drainage without ponding.
- Construct stable, erosion-resistant earthen side slopes.
- Prepare sub-grade for foundations, including consolidation, soil remediation, mass excavation and backfill, pile driving, etc. as required to mitigate unacceptable settlements and to provide sound bearing for the facilities. These provisions will meet or exceed the requirements noted in the geotechnical report.
- Prepare sub-grade to receive fills, where required.
- Prepare site grading that will incorporate site slope, site drainage, road and erosion protection.
- Remove root mats to a depth of not less than 6 inches below existing grade; holes will be refilled with material suitable for embankment and compacted.
- Protect identified environmentally sensitive areas as required by Applicable Laws.

3.6.1 Earthwork

Excavation, grading, backfilling, and compaction will be performed as dictated by the soil characteristics of the site, the geotechnical study, the Project design criteria, and Applicable Standards. Earthwork will be performed in accordance with Applicable Laws and Applicable Standards.

The work will include removing and disposing of unsuitable materials such as organic matter from areas on which fill is to be placed, and excavating and deposing of materials from areas where existing grade is to be raised. Grading of cuts, fills, and drainage ditches will be provided as required.

At no time will filling operations proceed when the ground or fill material is water soaked.

3.6.1.1 Grading

Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain.

The final grade adjacent to equipment and buildings will be at least 6 inches below the finished floor slab unless otherwise specified and will be sloped away from the building to maintain proper drainage.

Finish site grading will be adequately established to deter surface pooling and promote surface drainage away from equipment and structures.

3.6.1.2 Backfilling

Areas to be backfilled will be prepared by removing unsuitable material and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill.

Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve the specified density. In order to verify compaction, representative field density and moisture-content tests will be taken during compaction.

Granular load-bearing backfill will be sound, durable crushed rock, clean sand and/or gravel.

Selected suitable backfill material will be available at the site or borrowed as required to satisfy Project design criteria, and the requirements identified in the geotechnical report.

Pipe trench bedding material will be clean sand, as required.

Where it is necessary to remove only a portion of the unsuitable materials and backfill, the backfilling operation will begin by stabilizing the existing materials to enable proofrolling or normal construction equipment to operate thereon.

3.6.1.3 Compaction

Structural fill supporting foundations, roads, and parking areas will be compacted to a minimum of 98 percent of the Modified Proctor maximum dry density in accordance with ASTM D1557. Embankments, dikes, and backfill surrounding structures will be compacted to a minimum of 95 percent. General backfill will be compacted to at least 90 percent. These compaction values may be adjusted by the Project's Engineer of Record.

Areas compacted by hand-operated mechanical tampers will be compacted to the same minimum compaction as the rest of the fill. Care will be taken so that the fill in these areas is integral with the rest of the fill.

3.6.2 Clearing and Grubbing

Areas to be graded will be cleared of all vegetation. Waste from clearing will be disposed offsite in accordance with applicable laws.

3.6.3 Stripping

All topsoil and other organic materials will be stripped from the areas to be graded before starting earthwork. Topsoil will be placed in a temporary stockpile for later recovery and use for landscaping the site. The stockpile will be provided with temporary erosion control facilities.

3.6.4 Disposal of Unusable Soils

Disposal of unusable soils will be accomplished in accordance with all applicable laws.

Large rocks and cobbles may be segregated and reused onsite for areas where the materials meet requirements for riprap.

3.6.5 Erosion Control

Temporary facilities will be provided for control of erosion and turbid runoff during earthwork operations and from graded areas until they are stabilized. Temporary facilities will be in accordance with Applicable Laws and Applicable Standards.

Permanent erosion control facilities for surface runoff as required for ditches and slopes, such as riprap, headwalls, grass, rock surfacing and slope pavement, will be provided and be acceptable to regulatory agencies.

All excavations will be carried out and supported in such a manner as to prevent flooding or ponding of water and damage or interference to structure, services, or stored equipment/materials.

Excavations for foundations will be sealed with a concrete mud mat or seal slab, if required, as soon as possible after being excavated and inspected.

Fill materials will be suitable for the intended purpose and will not include materials hazardous to health, material susceptible to attack by ground or groundwater chemicals, material susceptible to swelling or shrinkage under changes in moisture content, highly organic or chemically contaminated materials, or any other unacceptable materials.

Compaction of fill materials will be carried out as soon as practicable after deposition of fill materials. Fill will be compacted to the densities appropriate to the design requirements, fill type, and depth of layers.

3.6.6 Existing Underground Facilities

Existing underground lines, utilities, obstructions, etc. will be identified and redesigned, relocated, or removed as necessary.

3.7 Access

The Project site will be accessed off of the Sycamore Landfill Road, along the southwestern edge of the property. The access road will be required for both the construction and operation of the Project.

Construction of the access road will require protection of the existing drainage structure along the northern side of the Sycamore Landfill Road, as well as protection of the natural gas line that will be installed to services the Project.

The access road to the Project will require two lanes (one lane each direction) and will be paved with asphalt. The road must be designed to support the necessary loads during both the construction and operation phases of the Project, including (but not limited to cranes, fire engines, and other equipment requiring an extended turning radius and load rating.

A separate truck unloading area or turnout for heavy equipment (excavators, bulldozers, etc.) will be included along Sycamore Landfill Road to allow the unloading and loading of the construction equipment to be conducted off of the Sycamore Landfill Road.

3.8 Drainage Systems for Clean Stormwater, Sanitary Wastewater, Oil-Contaminated Wastewater and Process Wastewater

The Project will be provided with the following drainage systems:

- Clean stormwater drainage system
- Sanitary wastewater system
- Oil-contaminated wastewater system
- Process wastewater system

3.8.1 Clean Stormwater Drainage System

Clean stormwater runoff is runoff from Project areas not subject to contamination. The stormwater drainage will be maintained within the existing sub-watersheds to the extent practical. Clean stormwater will be collected via a new stormwater drainage system and discharged to the natural water course via a culvert under Sycamore Landfill Road.

Stormwater draining from offsite, northeastern areas will be directed along the northern edge of the plant site, around the plant site.

The stormwater drainage system for clean stormwater outside of the fenced plant site will consist of drainage swales, channels, culverts and where appropriate, concrete lined channels and energy dissipation materials.

Surface drainage systems inside the Project will be sized to discharge the 10-year, 24-hour runoff without flooding roads and the 50-year, 24-hour storm event without flooding the Project and equipment. (The storm events will be as defined by the San Diego County Hydrology Manual or local regulations if more stringent.)

An open ditch system is not allowed for drainage within the power plant site. The storm drainage system includes catch basins for collecting stormwater and an underground piping system with manholes at all junction points and turns.

The entire property area affected by the Project will be equipped with provisions to drain clean stormwater runoff into the clean stormwater drainage system.

The stormwater runoff system will be designed and constructed in accordance with ASCE Manual No. 77, ”Design and Construction of Urban Storm Water Management Systems.”

Roof drains from the administration/control/maintenance building will discharge directly into a stormwater drainage system and not flow over parking lots, ground slabs, etc.

When culverts are utilized, the inlets and outlets will be provided with permanent erosion protection.

3.8.2 Stormwater and Secondary Containment Structures

Secondary containment structures and basins will be included around outdoor chemical and oil containing equipment and tanks. These containment structures will be designed to drain to a sump. The sump will be equipped with a valved outlet for draining collected rainwater to the clean stormwater drainage system. Some containment basins may be designed to have clean rainwater manually pumped out. The containment basin will have normally closed valves that will be designed to close automatically after use, so as to eliminate the possibility of being accidentally left open. Provisions will be provided in the containments to conveniently visually inspect the contained liquid and conveniently obtain a grab sample prior to release to stormwater system.

Unless greater volume is required by the applicable codes, these outdoor containments will be capable of holding 100 percent of the volume of oil or chemicals contained within the largest tank or equipment in the containment structure, plus the rainfall of the 25 year, 24-hour storm.

3.8.3 Sanitary Wastewater System

Sanitary wastewater will be collected by gravity and discharged to the on-site septic tank and drain field. The onsite wastewater treatment system will be designed with a septic tank and leach field. The sanitary system will be gravity flow and will be designed and constructed in accordance with the San Diego Regional Water Quality Control Board (SDRWQCB). The SDRWQCB has jurisdiction under the California Water Code Section 13282 and transfers jurisdiction to the County of San Diego, Department of Environmental Health (DEH). The sanitary system will be in accordance with the requirements and obtain a permit from the San Diego County DEH. Three or four percolation test borings will be drilled in the proposed leach field location to identify the average infiltration rate. A certified San Diego County sanitary sewer system consultant will be used for the design of the septic tank and leach field system.

3.8.4 Oil-Contaminated Wastewater System

An oil-contaminated wastewater sewer system will be provided to collect discharges from areas that have potential for oil contamination, including the following:

- Floor and equipment drains with the potential for contamination with oily wastes
- Engine area floor and equipment drains
- Maintenance shop area (including air compressor room/area)
- Storage area (lube oil drums)
- Drains, overflow etc. from oil unloading, storage and handling areas

All equipment and piping having the potential to spill or leak oil and not buried underground will be provided with a secondary containment structure in order to contain the oil in the event of a spill. Areas where only minor oil leakage is possible will have equipment-skid-attached containment for local collection and subsequent cleanup, when required.

Any oil-contaminated wastewater, from the areas listed above, will be directed by gravity to one of two bunkered waste water holding tanks of approximately 3,000 gals each. Contents will periodically be pumped to a tanker truck for disposal by a properly-licensed contractor.

Underground gravity lines carrying oily wastewater will not require double containment piping.

3.8.5 Process Wastewater

Discharges to the process wastewater sewer system will be non-oily wastewater with a potential for chemical contamination. These include equipment drains such as engine drains and area or building drains that contain potentially chemical contaminated runoff. These areas will be collected using floor drains, trenches, or sumps and gravity drained to one of two bunkered waste water holding tanks of approximately 3,000 gals each. Contents will periodically be pumped to a tanker truck for disposal by a properly-licensed contractor.

At a minimum, the following areas will be included:

- Drains with the potential for non-oily contamination
- Chemical bulk storage area building drains
- Chemical tank spill containment area drains
- Chemical truck spill containment area drains
- Sample panel building drains
- Any chemical sink drains

3.9 Roads, Parking Lots, and Walkways

The plant roads will be asphalt concrete on sub-base of properly stabilized soil aggregate mixture. The paving and sub-base thickness will be based on design and construction traffic loads. The Project access road from Sycamore Landfill Road will be 24 feet wide. The main plant perimeter road will be a minimum of 20 feet wide, or as required by authority having jurisdiction. The corners of plant perimeter road will be designed with a 50-foot outside radius to allow large vehicles (including fire engines) to negotiate the corners. The road inside of the switchyard area may be rock surfaced only. All road surfaces will be designed and paved to allow for proper drainage (puddling of water is not acceptable) and to allow transportation of heavy equipment and materials throughout the plant.

Parking spaces will be provided along the southern side of the Engine Hall for workers at the plant.

3.9.1 Project Roads

The main Project access road will be connected to the existing Sycamore Landfill Road and the intersections and roads will meet all Applicable Laws.

A looped interior Project road will be provided around the central Project area. Other interior Project roads will be provided where access is required to equipment, pump structures, or entrances to buildings or enclosures.

Roads will have minimum overhead clearance requirements to enable movement of equipment for removal or maintenance.

3.9.2 Road Width and Clearance Requirements

The minimum road widths are shown in Table B.1-1.

Table B.1-1 Minimum Road Widths

Road	Total Width (feet)	Paved Width (feet)	Shoulder Width (feet)
Project Access Road	30	24	3
Interior Roads	26	20	3
Entrances to Buildings/enclosures	Access width will match roll-up door width		

Note:
Or width as otherwise required by the authority having jurisdiction.

3.9.3 Road Pavement

Road pavements will be designed for AASHTO H-20 truck axle loads and loads of the heaviest piece of equipment transported or removed from the site. A load of up to 95,000 pounds may be required in the design to allow for fire truck access.

Parking pavement and all accessible areas of the power plant will be designed for passenger cars and light trucks.

Design life of the asphalt pavement will be 10 years.

3.9.4 Parking Area

A parking area will be provided adjacent to the administrative portion of the engine hall. The number and type of spaces will be per the authority having jurisdiction. The parking lot will be used for plant personnel and visitors.

3.9.5 Chemical Unloading

Chemical unloading areas including truck pads will be contained to prevent releases from entering the environment. Appropriate coatings will be provided inside the concrete containment areas.

3.9.6 Project Area Surfacing

Final area surfacing will be provided as shown in Table B.1-2.

3.9.7 Surfacing Plan

The paving plan including cross-section will be drawn on a copy of the general arrangement drawing.

Space will be available and identified on the Project site for maintenance laydown. This space will be indicated in the paving plan.

Table B.1-2 Final Project Area Surfacing

Type	Minimum Thickness	Location
Reinforced concrete	6 inches	All chemical truck unloading, spill containment areas, and other hazardous chemicals
Base material or crushed rock area surfacing (well graded material with maximum size of 1 inch) (ASTM D2940, ASTM D448, Size No. 57 or similar)	Design cross section providing adequate load bearing capacity for equipment and vehicular traffic	All unpaved areas outside the loop road with the potential to support maintenance equipment, mobile cranes, fork lifts and other wheeled vehicles
Base material or crushed road area surfacing (well-graded material with maximum size of 1 inch, ASTM D448, Size No. 57 or similar. Color or gradation to be distinguishable from drivable surface areas).	4 inches	All areas loop road not requiring vehicular access
Crushed rock area surfacing (ASTM D448, size no. 3)	Design cross section providing adequate load bearing capacity for equipment, 8-inch minimum	Unpaved sides of the radiators as required to support cranes used to remove fans, blades and motors.
Seeding or other appropriate ground cover	N/A	All disturbed areas outside of the engine hall or otherwise unpaved or surfaced Ditches
Asphalt		Perimeter road, internal roads to roll-up doors, Parking areas and adjacent to parking areas
Crushed rock	Good Engineering standard	Construction laydown areas

3.10 Fencing and Signage

The Project site will be identified with appropriate signage and fence.

Security fencing will be provided around the entire power plant area with separate security fencing around the entire switchyard.

Site perimeter fencing will be minimum 8-foot-high chain link topped by an extension arm holding three strands of barbed wire at 45° facing out. (Fencing will have pipe line posts at maximum 10'-0" centers, and a top and bottom tension wire.)

All posts, rails, fabric, wire, and gates will be galvanized. Interior road gates and secondary plant access gates will be 8-foot high by 24-foot wide automatic, rolling gate.

The gate across the main access road to the Project will be a 24-foot wide, motor-operated slide gate designed for use as a gate for an industrial Project. Gate will be designed to be operated both from the control room and locally using a card reader. A permanent goose-neck- mounted

card reader, standard-mounted lighting fixture, an intercom, and a fixed camera for viewing persons using the card reader/intercom will be provided at the main gate.

The Project switchyard fencing will be 8 feet high and will be considered independent of the Project. The gates entering the switchyard will be manually operated gates. Fencing layout, including gates, will be shown on the design drawings.

The fence will be grounded to limit step potentials below the permissible touch levels of IEEE 80 Safety in AC Substation Grounding.

Rights-of-way will be marked as required by Applicable Laws.

3.11 Buildings

The Project will consist of one main building which will house the following: administration, control room, reciprocating engine generator sets, warehousing, maintenance shop, and electrical switchgear.

Various other minor buildings, including a control house, located in the switchyard, may be required for the Project.

Power generation equipment (reciprocating engine generator sets) will be placed inside a building and will be suitably protected from the environment conditions at the site so maintenance work can be safely and efficiently performed.

The building may be pre-engineered, provided all specified design criteria are satisfied including overhead cranes as well as requirements by local, state, and federal building codes, and permitting agencies. Pre-engineered buildings will be designed as partially enclosed in accordance with the requirements of the MBMA Low Rise Building Systems Manual.

The miscellaneous electrical equipment enclosures for the CEMs, switchgear, MCCs, power distribution centers (PDCs), fire water pump, etc. may be modular, insulated weather-tight structures purchased with the equipment, provided all specified design criteria are satisfied in appropriate sections of this specification.

3.11.1 Location and Footprint of Buildings and Storage

The control room, warehouse, file storage, lunch room, and maintenance areas will be located in a centralized area in close proximity to each other.

Project buildings will be designed to accommodate no less than the specified number of employees as determined in the plant pro forma.

Project buildings will be sized appropriately for a 30-year plant service life. Adequate chemical storage space will be provided for 30 days of operation.

Buildings will be adequately sized and designed for ease of removal of large equipment (including such features as roll up doors, overhead crane, and trolleys).

3.11.2 Building Requirements and Sizes

The control, maintenance, and power house areas may be combined and will be arranged to provide sufficient space for plant operations and maintenance activities. These areas may be combined into one building (and may be one or two stories with a high-bay/low-bay arrangement). The maintenance areas will be designed with 20-foot (minimum) eave height. The control room, electrical switchgear room, battery room, instrument and electronics area will have minimum 14-foot eave height.

The buildings will house areas including the administration areas, control room, control equipment room, battery room, electrical equipment, communications room, and maintenance area (including an I&C area). These buildings will be enclosed, weather tight buildings. The high-bay areas will contain the plant maintenance area and will include a roll-up steel door(s) to accept large pieces of equipment. The low-bay areas will contain the station control room, battery room, electronics room, offices, and washrooms.

The administration, control room, and maintenance areas will be provided with power receptacles, and telephone and communications connections, as required and applicable. The power house and maintenance areas will be provided with service and instrument air drops, service water drops, and welding stations.

The offices, control room, and maintenance areas will be designed to meet the requirements of Applicable Laws. Space allocation for the various buildings and work areas are noted below. Building and work areas sizes are approximate and will be finalized during the detailed design phase of the project. Individual room sizes may vary but the building will have a minimum of the total square footage indicated in Table B.1-3.

Table B.1-3 Final Project Area Surfacing

Buildings and Work Areas	Size (Square Feet)	Minimum Inside Height (feet)
Buildings		
Control/Maintenance Area	5,000	10
Engine Hall Area	23,000	22
Electrical Switchgear Area	4,500	10
Control/Maintenance Area Rooms		
Control Room	900	10
DCS/PLC Room	400	10
Communication Room	150	10
Men's Restroom	100	8
Women's Restroom	100	8
Lunch Room & Kitchen	250	8
File Room	200	8
Conference Room	400	8
Plant Manager's Office	200	8
Two Staff Offices (size per office)	150	8
Janitor's Closet	40	8
Storage Closet	40	8
I&C Area	250	8
Maintenance Area	3,000	22

3.11.2.1 Control/Maintenance Building

The Control/Maintenance Area will include the control room, office space, and area facilities for all plant employees.

The control room will be sized for complete access to the control equipment and direct access to the site for operations. The room will be equipped with a false ceiling. The room will have lighting placed to reduce glare on the computer screens. Windows will be provided with window treatments and located to allow viewing of the engine hall area. Wiring for the control equipment will be behind walls or under the floor. Exposed conduits will not be allowed in the control room. Electrical panels located in the control room will be wall-mounted units. Conduits and wiring will not be exposed. Work space will have an ergonomic design.

The building will include offices for plant personnel, janitorial closet, storage closet, file room, lunch area, conference room, kitchen (with cabinets, fixtures, and appliances), maintenance area including Instrumentation and control (I&C) area, and men's and women's restrooms . The control room area will include the control room, Distributed Control System/Programmable Logic Controller (DCS/PLC) room, and communications room.

Reinforced concrete grade slabs in the maintenance area and I&C area will be treated with a floor hardener and oil-resistant sealer to accommodate maintenance or laydown. Interior partitions will be gypsum wallboard on metal studs. The walls between maintenance area and I&C area will be Concrete Masonry Unit (CMU) material. The maintenance building will be an exposed structure, but the walls will have 8 foot high interior liners to protect insulation.

Floor drains will be provided in the maintenance area, I&C area, and restrooms. The men's and women's restrooms will be tiled.

3.11.2.2 Engine Hall

Walls surrounding the engine-hall area and the auxiliary areas will be of non-combustible materials. The power house will be designed to house all the engine generator sets, and provided with adequate operation and maintenance facilities.

Adequate catwalks and service platforms will be provided for engine and generator maintenance.

Adequate sound proofing and noise attenuation will be provided to meet site boundary noise requirements.

Reinforced concrete grade slabs in the engine hall will be treated with a floor hardener and oil-resistant sealer to accommodate maintenance or laydown. Floor drains will be provided to eliminate any standing water. The floor drains will be plumbed to the waste water holding tanks.

Adequate lay down space will be provided such that simultaneous engine overhauls can be accommodated.

A minimum of 15-foot by 15-foot reinforced concrete foundation, curbed and drained to the waste water holding tank, may be provided adjacent to the building for a drum storage area. The building foundation will have a grating covered trench which slopes to sump. The sump and trench will be drained to the waste water holding tank.

The fire pump house will house one electric fire water pump, one diesel fire pump, and one jockey pump. Access doors will be provided for maintenance of the pumps.

3.11.2.3 Electrical Switchgear Building

The electrical switchgear will be housed in a room located near the control room. Access to the electrical room will be provided by one approximately 12-foot-high by 10-foot-wide roll-up door and double, hollow-metal fire-rated doors to the outside. All areas will have an exposed structure with 8-foot wall liners, or be constructed of masonry CMU, to protect the insulation. The DC battery system will be located in the electrical switchgear room.

3.12 Painting and Coatings

The Project coatings will be appropriate to provide environmental protection to the painted and coated items and provide for very low maintenance. Paintings and coatings will be suitable for 25 years.

Painting and coating system will include uniform color coordination for system designation. All exposed surfaces of the facilities will receive a protective coating system. All interior surfaces not coated will be painted. Concrete will be coated as required to protect against environmental conditions and chemical exposure.

All outdoor structural and miscellaneous support steel will be galvanized in accordance with ASTM A123, ASTM A153, and ASTM A385. Steel in high moisture areas, grating, embedded anchor bolts, assemblies, nuts, washers, plates, and assemblies are to be galvanized. Miscellaneous embedded plates will also be galvanized.

Indoor structures, such as building columns, will be painted. All paint coating systems will consist of surface preparation, a prime coat, and a finish coat. High-quality paint products, such as manufactured by Ameron, Carboline, Ceilcote, DuPont, Glidden, Porter, Sherwin Williams, or Tnemec will be used. Surface preparation and paint system application will be in accordance with the paint system manufacturer's recommendations. The primer, intermediate coat, and finish coat will be from the same manufacturer.

The following protective coating systems will be used:

a. Exposed structural steel, steel piping, and equipment will have a surface preparation as recommended by the paint manufacturer, a primer coat (2-4 mils dry film thickness [DFT]) of two- component inorganic zinc and a finish coat (4-6 mils DFT) of semi-gloss polyurethane paint.

b. Steel areas where chemical exposures (acidic, neutral, or alkaline) are anticipated to occur will have a surface preparation as recommended by the paint manufacturer, a primer coat (4-6 mils DFT) of polyamide epoxy paint, and a finish coat (2-3 mils DFT) of acrylic aliphatic polyurethane paint.

c. Externally exposed metal surfaces with service temperatures of 450°F to 750°F will receive a SSPC SP10 surface preparation, a primer coat (2-2.5 mils DFT) of inorganic zinc silicate paint, and a finish coat (1.5 mils DFT) of silicone aluminum paint.

d. Environmentally controlled areas with interior concrete and concrete masonry components requiring painting will have a surface preparation that is clean, dry, and free of contaminants, a primer coat (thickness rate per paint manufacturer) of masonry filler, an intermediate coat (2-3 mils DFT) of low-gloss acrylic latex, and a finish coat (2-3 mils DFT) of low-gloss acrylic latex.

e. Exterior and non-environmentally controlled areas with concrete and concrete masonry components requiring painting will have a surface preparation that is clean, dry, and free of contaminants, a primer coat (thickness rate as recommended by the paint manufacturer) of masonry filler, an intermediate coat (2-3 mils DFT) of water-borne acrylic paint, and a finish coat (2-3 mils DFT) of water-borne acrylic paint.

f. All drywall areas will have a smooth, clean, and dry surface preparation, a primer coat (0.5 to 3.0 mils DFT) of sealer or thinned finish coat as recommended by the paint manufacturer, and intermediate coat (1-2 mils DFT) of low-gloss acrylic latex paint, and a finish coat (1-2 mils DFT) of low-gloss acrylic latex paint.

g. The interior surfaces of steel tanks for the storage of domestic and service water will have a SSPC SP5 surface preparation, and two coats of epoxy polyamide (each coat 4-6 mils DFT) meeting or exceeding the requirements of ANSI/NSF Standard 61 for potable water tanks.

h. The interior surfaces of steel tanks for the storage of high purity water will have a SSPC SP5 surface preparation, a primer coat (4-6 mils DFT) of two-component zinc-filled epoxy, and a finish coat (4-6 mils DFT) of alaphatic amine epoxy.

i. The exterior surfaces of steel tanks will receive a primer coat (4-6 mils DFT) of two-coat zinc-filled epoxy and finish coat (4-6mils DFT) of polyurethane paint.

j. Building exterior finish coatings will be applied to all roof and wall panels and decks, wall louvers, flashings, gutters, trim, and other exposed galvanized surfaces.

Design engineer approved alternative materials and applications to the above coating schedule may be substituted.

3.13 Design

The design will conform to Applicable Laws and Applicable Standards. The design will be based on the CBSC, and other applicable local or state building code, the ACI, and AISC. All buildings, structures and equipment will be designed and built in accordance with Applicable Laws and Applicable Standards.

Strength design will generally be employed for reinforced concrete structures, and allowable stress design or load and resistance factor design employed for steelwork.

Wind, rain, and earthquake loading will be in accordance with Applicable Laws and Applicable Standards.

The design will take account of all applied loads, including dead, live, impact, thermal, dynamic, settlement, movement, and seismic, and other loading conditions where appropriate. Temporary loads during maintenance and erection will be considered.

Platforms will be designed for a minimum live load of 100 pounds per square foot (psf). Platform design will employ the use of grating in lieu of checkered plate unless required for containment purposes. All handrail, toe plate, ladders, cages, gates, etc., will be in accordance with OSHA Standard Rules and Regulations.

Pre-engineered building rafters will be designed for the appropriate collateral loading from roof supports, Heating Ventilation and Air Conditioning (HVAC) ducts, cable tray, and piping.

Grade slabs (engine equipment laydown) will be designed, at a minimum, for 300 psf. Ground floor slabs for shops and auxiliary buildings will be designed, at a minimum, for 150 psf. Storage areas will be designed for actual weight of material but no less than 150 psf.

Vendor-generated structural steel details, concrete reinforcing details, and erection drawings are to be reviewed and approved by an appropriate Professional Engineer, registered in California.

Access doors and hand rails will be designed and located for easy access for maintenance and inspections. Adequate hand railing and fall protection barriers will be installed for maintenance activities.

3.14 Construction

Working methods will ensure the construction of stable structures able to withstand all applied loadings during construction and for the design life of the Project without collapse, failure, or excessive deformation such as to cause any damage, loss of function, or durability problems.

A permanent Project benchmark will be established on the Project site based upon U.S. Geological Survey vertical datum. Settlement monitoring points will be provided, with a minimum of four points for each end of the bank of engines. The existing elevation at each point will be documented before setting of equipment.

All welding will be performed by welders qualified in accordance with AWS D1.1, using only procedures qualified in accordance with AWS D1.1.

3.15 Testing and Inspections

A program for testing soils during earthwork and when underground utilities and foundations are installed will be utilized. Criteria to be specified in final Geotechnical report.

The minimum moisture and density testing requirements for structural fill will be one test per 75 cubic yards with at least one test under each foundation greater than 15 square feet or as specified by Geotechnical Report.

In-place representative field density tests will be performed in accordance with ASTM D 1557 or as specified by Geotechnical Report.

If a compacted area fails to meet the specified compaction requirements, two additional tests will be performed for that area. If the results of either of the two additional tests-prove unsatisfactory, the area will undergo additional compaction and testing until test results meet the minimum compaction requirements.

Records of inspection and testing of soils to ensure compliance with design assumptions will comply with Applicable Standards. If pile-supported foundations are to be used, a pile load test program will be developed and implemented.

Testing and inspections of structures will be in accordance with Applicable Standards. Concrete test cylinder sets will be taken at the minimum rate of one set per day but not less than once for each 150 cubic yards for slabs, foundations, or walls. Concrete test cylinder sets for paving will be taken at the minimum rate of 1 set per day but not less than once for each 150 cubic yards, nor less than once for every 5,000 square feet. As a minimum, one set of cylinders will be taken for each equipment foundation, with exception that one set of cylinders may be made for each concrete truck load where multiple small foundations are poured from a single load. Test procedures will be in accordance with the appropriate ASTM standards.

A quality control system will be used to validate type and grade of high-strength bolts by sampling and metallurgical testing.

A testing program of high-strength bolts and nuts will be conducted to ensure that each bolt shipment meets the appropriate ASTM standards for dimensional tolerances and material quality.

All structural welds will be subject to inspection in accordance with weld quality requirements provided in AWS D1.1. Critical welds will be inspected as required, and all other welds will be subject to random inspection.

APPENDIX B.2

STRUCTURAL ENGINEERING DESIGN CRITERIA

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STRUCTURAL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the project will be completed in accordance with various predetermined standard practices and project specific practices. An orderly sequence of events for the implementation of the project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Startup, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the project. The general foundation and civil engineering design criteria defined herein form the basis of the design for the foundation and civil systems of the project. More specific design information will be developed during preliminary and detailed design to support equipment procurement and construction specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 10B2 summarizes the applicable codes, standards laws and ordinances and Section 10B3 includes the general criteria for foundations, design loads, and, general site information.

2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

The design and specification of work will be in accordance with all applicable laws and regulations of the federal government, the State of California, and with the applicable local codes and ordinances. The following laws, ordinances, codes, and standards have been identified as applying to civil engineering design and construction.

The edition and/or addenda to a law, ordinance, code, or standard that has been adopted and is in place at time of plant design and construction will apply to work performed for this Facility.

A California Professional Engineer stamp is required on design documents.

2.1 State and Local Building Codes, Standards and Ordinances

- Code, Rules and Regulations of the State of California
- California Building Standards Code (CBSC)

- International Building Code (IBC)
- California Electrical Code
- California OSHA (CALOSHA)
- San Diego Municipal Code: Land Development Code - Steep Hillside Guidelines
- Local ordinances, regulations, and requirements

2.2 U.S. Government Codes, Ordinances, and Standards

- Occupational Safety and Health Act (OSHA)—29 CFR 1910, 1926
- Federal Aviation Agency (FAA)—Obstruction Marking and Lighting AC No. 70/7460-IJ)
- Environmental Protection Agency (EPA)—40 CFR 423, 40 CFR 60, 40 CFR 72, 40 CFR 75, 40 CFR 112
- Appendix A to Part 36, "American Disability Act Accessibility Guidelines for Buildings and Facilities (applicable only to administrative and control room areas).

2.3 American National Standards Institute

The following standards of the American National Standards Institute (ANSI) will be followed:

- B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- B16.5 Steel Pipe, Flanges, and Fittings
- B16.34 Steel Valves
- B30.17 Overhead and Gantry Cranes

If comparable international standards to ANSI standards are proposed by Contractor, the Contractor has full responsibility to confirm the international standards are equal or better than ANSI standards, and that the deliverables are acceptable per the codes, standards, and permits of the site.

2.4 Industry Standards

Applicable standards issued by the following industry organizations:

- American Association of State Highway and Transportation Officials (AASHTO)
- American Concrete Institute (ACI)
- American Gas Association (AGA)
- American Institute of Steel Construction (AISC)
- American Iron and Steel Institute (AISI)
- American Petroleum Institute (API)
- American Society for Nondestructive Testing (ASNT)
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
- American Water Works Association (AWWA)

- American Welding Society (AWS)
- Crane Equipment Manufacturer's Association of America (CMMA)
- Metal Building Manufacturers Association (MBMA)
- National Association of Corrosion Engineers (NACE)
- National Concrete Masonry Association (NCMA)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Steel Structures Painting Council (SSPC)
- Thermal Insulation Manufacturers Association (TIMA)
- Welding Research Council (WRC)

If comparable international standards to above U.S. industry standards are proposed by Contractor, the Contractor has full responsibility to confirm the international standards are equal or better than the U.S. industry standards, and that the deliverables are acceptable per the codes, standards, and permits of the site.

3.0 STRUCTURAL DESIGN CRITERIA

The following design criteria will govern the requirements regarding dead and live loads, other loads, and loading combinations in the design of structures. The loads specified herein are the minimum loads to be considered in the design.

Steel structures will be designed by either the working stress method (ASD) or load reduction factor method (LRFD).

Reinforced concrete structures will be designed by the ultimate strength method.

3.1 Site Conditions

The Project will be designed in accordance with the following Site Conditions:

3.1.1 Site Elevation and Barometric Pressure

Site Mean Elevation is approx. 460 feet above mean low sea level

Site Standard Barometric Pressure at Site Mean Elevation is approx. 29.42 inHg

3.1.2 Temperatures

The outdoor operating temperature range for all equipment:

- 35 °F, Minimum Dry Bulb Temperature
- 95 °F, Maximum Dry Bulb Temperature

The Peak Summer Conditions (i.e., June through September), as determined by the average of the summer monthly maximum daily peak dry bulb temperatures and coincident relative humidity for 1947-1995:

- 81 °F, Dry Bulb Temperature, 58% Coincident Relative Humidity

3.1.3 Precipitation, Wind, Snow, and Earthquake

The Project will be designed for the maximum rainfall conditions listed below, in inches:

- 2.0 inches, 2-year, 24-hour maximum
- 3.5 inches, 10-year, 24-hour maximum
- 4.5 inches, 25-year, 24-hour maximum
- 5.0 inches, 50-year, 24-hour maximum
- 5.5 inches, 100-year, 24-hour maximum

Design snow loads will be in accordance with the requirements set forth in the latest editions of the California Building Standards Code (CBSC), and local governing building code. Design wind loads will be in accordance with the requirements set forth in the CBSC, and local governing building code.

The applicable basic wind velocity site specific exposure is 85 miles per hour (3-sec peak gust), Design Wind Velocity at a point 33 feet above ground level.

All structures shall be designed for wind loading/pressures based on the following minimum design parameters in accordance with the California Building Standards Code

- Exposure Type: C
- Importance Factor

  (I_w) = 1.0

Seismic design loads will be in accordance with the requirements set forth in the CBSC, and local governing building code. The site will be assigned a soil profile type as substantiated by geotechnical data for the specific site. The applicable seismic zone and minimum parameters are:

- Mapped Spectral Response Acceleration 0.2 s S_s = 1.120
- Mapped Spectral Response Acceleration 1.0 s S_1= 0.320
- Importance Factor, IP = 1.00

3.2 Design Loads, Load Combinations and Allowable Stresses

3.2.1 Dead Loads

Dead loads will be considered as the weight of all permanent construction, including walls, floors, ceilings, stairways, all fixed empty vessels and equipment, built-in partitions, structures, fireproofing, insulation, piping, and electrical conduits.

3.2.2 Live Loads

Live loads will be defined as those loads produced by the use and occupancy of the buildings or other structures and do not include environmental loads such as wind load, snow load, rain

load, earthquake load, or dead load. Live loads on a roof are those produced (1) during maintenance by workers, equipment, and materials and (2) during the life of the structure by movable objects. Live loads will be uniformly distributed over the horizontal projection of the specified areas and will have the minimum values noted below.

3.2.2.1 Platforms, Walkways, and Stairs

A uniform live load of 100 pounds per square foot (psf) will be used. In addition, a concentrated load of 2 kips will be applied concurrently to the supporting beams to maximize stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

A uniform load of 50 psf will be used to account for piping and cable trays where applicable. Where the piping and cable tray loads exceed 50 psf, the actual loads will be used.

3.2.2.2 Pipe Racks

A minimum uniform load of 100 psf will be used for each level of the pipe racks. Where the piping and cable tray loads exceed 100 psf, the actual loads will be used. In addition, a concentrated load of 5 kips will be applied concurrently to the supporting beams to maximize stresses in the members, but the reactions from the concentrated loads will not be carried to columns.

Hangers for piping and equipment loadings, anchor forces, and other restraining forces will be determined by engineering analysis. In areas where numerous miscellaneous small bore piping, conduit, and cable tray loads will exist, an additional uniform load to be determined by the structural engineer will be added to the design loads.

3.2.2.3 Ground Floor (Slab at Grade)

Design will be based on equipment weight, storage, or laydown weight or a uniform load of 250 psf, whichever is greater.

3.2.2.4 Thermal Forces

Thermal forces caused by thermal expansion of equipment and piping under all operating conditions will be considered.

When portions of a structure are not free to expand or contract under temperature variations, allowance will be made for stresses resulting from temperature change. When portions of a structure are subject to unequal temperature variations, allowance will be made for stresses resulting from the variation.

3.2.2.5 Dynamic loads

Dynamic loads will be considered and applied in accordance with Applicable Standards.

Vibration load will be defined as those forces that are caused by vibrating machinery such as pumps, blowers, fans and compressors, engines and generators.

All supports and foundations for vibrating equipment will be designed to dampen vibrations and as required by the equipment manufacturers. Allowance will be made for such dynamic effects, including impact, by increasing the computed live load value by an adequate percentage.

For structures supporting elevators, machinery or craneways, design for impact will be as required by ASCE 7 (latest adopted edition).

3.2.2.6 Truck Loads

Roads, pavements, underground piping, conduits, sumps, and foundations subject to truck traffic will be designed for HS-20-44 loadings in accordance with AASHTO Standard Specifications.

A surcharge load of 250 psf will be applied to the Project structures where accessible to truck traffic.

3.2.2.7 Wind Loads

All structures will be designed for a basic wind velocity in accordance with the requirements of the State of California Building Standards Code as listed in 3.1.3 above.

3.2.2.8 Seismic Loads

Structures will be seismically designed in accordance with the requirements of the State of California Building Standards Code.

3.2.2.9 Other Loads

Other loads used to predict the structural response of structures will include hypothetical loads representing the influence of piping, including water hammer, and loads at anchor points and electrical installations not included in the normal dead or live loads. Pressure or suction loads such as encountered in ductwork will be taken into account, including dynamic loads from operating equipment.

Earth pressures will be defined as the active and passive lateral forces associated with soil and hydrostatic pressures.

Handrails/guardrails for stairs, platforms, or other uses will be designed to withstand a lateral load of 50 pounds per linear foot (plf) or 200 pounds applied in any direction at any point on the top of the rail.

3.2.2.10 Allowable Stresses

- Concrete: In accordance with ACI 318 Code
- Masonry: In accordance with the California State Building Standards Code

3.2.2.11 Load Combinations

Appropriate loading combinations will be used for structural steel and reinforced concrete to comply with applicable codes and standards and with vendor requirements.

3.2.2.12 Factor of Safety

Minimum factors of safety for all structures, tanks, and equipment supports will be as shown below:

- Overturning 1.50
- Sliding 1.10 for seismic load
  1.50 for wind load
- Buoyancy 1.25
- Uplift due to wind 1.50

3.3 Architectural

All buildings will be weather tight with insulated metal siding and standing-seam roofing. Buildings will have insulated walls, roof, and ceilings designed to complement the specific building area use and optimize HVAC system design. For example, air conditioned areas will use wallboard and non-air conditioned areas will use 26 gauge steel liner panels.

The outside of the exterior building panels will have a baked-on Kynar 500, or equivalent, coating system having a minimum of 70% Kynar resin. Wall insulation will use a minimum R-13 fiberglass blanket insulation with UL 25 vapor retardant. The wall panel thickness will be as required to provide an insulated wall heat transmission coefficient "U" per ASTM C236 not greater than 0.10 Btu/hr-ft^2-°F. The pre-fabricated modular equipment enclosures will have the supplier's standard industrial finish. All exterior doors will have weather protection awnings or vestibules.

Roof slopes will be within the range of 0.5 to 1 inch of rise per 12 inches of run. The outside of the exterior panel will have a baked-on Kynar 500, or equivalent, coating system having a minimum of 70% Kynar resin. Minimum R-19 fiberglass blanket insulation with UL 25 vapor retardant will be used and attached to the ceiling with metal components such that there is no sagging. Roof panel thickness and width will be as required to provide a "U" factor of 0.08 or less and gauge and shape of panels will be sufficient to withstand all design loadings without excessive deflection or vibration.

All buildings will be provided with gutters and downspouts, routed to the storm drain systems.

Suspended lay-in acoustical tile ceilings, vinyl composition floor tile with resilient base, and recessed fluorescent lighting will be provided in offices, restrooms, lunch room, conference room, storage areas, electronics room, and the control room. Partitions in the administration area will consist of painted gypsum board on each side of metal studs. High-bay buildings such as the power house and maintenance area will have high-pressure sodium vapor, or similar, lighting,

For high-moisture areas ceilings will have moisture resistant, lay-in tiles. Unglazed ceramic tile will be used on floors in high moisture areas such as locker rooms, showers, and toilets.

Steel-troweled, surface-hardened concrete will be used in unfinished areas. Any chemical containment areas will be of concrete construction and use barrier coatings or linings as required for the chemical environment.

All wall surfaces, ceilings, doors, and frames will be painted. The color scheme for the project will be selected by the Owner from color samples submitted by the Contractor.

Windows will be manufacturer-standard aluminum, factory tinted, used in commercial or industrial applications, as appropriate.

Double doors with transoms will be provided where required for equipment removal and access.

Doors will meet the requirements of Steel Door Institute-recommended specifications 100-91, Grade II, Model 2. Doors will be heavy-duty seamless-composite construction using 18 gauge galvanized face sheets. Door frames will be formed of 16 gauge steel to the sizes and shapes required. Doors for the pre-fabricated modular equipment enclosures will be the supplier's standard for industrial applications.

Doors and frames in the outer limits of environmentally controlled areas will be fully insulated. Where fire doors are required, the door, frame, and hardware will bear a certification label from Underwriter's Laboratories for the class of opening and rating.

Doors will be finished with glass and glazing at the following locations: building entries and exits, control room, laboratory, hallways, offices, and any other high traffic areas where viewing windows will help prevent the doors from being opened into oncoming traffic. Glass and glazing will conform to the requirements for glazing materials for Category II products in accordance with the Safety Standards for Architectural Glazing Materials 16 CFR 1201, and installed in accordance with the publications of the Flat Glass Marketing Association.

The Contractor will provide locks on each door and 10 sets of a coordinated master key set for all lockable panels, hatches, covers, doors, etc.

Rolling steel doors will be interlocking galvanized steel slats to withstand a wind pressure of 25 pounds per square foot. Doors will be motor operated with manual override and three push-button controls.

Fire-rated assemblies will be provided when required by building or fire codes. Penetrations through partitions will be provided with fire stops. Insulation will be used for sound and thermal control in walls between and around finished rooms and air-conditioned areas.

The Contractor will supply all fixtures and appliances for the control/maintenance building. Contractor will provide commercial-grade carpeting in offices, conference room, file room, and lunch room. The carpet style and color scheme for the project will be selected by the Owner from samples submitted by the Contractor.

Piping and electrical conduit and equipment along the walls within the maintenance area will be located to maximize the amount of space available for shelving.

3.3.1 Building Systems

The Project will include ventilation and air conditioning for each building. All HVAC and ventilation systems throughout the plant will be sized and installed appropriately for climate and dust control as defined in other sections.

3.4 Foundations for Equipment and Structures

All equipment foundations, retaining wall structures (i.e. reinforced soil segmental retaining wall), and concrete structures will be designed and built per manufacturers' criteria, the soil investigation, and the geotechnical report.

Soil stabilization, remediation, piles, etc. will be provided as required for all plant facilities including buried lines and facilities as required by the geotechnical investigation report.

Foundation analysis and design will be performed for the engine and generator as recommended by the respective equipment manufacturers. All foundations designed for rotating equipment will be adequate, and will not be subject to failure due to induced vibration. In addition, foundations for rotating equipment will not result in unreasonable vibration levels, consistent with Prudent Utility Practices or violate OEM guidelines.

Foundation analysis for major equipment will include the evaluation of total and differential settlement. At grade, outdoor tank foundations may be ring-type or reinforced concrete mat design. Tanks, equipment skids, pumps, and supports will be installed on raised slabs or pads for corrosion protection.

Dynamic foundation analysis will be performed for the engine generators. The design will ensure that all foundations for rotating equipment are adequate and will not be subject to failure due to induced vibrations. In addition, foundations for rotating equipment will not impart unreasonable vibration levels, consistent with normal utility industry practice, as well as OEM guidelines and specifications, to surrounding foundations and equipment.

Grade-floor elevations of buildings and the tops of foundations for major outdoor equipment at grade will be at a minimum 6 inches above the high point of the finished grade elevation. All concrete will be designed per applicable American Concrete Institute (ACI) standards.

Oil-filled transformer foundations will have an integral reinforced concrete spill containment area. Ground wires will be embedded in foundations and stubbed up at their final location to prevent a tripping hazard.

3.5 Retaining Walls and Structures

Reinforced soil segmental retaining wall(s) (reinforced SRW) are gravity retaining walls with an expanded width created by a geosynthetic reinforced (infill) soil mass located behind a column of dry-stacked SRW units. The reinforced SRW will be designed in accordance with the NCMA design manual (or other engineer-approved methodology). The design will be prepared, signed, and stamped by a professional engineer licensed in the State of California.

The reinforced SRW design procedure will generally entail:

- Definition of Wall Profile and Geometry – including design height (approximately 10 feet each), backslope, selection of SRW units, embedment and surcharge for each section, drainage materials and components, etc.;
- Obtaining Site-Specific Soil Parameters and Analysis – including unit weight, permeability, shear strength (friction angle and cohesion), compressibility, bearing capacity, workability, groundwater conditions, etc.;
- External Stability Analysis - including bearing capacity (shear failure or deformation), base sliding, overturning, etc.;
- Internal Stability Analysis – including determination of reinforcement design properties (geosynthetic reinforcement material, number of layers, elevations, etc.), tensile stresses, pullout, internal wedge failures/sliding, etc.;
- Local Stability Analysis – including facing connection strength of all geosynthetics, resistance against bulging at face, unreinforced heights, etc.;
- Global Stability Analysis –overall slope stability failure (general mass movement) for the entire reinforced SRW structure (all sections) and adjacent soils that may result from grade, soil strength, groundwater regime, and additional gravitational forces imposed on the site soils (i.e. buildings, equipment, etc.);
- Seismic Loading Analysis; and
- Settlement Analysis.

The maximum exposed vertical height for each section (or step) of wall will be 10 feet with a minimum horizontal spacing of 3 feet between each individual wall in the stepped wall system (measured from back of the top course SRW unit of the lower wall to face of the leveling pad of next higher step SRW).

It should be noted that a detailed geotechnical investigation will be required to obtain the site-specific soil data and strength parameters required for the design analysis (based on the project layout drawing). Additional geotechnical analysis will also be required for any imported soil materials to be used for construction of the stepped SRW system in order to determine suitability for use in the reinforced SRW system.

Factors of Safety

Minimum factors of safety and other applicable design criteria for the soil-reinforced SRW structures will be as shown below:

- Base Sliding 1.5
- Overturning 2.0
- Bearing Capacity 2.0
- Global Stability 1.3 – 1.5
- Tensile Overstress 1.0
- Pullout 1.5
- Facing Shear Capacity 1.5

- Connection 1.5

Other Design Criteria

- Uncertainties 1.5
- Facing Shear (serviceability) 0.75 inch
- Connection (serviceability) 0.75 inch (max)
- Minimum Base Width 0.6H
- Minimum Wall Embedment 0.5 foot (min)*
- Minimum Anchorage Length 1.0 foot

* This is the minimum depth. Based on the adjacent slope in front of the proposed wall section, the minimum embedment depth of the wall is the exposed height of wall (H')/20 for horizontal walls, H'/10 for horizontal abutments, H'/10 for 3H:1V lower slopes, and H'/7 for 2H:1V lower slopes.

3.6 Concrete Work

Concrete design will be in accordance with the latest release of ACI codes 318, and 350.

Exposed concrete floors within the administration, control, warehouse, maintenance, water treatment, chemical feed, and unloading areas are to have a brushed finish and be sealed to impart chemical resistance where such exposure is possible.

Duct banks that run under roads and maintenance areas will be adequately reinforced to withstand anticipated loads.

3.7 Masonry Work

Structural masonry will be designed in accordance with ACI - 530, "Building Code Requirements for Masonry Structures."

3.8 Steel Work

The steel structure to be used for pipe racks, the power house, and warehouse/maintenance shop will be designed, fabricated, and erected in accordance with American Institute of Steel Construction specification.

Bolts and nuts for galvanized structural steel will be mechanically galvanized. or hot dipped galvanized.

All materials will be free of imperfections. Rolled structural steel wide flange shapes will confirm to ASTM A992. All other structural steel shapes, bars, and plates will confirm to ASTM A572, Grade 50, unless otherwise noted on the design drawings. Steel pipe and handrails, guardrails and posts will confirm to ASTM A53, Grade B Type E or S. Handrails, guardrails and posts will be 1-1/2 inch nominal inside diameter standard weight pipe. Rectangular, square and round hollow structural sections (HSS) will confirm to ASTM A500 and/or ASTM A501.

All hoist and monorail support beams will be clearly marked with their rated capacity.

3.8.1 Steel Grating and Steel Grating Stair Treads

The steel to be used for grating and grating treads will conform to ASTM A1011, commercial steel (CS, Type B). The ITW Ramset/Red Head Grating Disk system, or equivalent, will be used for fastening. Stair treads will be provided with nonslip abrasive nosings. The treads will have end plates for attaching to stringers. Grating will be of the rectangular type and consist of welded steel construction. Grating will be hot dip galvanized after fabrication in accordance with ASTM A 123. Outdoor grating will have a serrated surface. Grating will have at least a 1-inch bearing support and be designed for a minimum live load of 100 psf. Deflection will be limited to 1/200 of the span.

Floor or platform openings around the engines, pressure vessels, piping, and equipment subject to expansion will be protected as follows:

- Openings around penetrating objects exceeding 1.5 inches in width will be protected by toe plates
- Openings around penetrating objects exceeding 8 inches in width will be protected by toe plates and handrails

Cutouts required for any type of penetration, including those to be made in the field, will be provided in the floor grating. Cutouts smaller than 6 inches will be banded with bars as thick as the bearing bars. Cutouts 6 inches and larger will be banded with a 0.25-inch-thick toe plate projecting 4 inches above the finished floor.

Additional support members for the larger opening will be provided as required.

The direction of bearing bars will be consistent within the floor framing system, and they will be aligned with the adjoining section.

At the joints, the end of one section will be banded to prevent other sections from telescoping.

Surfaces on which the galvanized finish has been damaged, scratched, or defaced before acceptance will be cleaned and touched up with galvanized repair paint in accordance with the paint manufacturer's instructions.

3.8.2 Stairs and Ladders

Stairs will be provided for the purposes of traveling from one elevation to another. Vertical ladders may be provided only where personnel access is infrequent. Safety cages and/or other devices will be provided for fixed ladders per OSHA, and will have landings no further than every 30 feet. Safety cages and ladder openings will include self-closing gates.

3.9 Design

The design will conform to Applicable Laws and Applicable Standards. The design will be based on the CBSC, and other applicable local or state building code, the American Concrete Institute (ACI), and American Institute of Steel Construction (AISC). All buildings, structures and equipment will be designed and built in accordance with Applicable Laws and Applicable Standards.

Strength design will generally be employed for reinforced concrete structures, and allowable stress design or load and resistance factor design employed for steelwork.

Wind, snow, and earthquake loading will be in accordance with Applicable Laws and Applicable Standards.

The design will take account of all applied loads, including dead, live, impact, thermal, dynamic, settlement, movement, and seismic, and other loading conditions where appropriate. Temporary loads during maintenance and erection will be considered.

Platforms will be designed for a minimum live load of 100 psf. Platform design will employ the use of grating in lieu of checkered plate unless required for containment purposes. All handrail, toe plate, ladders, cages, gates, etc., will be in accordance with OSHA Standard Rules and Regulations.

Pre-engineered building rafters will be designed for the appropriate collateral loading from roof supports, HVAC ducts, cable tray, and piping.

Grade slabs (engine equipment laydown) will be designed, at a minimum, for 300 psf. Ground floor slabs for shops and auxiliary buildings will be designed, at a minimum, for 150 psf. Storage areas will be designed for actual weight of material but no less than 150 psf.

Vendor-generated structural steel details, concrete reinforcing details, and erection drawings are to be reviewed and approved by the Contractor's Professional Engineer, registered in the state where the Project is located.

Access doors and hand rails will be designed and located for easy access for maintenance and inspections. Adequate hand railing and fall protection barriers will be installed for maintenance activities.

3.10 Construction

Working methods will ensure the construction of stable structures able to withstand all applied loadings during construction and for the design life of the Project without collapse, failure, or excessive deformation such as to cause any damage, loss of function, or durability problems.

A permanent Project benchmark will be established on the Project site by the Contractor based upon USGS vertical datum. Settlement monitoring points will be provided, with a minimum of four points for each end of the bank of engines. The existing elevation at each point will be inscribed on an embedded brass marker before setting of equipment.

All welding will be performed by welders qualified in accordance with AWS D1.1, using only procedures qualified in accordance with AWS D1.1.

3.11 Testing and Inspections

A program for testing soils during earthwork and when underground utilities and foundations are installed will be utilized.

The minimum moisture and density testing requirements for structural fill will be one test per 75 cubic yards with at least one test under each foundation greater than 15 square feet.

In-place representative field density tests will be performed in accordance with ASTM D 1557.

If a compacted area fails to meet the specified compaction requirements, two additional tests will be performed for that area. If the results of either of the two additional tests-prove unsatisfactory, the area will undergo additional compaction and testing until test results meet the minimum compaction requirements.

Records of inspection and testing of soils to ensure compliance with design assumptions will be turned over to Owner and will comply with Applicable Standards. If pile-supported foundations are to be used, the Contractor will conduct a pile load test program.

Testing and inspections of structures will be in accordance with Applicable Standards. Concrete test cylinder sets will be taken at the minimum rate of one set per day but not less than once for each 150 cubic yards for slabs, foundations, or walls. Concrete test cylinder sets for paving will be taken at the minimum rate of 1 set per day but not less than once for each 150 cubic yards, nor less than once for every 5,000 square feet. As a minimum, one set of cylinders will be taken for each equipment foundation, with exception that one set of cylinders may be made for each concrete truck load where multiple small foundations are poured from a single load. Test procedures will be in accordance with the appropriate ASTM standards. Copies of test data will be provided to the Owner.

The Contractor will utilize a system to validate type and grade of high-strength bolts by sampling and metallurgical testing.

A testing program of high-strength bolts and nuts will be conducted by the Contractor to ensure that each bolt shipment meets the appropriate ASTM standards for dimensional tolerances and material quality.

All structural welds will be subject to inspection in accordance with weld quality requirements provided in AWS D1.1. Critical welds will be inspected as required, and all other welds will be subject to random inspection.

APPENDIX B.3

MECHANICAL ENGINEERING DESIGN CRITERIA

APPENDIX B.3
MECHANICAL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the project will be completed in accordance with various predetermined standard practices and project specific programs/practices. An orderly sequence of events for the implementation of the project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Start-up, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the project. The general mechanical design criteria defined herein form the basis of the design for the mechanical components and systems of the project. More specific design information is developed during detailed design to support equipment and erection specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 10C2 summarizes the applicable codes and standards, and Section 10C3 includes the general design criteria for piping, valves, insulation, lagging, and freeze protection.

2.0 DESIGN CODES AND STANDARDS

The design and specification of all work will be in accordance with all applicable laws and regulations of the federal government, the State of California, and the applicable local codes and ordinances. A summary of the codes and industry standards to be used in design and construction is listed below.

International codes and standards for equipment and components corresponding to the standards referenced below will be acceptable provided that they are acceptable to the appropriate authority having jurisdiction where appropriate.

A California Professional Engineer stamp is required on design documents.

2.1 State and Local Building Codes, Standards and Ordinances

- Code, Rules and Regulations of the State of California
- California Building Standards Code (CBSC)

- International Building Code (IBC)
- California Electrical Code
- California OSHA (CALOSHA)
- Local ordinances, regulations, and requirements

2.2 U.S. Government Codes, Ordinances, and Standards

- Occupational Safety and Health Act (OSHA)—29 CFR 1910, 1926
- Federal Aviation Agency (FAA)—Obstruction Marking and Lighting AC No. 70/7460-IJ)
- Environmental Protection Agency (EPA)—40 CFR 423, 40 CFR 60, 40 CFR 112
- Appendix A to Part 36, "American Disability Act Accessibility Guidelines for Buildings and Facilities (applicable only to administrative and control room areas).

2.3 American Society of Mechanical Engineers

The following standards of the American Society of Mechanical Engineers (ASME) will be followed:

- ASME Boiler and Pressure Vessel Code Sections:
  - I Power Boilers
  - II Material Specifications
    Part A: Ferrous Materials
    Part B: Nonferrous Materials
    Part C: Welding Rods, Electrodes, and Filler Metals
  - V Nondestructive Examination
  - VIII Pressure Vessel Division 1
  - IX Welding and Brazing Qualifications
- ASME B31.1 - Power Piping
- ASME Performance Test Codes:

The following performance test code may be used as guidance in conducting the performance for the Project:

- PTC 46 Overall Plant Performance
- PTC 17 Internal Combustion Reciprocating Engines
- PTC 1 General Instructions
- PTC -19.1 Measurement Uncertainty

2.4 American National Standards Institute

The following standards of the American National Standards Institute (ANSI) will be followed:

- B16.1 Cast Iron Pipe Flanges and Flanged Fittings

- B16.5 Steel Pipe, Flanges, and Fittings
- B16.34 Steel Valves
- B30.17 Overhead and Gantry Cranes

2.5 Industry Standards

Applicable standards issued by the following industry organizations:

- American Boiler Manufacturers Association (ABMA)
- American Gas Association (AGA)
- American Gear Manufacturers Association (AGMA)
- Air Moving and Conditioning Association (AMCA)
- American Petroleum Institute (API)
- American Society for Nondestructive Testing (ASNT)
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Crane Equipment Manufacturer's Association of America (CMMA)
- Expansion Joint Manufactures Association (EJMA)
- Fluid Control Institute (FCI)
- Heat Exchange Institute (HEI)
- Hydraulic Institute (HI) - Standard for Pumps
- Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry
- National Association of Corrosion Engineers (NACE)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA) National Fire Codes
- Pipe Fabrication Institute (PFI)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Thermal Insulation Manufacturers Association (TIMA)
- Tubular Exchanger Manufacturers Association (TEMA)
- Underwriters Laboratories, Inc. (UL) - fire protection equipment and office building only
- Welding Research Council (WRC)
- Equipment sourced from Europe may be constructed according to functionally comparable DIN and ISO standards.

2.6 Fire Protection System Codes and Standards

The fire protection systems will be designed in accordance with the specified codes, standards and recommendations, all applicable statutory requirements and amendments.

The specified codes, standards and recommendations will include:

- Local Adopted Codes, Standards and Amendments, and requirements of local jurisdictional authority.

CBSC and the local building and fire codes, standards, recommendations and amendments to be used will be determined during the Contractors Building and Fire Codes, and Life Safety Compliance Review.

- National Fire Protection Association (NFPA) Codes, Standards and Recommendation's
  a. NFPA 10, Standard for Portable Fire Extinguishers.
  b. NFPA 12, Standard on Carbon Dioxide Extinguishing Systems.
  c. NFPA 13, Standard for the Installation of Sprinkler Systems.
  d. NFPA 14, Standard for the Installation of Standpipe, Private Hydrants, and Hose Systems.
  e. NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection.
  f. NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.
  g. NFPA 22, Standard for Water Tanks for Private Fire Protection.
  h. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
  i. NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
  j. NFPA 30, Flammable and Combustible Liquids Code.
  k. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
  l. NFPA 54, National Fuel Gas Code.
  m. NFPA 68, Guide for Venting of Deflagrations.
  n. NFPA 70, National Electrical Code.
  o. NFPA 72, National Fire Alarm Code.
  p. NFPA 85, Boiler and Combustion Systems Hazard Code
  q. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  r. NFPA 101, Life Safety Code.
  s. NFPA 204, Standard for Smoke and Heat Venting.
  t. NFPA 221, Standard for Fire Walls and Fire Barrier Walls.

u. NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.

v. NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

w. NFPA 780, Standard for the Installation of Lightning Protection Systems.

x. NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems.

2.6.1 Other Codes and Standards

American Petroleum Institute (API) 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1, Division 1 and Division 2 will be used for the hazardous classification of equipment and systems.

The following referenced document(s) provides recommendations for fire protection of electric generating plants based on good industry practice and the applicable for the project sections will be used and implemented (should recommendations will be changed to “will”).

- NFPA 850 – Recommended Practices for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

The specified standards define minimum requirements only. They do not necessarily include all requirements necessary to satisfy the applicable local statutes, as interpreted by the Local Statutory Authorities.

Unless otherwise indicated, the issue of the specific code, standard or recommendations in effect at the time of the “construction plan submittal to the Local Statutory Authorities” will apply.

2.7 HVAC Standards

The following standards or other international standards as approved by the Owner will be used in the design of the HVAC system.

- ASHRAE Handbooks :
  - Fundamentals
  - HVAC Systems and Equipment
  - HVAC Applications
  - Refrigeration
- ASHRAE Standards:
  - 52.1, Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
  - 15, Safety Code for Mechanical Refrigeration
  - 62, Ventilation for Indoor Air Quality
  - 90.1, Energy Efficient Design of Buildings
- ANSI/ASME Standards:

  - ANSI/ASME B31.5, Refrigeration Piping
- SMACNA Standards:
- HVAC Duct Construction Standards, Metal and Flexible
  - Round Industrial Duct Construction
  - Rectangular Industrial Duct Construction Standards
- NFPA Standards:
  - 90A - Installation of Air Conditioning and Ventilating Systems
  - 90B - Installation of Warm Air Heating and Air Condition Systems
  - 204 - Smoke and Heat Venting
- IEC Standards:
  - 529 - Degree of Protectors for Electrical Equipment
- ARI Standards:
  - 410 - Forced Circulation Air-Cooling and Air Heating Coils
  - 430 - Central Station Air Handling Units
- AMCA Standards:
  - 210-85 - Laboratory Methods of Testing Fans for Rating
  - 500-89 - Test Method for Louvers, Dampers, and Shutters

3.0 MECHANICAL ENGINEERING DESIGN CRITERIA

3.1 Reciprocating Engines

The engines will be a four stroke, lean burn, pre-combustion, turbocharged and intercooled designed to burn natural.

Engines will be provided with engine heating and lubrication equipment for startups to full load within 10 minutes.

Engines will have common base frame mounted on the foundation by steel springs for engine and generator and flexible coupling between engine and generator.

Two independent compressed air systems for starting air and instrument air will be provided.

On-line wash system of turbocharger will be provided. The online water wash and drain system will be installed with all valves easily accessible for routine maintenance.

Engine cooling and oil cooling will be two independent separate cooling systems. It is acceptable to cool lube oil circuit and engine jacket water and radiators in one circuit.

Generator and controls will meet all WECC operating requirements.

CEMS sample and monitoring equipment will be provided for each engine and the equipment will be easily accessible for maintenance.

Engines will be factory tested to full load.

Engine service platforms will be provided for access to the top of engines and between engines.

Electric turning gear will be provided.

3.1.1 Starting Air System

Starting air system and starting air storage will be sized for rapid starting of all engines.

The starting air system will be an independent compressed air system. Compressed air from the starting air units will be stored in starting air tanks until it is used for starting the engines.

Starting air system will be capable of starting all engines in a rapid sequence with sufficient capacity to have all engines up and running in 10 minutes.

The total compressor capacity will be capable to recharge the starting air system within 120 minutes assuming 2 starts of all engines without recharging.

3.1.2 Intake Air

Charge air is extracted from outside the building. The location of the Charge Air inlets will be located to mitigate temperature increases of the Charge Air from exhaust ducts and radiator exhausts.

The intake air filter elements will be designed for the current Project Site conditions to meet the manufacturer's requirement.

Air inlet filters sized and located to allow extended operation of the engines without replacement.

3.1.3 Exhaust Gas System

The exhaust gas system directs exhaust gas from the engine out of the powerhouse to the atmosphere. Exhaust system will be separate for each engine with height and location to prevent recirculation into the air inlets.

The exhaust gas system will be equipped with explosion rupture disks to relieve the excess pressure in case of explosion due to unburned gas in the ducting. The outlets of the rupture disks will be ducted out from the powerhouse to the atmosphere.

Expansion bellows will be provided between the engine and the exhaust silencer.

The engine exhaust gas system and ducts will be fully insulated and protected inside the powerhouse. Outside the powerhouse, exhaust ducts will be insulated up to the SCR units and beyond as necessary for personnel protection and to minimize heat pick-up by the Charge Air.

SCR/CO/POC units will be provided to control NOx , CO and POC emissions. Reactor housing is sized with extra space for additional future layers of catalyst.

Each engine exhausts through an exhaust silencer and stack. Adequate access with ladders and platforms will be provided for maintenance of the emission control and monitoring systems equipment.

3.1.4 Common Base Frame

A common base frame will be provided for the reciprocating engine and generator to provide the necessary stiffness and resonance attenuation.

3.1.5 Flexible Coupling and Connections

A Flexible coupling and flywheel cover between engine and generator shaft is provided.

Flexible hoses and bellows for connections of the engine to external piping such as water, fuel, and starting air will be provided.

All exposed moving parts will have shrouds or covers.

3.1.6 Lubricating Oil System

The engine is automatically pre-lubricated during the starting sequence. Sample points will be provided to enable oil sampling when the engines are operating.

Separate storage tanks will be provided for clean oil and dirty oil. In addition a maintenance oil tank will be provide to store oil during maintenance requiring draining of an engine's oil system.. The system will include transfer pumps to transfer oil to and from the clean oil storage tanks.

New and used lube oil will be loaded and off loaded with onsite unloading pumps and with the capability to accommodate truck mounted transfer pumps.

3.1.7 Engine Cooling Systems

Cooling is critical to reliable and continuous Project operation. Each engine cooling circuit is connected to air blast coolers (radiators) located outdoors. The engine cooling water system includes one engine driven pump for the high temperature circuit, and one pump for the low temperature circuit (two pumps per engine). Lubricating oil heat exchanger— one per engine (plate type)—is provided for each engine. The lubricating oil is cooled with LT water.

Corrosion inhibiting additives must be used in the engine coolant water. The manufacturer's dosage, pH, and testing recommendations will be followed.

An elevated water surge tank will be provided for surge capability, system water level checking, venting, and adequate net positive suction head (NPSH) for supplying adequate pressure for the coolant water pumps. Vent valves will be provided to remove air from the system. Connections will be provided to add chemicals to the system and to take samples for testing chemistry.

3.1.7.1 Air Blast Coolers

The coolant water will be cooled in a closed circuit by air blast finned fan coolers with electric fans.

3.1.7.2 Heating Units For Jacket Water

Heating will be provided to pre-heat the jacket water circuit to the correct temperature for engine stating. The system will consist of a common gas fired water heating unit and electrically driven circulating pump with individual engine heat exchangers.

3.1.7.3 Maintenance water tank

The drainage of treated engine coolant water will be to the maintenance water tank and will be designed to enable quick drainage. This is to facilitate maintenance. The treated engine coolant water will be pumped back into the engine and reused after maintenance.

One or more maintenance water tanks may be provided.

Secondary containment will be provided will be provided in case of tank leaks or rupture.

3.1.8 Closed Cooling Water System

The closed cooling water system will be designed for removing the maximum heat rejected from all the auxiliary equipment identified and rejecting it to the atmosphere. Cooling water pumps, and cooling water heat exchangers (each isolatable for routine cleaning and tube plugging without plant curtailment), will be provided. For each engine, one 100 percent engine driven cooling pump for each circuit (HT and LT) will be provided.

The cooling water heat exchangers and pumps will be sized to supply adequate cooling water to the closed loop system. The system will be designed to provide adequate cooling for the site conditions. The system design will permit shutdown and maintenance of the individual items of equipment without interruption of the cooling function of the rest of the system.

Isolation valves will be provided at each engine for engine maintenance during Project operation.

3.2 Selective Catalytic Reduction

A selective catalytic reduction (SCR) system will be provided to control the emissions of NO_X and CO for natural gas or liquid fuel operation. The system may be a separate module for each engine or several engines may exhaust to a single module. The system may use 19-40 percent urea.

The systems will be full automatic and will include:

- Urea storage tank with minimum 10 day storage in gas mode and sufficient capacity to accept delivery of all contents of one delivery truck with a 2 day margin at full operation of existing tank contents
- Containment berm around the storage tank
- Truck unloading station
- Injection / forwarding pumps
- Mixing chamber
- Controls

Insulation and heat tracing of the urea tanks, piping, and pumps will be provided required.

3.3 Pumps

This section is not applicable to pumps that are on the engines, engine auxiliary modules, pre-engineered pipe racks or engine exhaust gas modules as shipped from the factory. Pumps that are shipped as part of the engines will be vendor's standard.

All pumps will be designed for continuous operation unless otherwise specified.

All pumps will be installed in positions convenient for operation and servicing. Where multiple pump installations are required, each pump and its associated equipment will be arranged in such a manner as to permit easy access for operation, maintenance, and pump removal without affecting plant operation. Lifting lugs, eye bolts, and other special tackle will be provided to permit easy handling and removal of the pump and its components, if weighing over 40 lbs.

Standard types of pumps will be used wherever possible. Only proven products and models are to be supplied.

Strainers (startup or permanent) will be installed in the suction piping of horizontal pumps or sets of pumps. The driver will be mounted on an extension of the pump bedplate and will drive the pump through a flexible coupling with OSHA coupling guard.

Pumping systems with variable flow requirement will have a recirculation line for pump protection. As a minimum, pumps with motors rated for 25 hp and above will be supplied with a recirculation line for protection. The recirculation line will normally be routed to the source from which the system takes suction. Modulating or two-position automatic recirculation valves or restriction orifices will be used as applicable.

3.3.1 Pump Types

Centrifugal pumps will be used wherever possible. Positive displacement screw pumps may be used when handling fuel and lubricate oils, and reciprocating pumps will be accepted for chemical dosing and metering purposes.

3.3.2 General Design and Construction

All pumps will be designed to withstand 1.5 times the pump shut-off pressure, under maximum suction pressure conditions, unless otherwise specified. All pump shafts will be of ample size to transmit the full output from their drivers. Impellers will be fitted to the shaft in a suitable manner that will permit the transmission of the maximum torque developed under any operating condition and removal without damage to either impeller or shaft.

All pumps will be selected such that they do not cavitate under the expected range of operating conditions.

Renewable wear rings will be fitted to the casing and impeller.

All pumps will be constructed of materials specifically designed for the conditions and nature of the pumped fluid and to resist cavitation, erosion, and corrosion.

Seals will be provided and must meet the working conditions. Where appropriate mechanical seals will be utilized.

Centrifugal pumps will be of the horizontal-shaft type. Each horizontal pump will be mounted with its driving motor on a common baseplate of rigid construction.

The construction of the pump casing will be two parts, an upper part and a lower part, for easy maintenance. For small process pumps, in lieu of split case construction, back pullout of impeller arrangement may be provided.

Vertical-shaft centrifugal pumps may be employed when pumped liquids are at or near their boiling point. Pumps for such duties must be carefully sited to ensure that the Net Positive Suction Head Available (NPSHA) under all operating conditions will be adequate for the type of pump employed. The NPSHA values represent the worst operating conditions, i.e., the lowest atmospheric pressure, lowest suction pressure of the pump, and highest temperature of the pumped fluid.

Horizontal shaft, 3,600 rpm pumps of the centrifugal type will have balanced impellers and at least two bearings. The driver will be mounted on an extension of the pump bedplate and will drive the pump through a flexible coupling.

Centrifugal pumps will be of rigid-shaft design and will be designed such that the first critical speed of the pump, when coupled to its driver is at least 10 percent higher than the maximum operating speed. The entire rotor assembly will be statically balanced, and dynamic balancing is required in one of the following cases:

- Pump speed exceeds 1,500 rpm, capacity exceeds 250 gpm (56 m^3/h) and impeller diameter exceeds 6 inches (150 mm,).
- Pump speed exceeds 1,500 rpm for pumps of two or more stages.

Pumps will operate smoothly throughout the speed range in reaching their operating speed.

Where necessary the pumps are to be fitted with devices to ensure a minimum through- flow.

The piping upstream of a pump will be at least as large as the pump suction connection. Velocity will be limited to 3 fps if there is a suction lift (negative pressure).

3.3.3 Pump Characteristics

Where a number of pumps are used for the same purpose, they will be suitable for parallel operation and will be interchangeable.

The pump head characteristics will be such that the head will continuously increase with decreasing flow quantity with a maximum head reached at zero flow. Generally, a head increase of 15 percent above the duty point at zero flow will be acceptable.

In general, the capacity of all pumps will be so determined that under normal operation, their total rated running output is 110 percent of the process flow, if the suction level is controlled, and 115 percent of the process flow, if the suction is uncontrolled (i.e., free suction pump).

3.3.4 Fittings

Pumps will be installed with isolating valves, a discharge non-return valve, and suction and discharge pressure gauges, where applicable. All positive displacement pumps will be fitted with a discharge relief valve. Provisions for temperature measurement will be made in pump suction and discharge pipe sections adjacent to the pump flanges, where applicable.

All couplings and any intermediate shafting will be supplied with removable type coupling guards that will cover the rotating parts.

Coupling halves will be so matched as to ensure accurate alignment. Horizontal shaft pumps will be driven by the motor through an approved type of flexible coupling. Vertical shaft and in-line pumps may be driven directly by the motor through a rigid coupling provided the motor thrust bearing has adequate margin to take care of the pump's maximum thrust.

Critical pumps provided with permanent strainers will be provided with differential pressure gauges and alarm facilities.

3.3.5 Bearings

On pumps utilizing ball or roller bearings, the inner race will be fitted directly onto the shaft and reliably fixed by a shoulder on the shaft. Bearings on vertical-shaft pumps will be so spaced as to prevent shaft whipping or vibration under any mode of operation.

Bearing housing on horizontal shaft pumps will be effectively protected against the ingress of water, pumped fluid, and dust with suitable non-ferrous deflectors.

3.4 Piping

This section is not applicable to piping systems that are on the engines, engine auxiliary modules, pre-engineered pipe racks, or engine exhaust gas modules as shipped from the factory. Piping that is shipped as part of the engines will be vendors standard.

Piping materials, fabrication, and erection will be in accordance with ASME B31.1 "Power Piping" except as noted otherwise herein. All piping in services with design temperatures 750 F or above will be seamless. Electric Fusion Welded Pipe (EFW) may be used, as long as all requirements of ASME B31.1 are met.

Extra strong or schedule 80 will be used for all piping 2 inch and smaller except for stainless steel construction where schedule 40S may be used. Socket weld construction will be used for all piping 2 inch and smaller. All threaded piping will be schedule 80 minimum. Maximum line size for threaded connection will be 2". Threaded connections at equipment will be provided with unions.

Minimum corrosion allowances for all piping systems will be per ASME B31.1 requirements and standard industry practices for facilities with a 30-year design life. Natural gas systems will use butt weld construction for all sizes 2.5 inches and larger. Water and water-based systems using steel pipe may be either butt weld or flange construction for sizes 2.5 inches and larger.

All critical above ground pressure piping will be tested as required by ASME B31.1.

Potable water piping will be schedule 80 PVC pipe or HDPE and fittings with bronze valves except for exterior piping in rack will be schedule 80 A53 galvanized with 3000# cadmium plated A105 threaded fittings. Potable water will supply safety showers/eye washes, which will be furnished for the following locations:

- Chemical feed storage and metering area

All piping furnished with the equipment regardless of size and service will be provided with all necessary rigid and spring hangers, supports, braces, and anchors required to properly support the piping systems and will include necessary expansion loops to provide flexibility. Piping support steel length will be limited to a maximum of 15 feet. All welding

of piping systems will be performed by welding operators who have been qualified in accordance with the applicable requirements of Section IX of the ASME BP&V code.

All materials for piping, valves, fittings, pressure vessels, and associated piping components will conform to the applicable Codes. Valves will be appropriate for the pressures and temperatures of each specific application. Gate valves will not be used for throttling. Adequate pipe support systems to allow pipe expansion, contraction, and appropriate seismic loads will be provided.

Where pipe runs pass through open penetrations, floors, or walls, either individually or collectively, floor or wall collars or other approved curbing will be provided. Floor collars will extend to an approved height.

Instrument air branches will be taken from the top of the mains. Service air branch pipe to points of use will terminate in positive locking Schrader-type hose coupling.

Piping may be routed on overhead pipeways or sleeperways; it may be supported from the building structure using pipe supports or rod hangers; or it may be buried. Space for electrical and instrument conduit runs will be provided on the pipeways and sleeperways as required. Underground piping will be provided with adequate corrosion protection, if required. Fire water loop piping and potable water piping will normally be routed underground.

Carbon steel lines 2 inches and smaller will be Schedule 40 minimum. For the 2-inch and smaller alloy steel lines, the minimum pipe wall thickness will be calculated based on design conditions.

Minimum pipe size will be ½ inch, except for connections to equipment. Pipe sizes 1-1/4

inches and 5 inches will not be used except for connections to equipment.

Pipe wall thickness calculations will be based on the lowest strength component in the

system, considering all factors, including the possibility of pipe and fittings having different maximum allowable stress values, and/or manufacturer’s minus tolerance.

Individual pipeline material classifications will be developed for each class of service. These material classifications will define the valves, pipe, fittings, flanges, gaskets, and bolting to be used.

Piping systems and components will be stress analyzed, if required, for thermal flexibility, support, pressure, vibration, seismic, fluid or gas flow reactions, and environmental factors, including effects on equipment.

The piping flexibility analysis will conform to the requirements of ASME B31.1.

As a minimum, computer analysis will be performed on all piping over 250°F or piping subject to dynamic transients.

Piping flexibility will be obtained through pipe routing or expansion loops unless limitations of space or economics dictate the use of flexible connectors.

Expansion loops, when installed in a horizontal plane, may be offset vertically to clear adjacent piping. Flexible connectors are to be used only when it is not feasible to provide flexibility by other means.

Proper installation and setting for all pipe supports will be verified (1) before initial heat up, and (2) during initial operation at full plant load or other maximum operating conditions (where possible).

3.4.1 Piping Materials

All pipe-work will be designed, fabricated and tested according to the requirements of the approved standard as required by this Technical Specification.

The material of the piping will be equal to or better than the following technical requirements:

- For design metal temperature up to and including 800°F, carbon steel (including plate material) will be used.
- For design metal temperature between 800°F and 950°F, approved low alloy steel will be used.
- For design metal temperature above 950°F, 2.25 percent Cr, 1 percent Mo steel will be used.

The outside of the embedded pipes will be protected by coatings.

Underground piping systems may use PVC or HDPE pipe where appropriate based on design conditions. Buried steel pipe will be coated and wrapped and cathodic protection should be considered as required by the soil conditions. Carbon steel bolts for mechanical joints will be wrapped. Cast iron valves may be used for wastewater, potable water, and fire protection only.

The cooling water and fire protection water piping will be made of carbon steel.

The pipes used for acids or caustic solutions will be made of anti-corrosive material.

Piping materials under special conditions will be as follows:

- Sodium hydroxide — Stainless steel or semi transparent FRP
- Hydrochloric acid — Polyvinyl chloride pipe or FRP

- Other chemicals — Polyvinyl chloride pipe or FRP

The materials of the piping leading from drains, vents, and so on to the shutoff valve on the main pipe will be made of the same material as the main pipe.

Potable water piping material will be in accordance with applicable plumbing code and suitable for the well or utility interconnect water chemistry.

Potable water piping will be schedule 80 PVC pipe or HDPE and fittings with bronze valves except for exterior piping in rack will be schedule 80 A53 galvanized with 3000# cadmium plated A105 threaded fittings. Potable water will supply safety showers and eye washes, which will be furnished for the following locations:

- Acid and caustic, ammonia or urea storage tank area(s)
- Chemical feed storage and metering area.

Compressed air piping between air compressors and air dryers will be carbon steel. Compressed air piping downstream of air dryers (instrument air) will be carbon steel or stainless steel. Other compressed air piping downstream of the receiver(s) (service air) will be carbon steel.

All pipes which are subject to corrosion, in addition to the normal design wall thickness, will have an additional corrosion allowance that is sufficient to ensure a minimum service life of 30 years and is, in any case, no less than 0.08 in (2 mm).

Piping will be so arranged as to provide clearance for the removal of any piece of equipment requiring maintenance with a minimum dismantling of piping and for easy access to valves and other piping accessories required for operation.

Overhead piping will have a minimum vertical clearance of 7 feet 2 inches above walkways and working areas and be of sufficient height above roadways to enable removal of the largest/heaviest equipment from the Project.

All pipe-work will be fabricated with appropriate connections used for pressure gauges, thermometers and any other corollary device as required by the plant design. Appropriate connections for Performance Test instrumentation will also be provided.

No pipe-work will be run in trenches carrying electrical cables.

Maximum design velocity of fluids through piping will take into account water hammer, erosion, and pressure drop of fluid in the lines.

Double-wall piping with leak detection will be provided for underground piping containing hazardous chemicals. In lieu of double wall pipe, contained coated pipe ways are acceptable, with leak detection.

3.4.2 Pipe Velocities

The velocity of flow in pipes is not to exceed the values in Table 10C-1 unless otherwise specifically mentioned:

Table B.3-1 Maximum Flow Velocity

Piping	Flow Rate feet per sec
Water Lines	
Closed cooling and cooling water	12
General service piping including domestic, firefighting, utility and irrigation water lines	10
City service piping	7
General pump suction lines	3
Air Lines	
Compressed air pipelines	80
Natural Gas Lines	
Fuel gas supply lines (with insulation to reduce noise levels)	170

Maximum design velocity of fluids through piping will take into account water hammer, erosion, and pressure drop of fluid in the lines.

3.4.3 Pipe Hangers and Supports

When located outdoors, corrosion-resistant variable and constant springs will be furnished that consist of all galvanized components except for the spring or coil, which will be neoprene coated. Rods, clevises, weldless eyenuts, and turnbuckles will be galvanized. All other hanger components may be painted per the requirements of section on painting.

3.5 Valves

This section is not applicable to valves that are on the engines, engine auxiliary modules, pre-engineered pipe racks or engine exhaust gas modules as shipped from the factory. Valves that are shipped as part of the engines will be vendor's standard.

Valves will be installed to meet valve manufacture's recommendation. For example, valve with vertical actuator will not be installed with actuator in any other way but vertical.

Valves may comply with European standards that are comparable with U.S. standards.

All safety and relief valves will comply with the appropriate ASME code and State of California regulations and will be supplied with all documentation.

All valves and valve actuators will be accessible for operation and maintenance.

Block valves will be provided at all equipment, except the air-side of rotor air coolers. Valving and other accessories will be positioned and physically spaced relative to other equipment so as to allow convenient access for operation and maintenance.

Valves will be arranged for convenient operation from an appropriate floor level or platform and will be provided with extension spindles or gearing, as required. Where extension spindles are fitted, all the thrust when opening or closing the valves will be taken directly on the valve body and all pedestals will be mounted directly on floor girders or other stationary members. Valves, valve handwheels, and/or valve actuators will not infringe on spaces or walkways. Valve

pedestals will be of approved design and be fitted with an indicator to show whether the valve is open or closed.

Hand-actuated valves will be operable by one person. Gear operators will be provided on manual valves when the rim pull required to open or close the valve is greater than 100 pounds.

Valve materials will be suitable for operation at the maximum working pressure and temperature of the piping to which they are connected. Steel valves will have cast or forged steel spindles. Seats and faces will be of low friction, wear-resistant materials.

Valves in throttling service will be selected with design characteristics and of materials that will resist erosion of the valve seats when the valves are operated partly closed.

Valves with position stops that limit the travel of each valve in the open or closed position will have the stops located on the exterior of the valve body to provide clear indication of full open and close positions.

In general, the valves will be standardized to use the same valve type and manufacturer to the extent possible.

Except where otherwise specified or approved, gate valves greater than 3 inches in diameter in high pressure classes will be of the parallel slide type or flexible wedge type, and, when in the fully open position, the bore will not be obstructed by any part of the gate. The internal diameter of valve ends will be the same as the internal diameter of the pipe. Gate valves in pressure classes 1500 and above, standard port size, will be used whenever suitable. Gate valves in high pressure classes will have butt-welded joints except where otherwise specified or approved.

Valves will not be installed in an inverted position.

3.5.1 Valve Types

3.5.1.1 Drain and Vent Valves and Traps

Double valving will be provided for drains and vents in Class 900 or higher piping service. Drain and vent valves can be ball, needle, globe, or gate valves.

Drain traps will be complete with air cock and easing mechanism. Internal parts will be constructed from corrosion-resistant materials and be renewable. Trap bodies and covers will be cast or forged steel and be suitable for operating at the maximum working pressure and temperature of the piping to which they are connected. Traps will be piped to the drain collection tank or to sumps.

Drain valves will have cast or forged steel bodies with covers and glands of approved construction. Spindles will be of stainless steel, and materials will be suitable for operation at the maximum working pressure and temperature of the piping to which they are connected.

Where valve seats are shrouded, the design of the shroud will be such as to prevent foreign matter from lodging in the valve seat.

3.5.1.2 Low-Pressure Water Valves

Low-pressure water valves will be butterfly type of steel or cast iron construction. Cast iron valves will have cast iron bodies, covers, gates (discs), and bridges; the spindles, seats, and faces will be bronze or stainless steel. For butterfly valves the seats and faces may be of soft seal material.

Low-pressure valves carrying liquids or gases at sub-atmospheric temperatures (e.g., carbon dioxide storage) will be designed to meet ASHRAE and applicable industry requirements for refrigeration piping.

3.5.1.3 Instrument Air Valves

Instrument air valves will be ball type of bronze or stainless steel construction, with valve face and seat of approved wear-resistant alloy. An isolation valve will be provided at each branch point from main headers.

3.5.1.4 Non-Return Valves

Non-return valves will be provided on the discharge of all centrifugal pumps (and other pumps that allow backflow) to minimize manual operator actions during system filling, to prevent system backflow/drainage following pump trip or shutdown, and to prevent backflow from desuperheaters (where applicable). Check valves are not required for the closed cooling water pumps. Swing check valves will not be installed in vertical pipe runs.

3.5.1.5 Control Valves

Control valves in throttling service will generally be the globe-body cage type with body materials, pressure rating, and valve trims suitable for the service involved. Other style valve bodies (e.g., butterfly, eccentric disk) may also be used. Block valves will be provided upstream and downstream of all modulating control valves. Bypass valves will be provided except where bypass valve use is impractical or presents a potential safety hazard.

Control valve actuators will be the pneumatic-spring diaphragm or piston type. The actuator will be sized to shut off against at least 110 percent of the maximum shutoff pressure. Actuators will be designed to function with instrument air pressure ranging from 60 to 125 psig.

Valves will be designed to fail in a safe position.

Control valve body size will not be more than two sizes smaller than line size, unless the smaller size is specifically reviewed for stresses in the piping and calculations are provided to Owner for record purposes.

Where flanged valves are used, minimum flange rating will be ANSI 150 class. Control valves in 600 class service and below will be flanged where economical.

Critical service valves will be defined as ANSI 900 class and higher valves in sizes over 2 inches.

Severe service valves will be defined as valves requiring anti-cavitation trim, low noise trim, or flashing service, with differential pressures greater than 100 psig.

In general, control valves will be specified for a noise level no greater than 90 dBA when measured 3 feet downstream and 3 feet away from the pipe surface.

Valve actuators will use positioners that are manufacturer's standard.

Handwheels will be furnished only on those valves that can be manually set and controlled during system operation (to maintain Project operation) and do not have manual bypasses.

Control valve accessories, excluding controllers, will be mounted on the valve actuator unless severe vibration is expected.

Solenoid valves supplied with the control valves will have Class H coils, where available. The coil enclosure will normally be a minimum of NEMA 4 but be suitable for the area of installation. Terminations will typically be by pigtail wires.

The DCS/PLC will monitor both "Open" and "Closed" position switches for motor- operated valves and pneumatic-operated control valves used for "On-Off" service. Position switches will not typically be provided for control valves used for "throttling" service. Where required, automatic combined recirculation flow control and check valves or orifices will be used for pump minimum flow recirculation control. Modulating or two-position automatic recirculation valves or restriction orifices will be used as applicable.

Body material and rating will conform to piping specifications as a minimum.

In no case will the valve body minimum rating be less than that permitted by piping specifications.

Control valve body size will be 1-inch minimum. Sizes Body sizes smaller than 1 inch may be used for special applications with 3/4-inch-and- under line size, and for pressure regulator services. Reduced ports will be used as required. Body size will not be more than two pipe sizes smaller than the line. Valves for on-off service will normally be line size.

Valve type and size will be selected taking into account such factors as cost, operating and design conditions, fluid being handled, rangeability-required allowable leakage, noise, and any other special requirements. For general services, the following types will be considered:

- Cage Guided Globe Valves with balanced or unbalanced type trim.
- Single seated globe valves may be either top and bottom or top guided.
- Eccentric Rotating Plug Valves of the throttling type.
- Ball Valves of the throttling type.
- Butterfly Valves with either conventional or shaped discs.
- Special Body Types may be considered for special applications such as noise control.

Characteristics of the inner valve will be determined by the following system characteristics:

- Equal Percentage Characteristics will normally be used on loops that have large variations in valve pressure drops, fast pressure control loops, and most flow control loops. In processes where no guidelines are available, equal percentages will be used.
- Linear Characteristics will normally be used for most level control, slow pressure control loops, and loops where the measurement is linear and the variation in the pressure drop across the control valve is small. Linear characteristics will be used for three-way valves and for two-way valves used in three-way service.
- Quick Opening Characteristics will normally be used for off-on service and for direct connected regulators using low lift.

Valve trim will be stainless steel minimum, hardened as required for maximum service requirements. Severe service conditions may dictate consideration of other materials.

Guide bushings will be of corrosion-resistant material.

Packing glands will be equipped with flange-style gland followers, secured by two bolts. A lubricator with steel isolating valve will be provided where packing lubrication is required. Packing will be Teflon below 450°F and Graphoil for temperatures of 450°F and higher.

Extension bonnets will be provided on throttling services above 450°F and below 0°F, or in accordance with the manufacturer's recommendation.

Piston actuators will be furnished with pneumatic trip valve, volume tank, piping, and necessary components to lock-in supply air pressure on loss of supply air pressure to actuator to ensure proper failure position.

Split ranging of control valves will be done electronically using independent DCS/PLC outputs. Positioners will be the manufacturer's standard.

Valve leakage classes will conform to ANSI/FCI 70-2-1991 and shall be appropriate for the service.

3.5.1.6 Safety and Relief Valves

Safety valves and relief valves will be provided as required by Code. Safety and relief valves will be flanged and installed vertically. Piping systems will be protected as required by ASME B31.1. Equipment or parts of equipment that can be over-pressurized by thermal expansion of the contained liquid will be provided with thermal relief valves.

3.5.1.7 Instrument Root Valves

Instrument root valves and condensate pots will conform to the requirements of ASME B31.1.

3.5.1.8 Float-Operated Valves

Float-operated valves will be provided with small-bore float-operated pilot valves connected into each system, where necessary, to eliminate water hammer. Floats will be arranged to operate in a baffle tank, designed to prevent a turbulent water surface around the float.

3.5.1.9 High-Pressure Valves

Steel valves will have cast or forged steel spindles. Seats and faces will be of low friction and wear resistant.

Valves used for throttling service will be designated to prevent erosion of the valve seats when the valves are operated in a partly open condition.

Valves over NPS 2 inches in size and rated in pressure Class 900 and above will be provided with pressure seal bonnets. Valves over NPS 2 inches in size and rated in pressure Class 600 and below will be provided with bolted or welded bonnets

Valves under NPS 2 inches in size will be provided as follows:

- For Class 600 and under, use bolted bonnet.
- For Class 900 and over, use welded bonnet “T” pattern, or “Y” pattern style.

ANSI pressure Classes 900 and 1500 flexible wedge gate valves will be specified with pressure seal bonnet/cover joint, stellited integral or welded-in seat rings, lubricated bearing yoke sleeve (NPS 6 and larger), bolted gland, and the disc provided with stellited seating surfaces.

ANSI pressure Class 600 flexible wedge gate valves will be provided with bolted gland arrangement, integral or welded-in seat rings, provision for back seating, bolted-ring type body/bonnet joint, and yoke drive sleeve with ball or needle bearings and booster station as described above, except they will not include the bolted ring type body/bonnet joint.

3.5.2 Insulation and Freeze Protection

All piping subject to freezing will be freeze protected with electric heat tracing cable as described in the Electrical section. Piping will typically be insulated with mineral fiber per ASTM C547, Class 2 for operating temperatures up to 500F and calcium silicate per ASTM C533, Type 1 for higher operating temperatures. (Except that insulation on European sourced equipment will use equivalent international standards. Insulation will be covered with aluminum lagging with a thickness of 0.016 inches. The insulation and lagging system will provide a maximum cold face temperature of 140°F at an ambient air temperature of 95°F in still air.

Anti-sweat insulation will be flexible elastomeric cellular insulation conforming to ASTM C534.

3.5.3 Tanks

Tanks will be designed to ASME, API, AWWA and NFPA codes as appropriate for the intended service.

Large outdoor storage tanks will be welded or bolted construction. Design features will be provided as required to prevent damage to the tank wall during extended outages in subfreezing weather if required.

Nozzles on water tanks subject to freezing will project into the tank by a distance sufficient to permit continued operation with an ice layer on the inside of the tank wall.

Maintenance drains near the tank bottom will be provided for complete tank drainage. Containment systems will be provided for all tanks containing potentially hazardous liquids, including urea. Leak detection systems will be provided, as required by regulations or permits. All tank containment areas will be furnished with drains and/or low- point sumps.

The urea storage facility will be designed to either the ASME Pressure Vessel Code or to API 620. In either case, the storage tank will be protected by a secondary containment basin capable of holding 100 percent of the storage volume of the largest tank in the basin, plus the volume associated with 24 hours of rain assuming the 25-year storm.

Manholes, where provided, will be at least 24 inches in diameter. Ladders and cleanout doors will be provided on storage tanks as required to facilitate access/maintenance. Provisions will be included to allow proper tank ventilation during internal maintenance.

Unless otherwise specified or approved, tanks used for the storage of oil, raw water, treated fresh water, and condensate will be carbon-steel-plate stiffened and stayed in an approved manner where necessary.

Pipe connections for tanks will be made to reinforced nozzles. Pipe connections will be made with studs and not cap bolts.

Tanks that are to be insulated and lagged will be provided with external lugs where necessary.

A corrosion allowance of 1/16 inch for carbon steel and low chrome alloys will be used, except for lined or internally coated tanks.

Overflow connections and lines will be provided and be at least one pipe size larger than the largest input line or combination of inputs that can discharge simultaneously.

3.5.4 Heat Exchangers

Heat exchangers will be provided as components of mechanical equipment packages and may be shell-and-tube or plate type. Heat exchangers will be designed in accordance with Tubular Exchanger Manufacturers Association (TEMA) or manufacturer's standards. Fouling factors will be specified in accordance with TEMA or HEI.

Thermal relief valves will be provided for heat exchangers as required.

3.5.5 Pressure Vessels

Pressure vessels will be designed to ASME VIII Division 1 standards and in accordance with state and local requirements and will be registered with the National Board.

Pressure vessels will include the following features and appurtenances:

- Process, vent, and drain connections for startup, operation, and maintenance
- Materials compatible with the fluid being handled
- Shop-installed insulation clips spaced not greater than 18 inches on center for vessels requiring insulation

- Relief valves in accordance with the applicable codes
- Vessel capacity consistent with design requirements of the system and not less than required to absorb the maximum anticipated system transients.

Carbon steel tanks will have a minimum corrosion allowance of 0.06250 inch Where appropriate.

3.6 Fuel Supply System

The fuel conditioning equipment will process the fuel to meet the OEM requirements for the fuel to the equipment. The system will include the ability to heat the fuel to a temperature acceptable to the engine manufacture with suitable means within the restriction of the Project's environmental consents (including the Environmental Permit). Coalescing and

Particulates filtering will be provided.

The fuel system will be designed to supply the total engine load demands under all ambient conditions.

3.6.1 Natural Gas

Fuel conditioning system will include the following equipment:

- Scrubber, coalescent gas filter, and gas heaters to ensure that natural gas quality meets the requirements of the engine supplier while improving overall cycle efficiency
- One fuel gas drain tank, with level switch alarmed to the control room
- Pressure regulating station
- Natural gas metering station
- Fuel
- Cathodic protection on the gas pipeline to meet SDGE gas interconnection requirements or AGA as applicable.

3.7 Sump Pumps

Single sump pumps will be furnished as required. The pumps will be equipped with guide bars for removal and automatic discharge connections.

A control panel complete with auto/manual control, starters, level switches, etc., will be included. Pumps will operate at high-high level.

3.8 Potable Water

Potable water for personnel use, service/fire water supply, will be delivered to the site via truck. The source will be from one of several nearby water suppliers.

The Project potable water system will consist of potable water distribution system equipment, including a potable water storage tank, valves and backflow preventors as required to meet local and state requirements. The water distribution system will be sized to deliver peak demand to each building at a normal pressure of 40 psi and a maximum pressure of 80 psi. Minimum pipe

size for building service will be ¾ inch. System will be designed to utilize these pressures considering peak flow demand of the components.

3.9 Fire Protection System

3.9.1 General

A complete stand-alone fire protection and fire detection alarm and notification systems, and related subsystems, sprinkler systems, fixed water spray systems, fire protection water supply systems, clean agent extinguishing system, standpipe and hose station connections, and hand held portable fire extinguisher, hereinafter referred to collectively as the fire protection system.

The system will be designed and installed in accordance with National Fire Protection Association (NFPA) requirements and recommendations, applicable State of California Building and Fire Codes, Standards and Amendments, Federal and County Codes, and the local authorities having jurisdiction.

The fire protection systems and related subsystems are intended as a life safety system and equipment protection, and will be designed and supplied consistent with that objective.

3.9.2 Responsibility

The fire protection systems supplied will be designed in a consistent manner throughout the premises and all components will be able to operate to meet all requisite functions in a consistent manner.

All design drawings and calculations will be signed and sealed by a State of California Registered Professional Engineer currently practicing engineering in the State of California. Submittal packages will be submitted to the Local Authorities having Jurisdiction for review, comments and approval of the various fire protection designs, equipment and installations.

3.9.3 Fire Protection Master Plan and Design Basis

A Fire Protection Master Plan and Design Basis will be prepared for the Project. This will consist of as a minimum the following documents:

a. Building and Fire Codes, and Life Safety Compliance Review Report
b. Fire Risk Evaluation Report
c. Hazardous Area Classification Evaluation

Building and Fire Codes, and Life Safety Compliance Review – The report will identify and address for each building, pre-engineered and/or pre-fabricated building, equipment enclosure and/or structure at a minimum the following:

a. Applicable building and fire codes, standards, recommendations and amendments.
b. Building classification, occupancy and permitted construction types.
c. Building height and area limitations.

d. Fire resistance requirements for floors, exterior and interior walls and structural supports.

e. Egress and exiting requirements.

f. Detailed exit analysis and calculations. Prepare exit analysis drawings documenting occupant loads, required exit widths, occupant load distribution and travel distances.

g. Combustible and flammable gases and liquids process equipment and storage fire protection, quantity limitations, and storage requirements.

h. Accessibility requirements.

i. Fire Department access and fire fighting facilities.

j. Occupancy and area separation requirements.

k. Fire alarm and detection systems.

l. Sprinkler/Standpipe and fire hose station requirements (duration, flows, pressures and densities).

m. Fire protection water supply requirements.

n. Emergency power and lighting requirements.

o. Smoke control and ventilation requirements.

The Building and Fire Codes, and Life Safety Compliance Review will be performed by a State of California Fire Protection and Engineering (FPE) Firm experienced in the preparation of fire protection master plans, building code reviews and reports and exit/egress analysis calculations and diagrams.

Fire Risk Evaluation - A NFPA 850 fire risk evaluation will be initiated as early in the design process as practical to ensure that the fire prevention and fire protection recommendations as described in this document have been evaluated in view of the plant-specific considerations regarding design, layout, and anticipated operating requirements. The evaluation should 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. The fire risk evaluation should be approved by the owner prior to final drawings and installation.

Hazardous Area Classification Evaluation - The basis for classification evaluation will be NFPA 70 (National Electrical Code [NEC]), NFPA 497, API 500, vendor information and other standards, as applicable.

3.9.4 Materials, Equipment and System Components Listings and Approvals

All materials, equipment and system components furnished, will be new and approved by local statutory authorities (approved for use by the State of California Fire Marshal) and listed by Underwriters Laboratory (UL /ULI) and/or approved by Factory Mutual Research Corporation (FM) if required by Applicable Laws.

All materials, equipment and system components for which UL listing categories exist will be ULI listed for the intended application.

All materials, equipment and system components for which UL listing and/or FM approval is required will be listed in the current edition of the UL or FM Fire Protection Equipment Directories and will be delivered to the project site with factory applied, UL and/or FM stickers.

3.9.5 Fire Protection Water Supply and Water Storage

The required fire protection water supply (fire flow and duration) will be designed in accordance with the applicable codes and standards.

The water supply for fire protection will be provided directly from a dedicated supply in a water storage tank conforming to the requirements of NFPA 22 as a minimum. The fire water reserve will be based on the minimum required fire protection water flow and flow duration. The guaranteed fire water capacity will be based on the largest postulated fire flow per the Fire Protection Master Plan and Design Basis as required by NFPA 22. The storage tank will be filled by trucks and since there is no permanent water supply connection the total tank capacity will be two (2) times the minimum fire water capacity.

The tank will be provided with:

a. Fire protection water low level supervisory alarms and low temperature supervisory alarms both monitored by the plants fire detection and alarm system per NFPA 22 and 72, and the DCS/PLC system.

b. OSHA approved handrails, guardrails and ladders for inspection and maintenance of the tank.

3.9.6 Fire Pumps

The site will be provided with two (2) fire pumps both located within a fire pump house enclosure. The fire pumps will be sized to meet the applicable code requirements and the largest postulated fire(s) per the Risk Evaluation.

The types of fire pumps that will be provided are as follows:

a. One (1) 100 percent electric motor-driven centrifugal fire pump.

b. One (1) 100 percent diesel engine-driven centrifugal fire pump.

One (1) pressure maintenance pump (jockey pump) will be provided to maintain pressure in the underground fire protection water main system and also will be located in the fire pump house.

The fire pumps will be separated from each other by a two (2) hour rated fire barrier wall.

The diesel engine driven fire pump will be installed with a residential low noise type muffler.

Each fire pump area will be provided with:

a. An automatic wet pipe sprinkler system.

b. Low temperature supervisory device per NFPA 72.

c. Ventilation system.

All fire pump and sprinkler valves within each fire pump area will be provided with a valve supervisory (tamper) switch. The use of butterfly valves is prohibited.

The fuel oil storage tank for the diesel engine driven fire pump will be of double wall construction with tank leak detection system. The tank will be able to be refueled from both outside the pump house (external fuel connection with tank level gauge) as well as inside the pump house.

Remote monitoring and alarms meeting the requirements of NFPA 20 will be provided for both pumps.

The fire pumps will be designed and installed such that either fire pump can be taken out of service without affecting the use and operability of the other fire pump and the pressure maintenance pump.

The design, installation, and testing of the fire pumps will be in compliance with the requirements of NFPA 20, 70 and 72.

3.9.7 Fire Protection Water Main System and Hydrants

Fire water piping may run both above and below ground. Piping materials and sizes will meet the requirements of the local jurisdictional authorities.

Underground piping will comply with the following:

The underground fire protection water main system and fire hydrants will be arranged around the structures, process areas including outdoor equipment throughout the power plant and switchyard. The size of the loop piping will be based on the calculated maximum demand and the requirements of NFPA 24 and per the Risk Evaluation.

The underground fire protection water piping will be constructed of a combination of cement lined ductile iron and AWWA C900 PVC Class 200. All underground piping shall be installed per NFPA 24 and manufacturer's recommendations.

The underground loop will be connected to the stations fire pumps using two parallel lateral underground water mains (primary and back up) with post indicator valves located on both sides of the lateral and between both of them.

The underground loop will be provided with post indicator valves (PIV's) to isolate sections due to a line break.

Laterals to buildings and outside equipment that have water based fire suppression system will be provided with outside isolation water control supply valves using PIV's (with valve supervisory (tamper) switches) to isolate the water supply.

3.9.8 Fire Hydrants

The distance between fire hydrants around the Power Island fire loop will be a maximum of 250 feet and hydrants will not located within 40 feet of building structures as required by NFPA 24. Additional hydrants will be provided so that no exposure is more than 250 feet from the nearest

hydrant so that a fire hose can be used. The number and placement of fire hydrants will meet the requirements of the local jurisdictional authority.

The fire hydrants will be provided with two hose connections and one fire pumper suction connection.

The entire design and installation of the underground fire protection water supply main system will be in compliance with the requirements of NFPA 24 and 291, and the local Statuary Authorities.

3.9.9 Fire Protection and Detection System

Table B.3-2 shows the anticipated fire protection and detection that will be provided:

Table B.3-2 Fire Protection and Detection Systems

Equipment, Area, and/or Building	Fire Protection Suppression System Type	Detection or Actuation Devices
Power House	Automatic wet pipe sprinkler system provided throughout the entire building. Class II hose stations located throughout the entire building	Gas Detectors, Manual pull stations located at each exterior exit door.
Power House Control Room	Pre-action sprinkler system	Smoke detectors at the ceiling level and beneath all raised floors
Maintenance Shop (includes Tools / Storage Room and beneath all Mezzanine)	Automatic Wet Pipe Sprinkler System	
Warehouse	Automatic Wet Pipe Sprinkler System	
I & C Shop	Automatic Wet Pipe Sprinkler System	
General Office Areas, Corridors, File & Copy Room(s), Conference Room, Janitor and Storage Room and Lunch Room	Automatic Wet Pipe Sprinkler System	
Both Women's and Men's Combination Wash Rooms and Locker Rooms	Automatic Wet Pipe Sprinkler System	
Telephone and Communication Room	Pre-action sprinkler System – Electric Release	Spot type smoke detectors, including beneath raised floors.
Operator Equipment and Storage Room	Automatic Wet Pipe Sprinkler System	
Electrical Equipment Rooms	Pre-action sprinkler System – Electric Release or Clean Agent Fire Extinguishing System	Spot type smoke detectors
Battery Rooms	Pre-action sprinkler System – Electric Release	Smoke detectors at the ceiling. Note: If the room is classified per the Fire Protection Master Plan and Design Basis, explosion proof smoke detectors are required.
Main Transformer	Automatic Water Spray (Deluge) System.	
Warehouse and Storage Buildings	Automatic wet pipe sprinkler system. Class II hose station located throughout the entire building.	

The specified required fire protection and fire detection outlined in the table above defines minimum requirements only. The table may not include all requirements necessary to satisfy the applicable local statutes, as required by the Local Statutory Authorities. Fire protection and detection equipment will comply with the NFPA code and the local jurisdictional authority.

All outdoor sprinkler system releasing valves subject to freezing will be installed in a heated weatherproof insulated enclosure. Each enclosure will be provided with a low temperature enclosure monitoring device monitored and annunciated by the fire alarm control panel in the control room.

A complement of 20-pound type, portable fire extinguishers rated for Class A, B, and C fires will be installed in accordance with local building code and NFPA 10. In addition, portable CO_2 extinguishers will be located in areas containing sensitive electrical and telecommunication equipment, such as the control room and the switchgear rooms. One portable wheeled dry-chemical extinguisher will be located in the engine area to provide extended manual suppression capability. Fire Extinguishers containing water or water- based agent and Listed for Class C will not be used.

3.10 Fire Detection System

The Main Fire Protection Panel (MFPP), located in plant main control room, will be integrated fire detection, evacuation signaling and auxiliary function control system. Remote panels may be included, but a central Main Fire Protection Panel located in the plant main control room is required. The system will be of the multiplex type. The Fire Protection Detection System will be designed and installed to meet the requirements of NFPA 72. The system will be provided with the capability of being remotely monitored.

Fire alarm bells, horns horn strobes, strobes, trouble horns, and chimes will be installed as determined by the Fire Protection Master Plan and Design Plan.

To allow manual initiation of a fire alarm, manual pull stations will be distributed throughout the Project as determined by the Fire Protection Master Plan and Design Plan. The manual pull stations will be equipped with a dual action releasing lever to reduce chances of accidental operation.

3.11 Compressed Air System

The compressed air system will consist of an instrument air and a station air system and will be separate and isolated from the air start system.

The instrument air system will have adequate dryers and filters to meet OEM quality specifications. Heated dryers with filters will supply dry (-40°F dew point at 125 psig), oil free air for use by control systems and instrumentation.

The station air system will provide air for maintenance tools and will have valved access points at convenient maintenance around the Project. The air will be dry and clean.

Adequate instrument compressed air storage will be provided to facilitate emergency shutdown of the plant. The instrument air receiver and piping will provide a minimum of 3 minutes of

compressed instrument air (pressure above minimum instrument requirement) for plant shutdown without instrument air compressor operation.

The major components of each of the Project's compressed air system consist of the following:

- Two 100 percent instrument air compressors and connection for portable compressor
- A minimum of one air receiver.
- Two 100 percent instrument air dryer and filters for oil removal. Ability to change out compressed air dryer elements and filters on line with no plant curtailments
- Instrument air distribution header
- Station air distribution

3.12 Cranes, Hoists, and Trolleys

A bridge crane(s) or overhead cranes will be provided with sufficient capacity for all overhaul activities in the power house. The crane(s) will allow for careful placement of equipment meeting engine manufacturer's requirements during maintenance work. The bridge crane will be CMAA Class C, complete with electric wire rope hoist and motorized trolley. A single speed hoist and single speed trolley shall be provided. Access to the crane shall be from a permanently mounted caged ladder.

During the design phase of the project and before any site construction, the engine equipment supplier will provide written descriptions for all disassembly and reassembly lifts required for all major scheduled inspections and overhauls of the engines and generators. This will include descriptions of the use and sizing of fixed and mobile cranes. The project design engineer will produce drawings and calculations to demonstrate the ability to avoid all fixed interferences while completing all required movements and lifts and the ability of the specified mobile cranes to be driven to the required locations using only the road surfaces and maintenance pads designed for maintenance crane loadings.

All equipment in the plant will be provided with a convenient arrangement for slinging or handling during overhaul.

Fixed cranes and hoists will be designed, manufactured, erected, and tested in accordance with the specified standards and codes. All crane structures and associated lifting tackle will be tested at lifting loads in excess of the rating of the crane as required by the specified standards and codes. Lifting cables will have enough length to lift loads the entire height without intermediate stops to adjust lifting tackle. Cranes and lifting tackle over 5 tons lifting capacity will be electrically operated and controlled from floor level

Each item of lifting equipment will comply with the minimum requirements of the applicable standards and codes with regard to:

- Identification markings
- Tests and inspection
- Quality/grade of material
- Dimensions

Brakes of an approved type will be fitted to the lift and hoist and to the hoisting, traversing, and dwelling motions of each crane. The brakes will be designed to operate automatically on interruption of the electrical supply to the motors and to arrest and hold, at any position, the greatest load carried by the motor. Brake design will minimize shock loading during application of the brakes. Crane hoists will be equipped with an independent manually operated brake, capable of holding the maximum load lifting capability of the hoist.

A separately mounted “stop” push button (“E-Stop”) will be provided in such a position as to be readily available for use by the operator. The emergency stop push button will trip the main contactor.

Electrically operated hoists will be fitted with automatic self-sustaining brakes. Electrical motors will be rated for the number of starts per hour as required by the specified standards and codes.

3.13 Heating Ventilating and Air Conditioning

HVAC will be provided for all buildings. The HVAC System will heat, ventilate and/or air-condition plant buildings and enclosures for personnel comfort, equipment environment protection and/or freeze protection. HVAC System design generally will comply with ASHRAE Handbooks and Standards.

Electric heaters in air-conditioned areas and ventilated areas will provide any necessary space heating.

Regarding engine hall HVAC, Contractor’s design of the HVAC will meet the requirements of the equipment being housed, and not for personal comfort or high efficiency.

3.13.1 System Function

HVAC systems will maintain the environmental conditions in terms of space temperature and humidity, air quality, and building pressurization in order to provide efficient equipment operation and comfortable working conditions for personnel.

3.13.2 Buildings and Enclosures

The following discussion applies to buildings, rooms, areas, and enclosures.

Maintenance of indoor environmental conditions will be accomplished with air conditioning systems or ventilation systems, as appropriate. Areas such as electrical switchgear rooms and battery rooms will be maintained at temperatures above those typical for air conditioned environments, yet below temperatures equal to or in excess of the outdoor ambient design temperature. Pre-filter and final filters will be used for all areas that are either air-conditioned or ventilated. Pre-filter efficiency will be 30 percent and final filter efficiency will be 80 percent based on ASHRAE 52.1-1992 or approved equivalent international standard.

Explosion-resistant construction will be used in all battery rooms where hydrogen may be developed or released.

The fresh air intakes for the control room will be elevated and separated by at least 3 to 5 feet vertically and 10 to 15 feet horizontally. Also, fresh air intakes will not be located on the same wall as any ventilation discharge from the battery rooms.

All ductwork will be galvanized steel. The duct system will include fire dampers, balancing dampers, insulation, flexible connections, etc., needed for a complete system. Products will meet NFPA 90A or approved equivalent international standard, and fire dampers will meet UL 555 or approved equivalent international standard. No products used in the duct construction will exceed the maximum rating of 25 for flame-spread and the rating of 50 for smoke-developed and fuel-contributed obscuration.

3.13.3 Air Conditioning System

A split packaged air conditioning system(s) or ventilation system(s), as appropriate, will be installed for rooms requiring maintenance of indoor environmental conditions, including the main control room, offices, storage areas, and battery room. The system(s) will provide constant volume air supply with a variable outside air supply capability of 10 to 100 percent (economizer) to achieve energy conservation. When outdoor air temperature and humidity conditions permit, the system will utilize outside air in lieu of refrigerant for cooling. Each AC unit will be provided with a compressor, evaporator coil, detached air-cooled condenser, electric heating coil, and a pre-filter and final filter. The HVAC system will continuously operate the year round. For the control room, two 100 percent capacity HVAC systems will be provided, one operating and one as standby.

The HVAC split units for the air conditioning system or ventilation system will include a mixing section with fresh air, exhaust air, and return air dampers, filter section (including pre-filter and final filter), electric pre-heating coil section, cooling coil section, supply fan section and return/exhaust fan section. The air conditioning system final filter will meet the requirements of 80 percent atmospheric dust spot efficiency based on ASHRAE Standard 52.1 or approved equivalent international standard.

Duct-mounted electric reheat coils will be provided for zone temperature control as well as high humidity control.

Careful consideration will be taken for locating outdoor air intakes considering prevailing wind direction, airborne sand and dust, and thermal exhaust from equipment such as radiators.

3.13.4 Battery Room Exhaust System

The exhaust system in the battery room will be operated continuously to maintain negative pressure and to avoid accumulation of hydrogen gas or leakage to neighboring rooms. Ducted exhaust intake will be directed upward to remove hydrogen accumulated at ceiling and in beam pockets.

Indoor air temperature will be kept below 85°F. Exhaust air rate will meet the requirement of not less than ten volume air changes per hour. Two 50 percent capacity in-line exhaust fans will be provided.

Exhaust fans and motors will be of explosion proof design.

3.13.5 Design Parameters

Control Building HVAC system indoor design temperatures are summarized in Table B.3-3.

Table B.3-3 Control Building HVAC System Indoor Design Temperatures

Room	System Type	Indoor Environmental Conditions
Control room/ Offices/ I&C maintenance / CEMS Enclosure	HVAC	75 ± 4°F, 50% RH
Battery Room	HVAC	75° +5° -5° F

The indoor environmental conditions will be met based upon the internal heat gain in the room and outdoor ambient design conditions as listed in Table B.3-4.

Table B.3-4 Control Building HVAC System Design Conditions

Service	Equipment Description
Control room/battery room	HVAC Split Packaged Unit 2 x 100%
Switchgear	HVAC split packaged Unit
Offices, I&C maintenance room/ and CEMS Enclosure	HVAC Split Packaged Unit
Mechanical maintenance area	Wall/roof exhaust, louvers, dampers
Electrical building	Supply fans, dampers, louvers
Fire pump enclosure	Supply fans, dampers, louvers
Power House	Supply fans, dampers, louvers

APPENDIX B.4

ELECTRICAL ENGINEERING DESIGN CRITERIA

APPENDIX B.4
ELECTRICAL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

The project will be constructed in accordance with industry standard practices and project developed specifications; its implementation will include an orderly sequence of the following project execution phases:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Startup, testing, and checkout
- Project completion

This appendix summarizes the codes, standards, and industry practices that will be used in the design and construction of the project. The general electrical design criteria defined herein form the basis of the design for the project electrical components and systems; more specific design information will be developed during detailed design phase. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 10D-2 summarizes the applicable codes and standards and Section 10D-3 includes the general design criteria for motors, power and control wiring, protective relaying, classification of hazardous areas, grounding, lighting, freeze protection, lightning protection, raceway, cable tray and conduit, and cathodic protection.

2.0 DESIGN CODES AND STANDARDS

The project design and specifications will be in accordance with all applicable federal, state, and local laws, ordinances, regulations, and standards (LORS). The codes and industry standards to be used in the design and construction are as follows:

- Anti-friction Bearing Manufacturers Association (AFEMA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Edison Electric Institute (EEI)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)

- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Act (OSHA)
- Underwriters' Laboratories (UL)
- National Association of Corrosion Engineers (NACE)

In addition to the general codes and standards listed above, the following specific standards will be utilized:

2.1 BATTERIES

NEMA IB 4	Determination of Ampere-hour and Watt-hour Capacity of Lead-Acid Industrial Storage Batteries for Stationary Service
IEEE 450	Recommended Practice for Maintenance, Testing and Replacement of Large Lead-Acid Storage Batteries
IEEE 484	Recommended Practice for Installation, Design and Installation of Large Lead-Acid Storage Batteries for Generating Stations and Substations

2.2 BATTERY CHARGERS

NEMA AB1	Molded Case Circuit Breakers
NEMA PV5	Constant-Potential Type Electric Utility (Semiconductor Static Converter) Battery Chargers

2.3 CABLE, LOW VOLTAGE POWER, CONTROL AND INSTRUMENT

ASTM B8	Concentric-Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-19-81	(NEMA WC3) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-68-516	(NEMA WC8) Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NFPA 258	Standard Test Method for Measuring the Smoke Generated by Solid Materials
NFPA 70	National Electric Code (NEC)
UL 44	Safety Standard for Rubber-Insulated Wires and Cable

2.4 CABLE, MEDIUM VOLTAGE POWER

ICEA 6	Ethylene Propylene Rubber Insulated Shielded Power Cables, Rated 5 through 69 kV
ASTM B8	Concentric Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-66-524	Cross Linked-Thermosetting, Polyethylene-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy
ICEA S-68-516	Ozone-Resistant Ethylene-Propylene Rubber Insulation for Power Cables Rated 0 to 35,000 Volts
ICEA S-19-81	(NEMA WC3) Rubber Insulated Wire and-Cable for the Transmission and Distribution of Electrical Energy
NFPA 70	National Electric Code (NEC)

2.5 CABLE TRAY

NEMA VE1	Cable Tray Systems

2.6 CATHODIC PROTECTION EQUIPMENT

ANSI B1.1	Unified Inch Screw Threads
ANSI B2.1	Pipe Threads
ASTM A518	Corrosion-Resistant High Silicon Cast Iron
ASTM B418	Cast and Wrought Galvanic Zinc Anodes for Use in Saline Electrolytes
NEMA AB-1	Molded Case Circuit Breakers
NEMA ICS	Industrial Controls and Systems
ICEA S-61-402	(NEMA WC5) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-66-524	(NEMA WC7) Cross-Linked-Thermosetting, Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

2.7 CIRCUIT BREAKERS, HIGH VOLTAGE

IEEE C37.04	Rating Structure for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.06	Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

IEEE C37.09	Test Procedure for AC High Voltage Circuit Breakers rated on a Symmetrical Current Basis
IEEE C37.010	Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.11	Requirements for Electrical Control for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis

2.8 CONDUIT

ANSI C80.4	Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
NEMA TC2	Fittings for Electrical Rigid Nonmetallic Conduit
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC9	Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
UL 6	(ANSI C80.1) Rigid Steel Conduit
UL 360	Flexible Liquid-tight Conduit
UL 514	Fittings for Electrical Rigid Nonmetallic Conduit
UL 651	Electrical Rigid Nonmetallic Conduit
UL 797	(ANSI C80.3) Electrical Metallic Tubing
UL 886	Hazardous Area Fittings

2.9 DISTRIBUTION PANELS

ANSI C971	Low Voltage Cartridge Fuses, 600 volts or less
NEMA AB1	Molded Case Circuit Breakers
NEMA ICS	Industrial Controls and Systems
NEMA KSI	Enclosed Switches.
NEMA PB1	Panelboards
UL 50	Electrical Cabinets and Boxes
UL 67	Panelboards

2.10 GROUNDING

ASTM B8	Specifications for Concentric-Lay Stranded Copper Conductors
IEEE 80	IEEE Guide for Safety in AC Substation Grounding
NEMA CC1	Electrical Power Connectors for Substations
NFPA 70	National Electric Code (NEC)

2.11 LIGHTING FIXTURES

NEMA FA1	Outdoor Floodlighting Equipment
NEMA LE1	Fluorescent Luminaries
UL 57	Standard for Safety, Electric Lighting Fixtures
UL 844	Standard for Safety, Electric Lighting Fixtures for Use in Hazardous Locations
UL 924	Standard for Safety, Emergency Lighting Equipment

2.12 LIGHTNING ARRESTERS

IEEE C62.1	Surge Arresters for AC Power Circuits

2.13 SECONDARY UNIT SUBSTATIONS

ANSI C37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures
ANSI C37.16	Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors
IEEE C37.20	Switchgear Assemblies
ANSI C37.50	Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures
ANSI C37.51	Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies
IEEE C57.12.00	General Requirements for Distribution, Power and Regulation Transformers
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
IEEE C57.12.90	Test Code for Liquid Immersed Distribution, Power and Regulating Transformers
IEEE C57.12.91	Test Code for Dry-Type Distribution and Power Transformers
IEEE C57.13	Requirements for Instrument Transformers

NEMA CC1	Electrical Power Connectors for Substations
NEMA TR1	Transformers, Regulators, and Reactors
NEMA ICSI	General Standards for Industrial Controls and Systems
NFPA 70	National Electric Code (NEC)

2.14 METAL-CLAD SWITCHGEAR AND NONSEGREGATED PHASE BUS

IEEE C37.04	Rating Structure for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.06	Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.20	Switchgear Assemblies Including Metal-Enclosed Bus
IEEE C57.13	Requirements for Instrument Transformers

2.15 MOTOR CONTROL CENTERS

NEMA ST20	Dry-Type Transformers for NEMA General Purpose Applications
NEMA AB1	Molded Case Circuit Breakers
NEMA ICS1	General Standards for Industrial Controls and Systems
NEMA ICS2	Industrial Control Devices, Controllers, and Assemblies
UL 67	Electric Panelboards
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 508	Industrial Control Equipment
UL 845	Motor Control Centers
NFPA 70	National Electric Code (NEC)

2.16 MOTORS, LOW VOLTAGE

AFBMA 9	(ANSI B3.15) Antifriction Bearing Manufacturers Association
NEMA MG1	Motors and Generators
NEMA MG2	(AFBMA 11/ANSI B3.16) Safety Standard for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators
NEMA MG13	Frame Assignment for Alternating Current Integral Horsepower Induction Motors

2.17 MOTORS, MEDIUM VOLTAGE

ANSI C50.41	Polyphase Induction Motors for Electric Power Generating Stations
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
NEMA MG1	Motors and Generators
NEMA MG2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators

2.18 NEUTRAL GROUNDING RESISTORS

ANSI C76.1	Requirements and Test Codes for Outdoor Apparatus Bushings
IEEE 32	Requirements, Terminology, and Test Procedures for Neutral Grounding Devices
NEMA CC1	Electric Power Connectors

2.19 RELAY PANELS

ANSI C37.20	Switchgear Assemblies Including Metal-Enclosed Bus
ANSI 37.90	Relays and Relay Systems associated with Electric Power Apparatus
ICEA S-19-81	(NEMA WC3) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

2.20 TRANSFORMERS, DRY-TYPE

ANSI U1	General Requirements for Dry-Type Distribution and Power Transformers
NEMA ST20	Dry-Type Transformers for General Application
UL 506	Standard for Safety, Specialty Transformers

2.21 ADDITIONAL CODES AND STANDARDS

Other recognized standards will be utilized as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

3.0 ELECTRICAL DESIGN CRITERIA

The peaking plant electrical system will be designed to shut down safely to stop condition with no damage to equipment in the event of loss of auxiliary power.

The plant electrical equipment and associated systems will be designed to provide a safe, reliable and cost-effective, power generation facility. The design scope will include the plant equipment and associated electrical systems required for collection of and transmission of the generated power the point of interconnection with the transmission system. The overall one line diagram (Drawing No. QBPP-E001) depicts the conceptual system design for the peaking plant.

The major components of the plant electrical systems include the following:

- Reciprocating engine generators (total of 11), complete with excitation system and appurtenances. Generator and controls designed to be able to meet all WECC operating requirements;
- Control Panel for each generator set and common control panels located remotely. The engine-generator sets will operate in parallel with each other to provide their collective output into the utility system;
- Two Medium Voltage Switchgear buses: one bus will collect outputs of six (6) individual generators and the second bus will collect outputs of five (5) individual generators. The summed power at each bus will be transmitted by the main breaker to a separate low voltage winding of the Generator Step-up Transformer via nonsegregated-phase bus duct;
- Generator Step-up Transformer, three-winding type for combining output of all reciprocating engine generators;
- Plant auxiliary power distribution systems including station service transformers, low voltage switchgear, 480V motor control centers, 480V distribution panels, dry type transformers, lighting & receptacle power panelboards, DC battery and battery chargers, UPS, etc. (AC and DC systems).

3.1 FREQUENCY AND VOLTAGE LIMITS

3.1.1 Frequency

The Plant will meet or exceed WECC operating frequency requirements, and will be capable of maintaining continuous operation for the periods defined below.

Frequency Range (Hz)	Operation
< 57 Hz	Instantaneous trip from grid
≤ 58 Hz	30 Seconds
≤ 58.4 Hz	1 minute
> 58.4 Hz and < 60.6 Hz	Continuous
≥ 60.6 Hz	1 minute
≥ 61.7 Hz	Instantaneous trip from grid

3.1.2 Voltage

The Project will be designed to accommodate continuous operation of the units when the transmission system voltage measured at the switchyard is within ± 5 percent of the rated value, subject to reactive power flow restrictions associated with the units. Additionally, the plant will be able to operate momentarily (up to 15 seconds) for voltage variations of +20 percent to -10 percent.

3.2 AUXILIARY DISTRIBUTION SYSTEM AND EQUIPMENT

Plant auxiliary equipment will be designed and constructed to comply with the following requirements:

- The control and protection equipment will comply with the ANSI, IEEE and NEMA standards with respect to permissible variations in frequency and voltage.
- The system will be designed so that the steady-state bus voltages will be within +5 percent of the nominal value, even though the auxiliary equipment will be selected with a broader range of operation.
- The voltage variation for the auxiliary equipment will be in accordance with ANSI/IEEE and NEMA standards. Auxiliary equipment will be able to accept voltage variations of ±10 percent under steady-state conditions and of ±20 percent under conditions of disturbance.

In general, the electrical systems and equipment will, as a minimum, comply with the applicable requirements of NFPA 70 (National Electric Code or NEC) in areas where applicable, such as office buildings; ANSI C2 (National Electrical Safety Code, or NESC); and the applicable equipment standards published by ANSI, IEEE, and NEMA. Circuit breakers, switchgear, and MCCs will be UL approved or listed.

All electrical equipment, including bus, breakers, transformers, motor control centers, etc., will be designed to withstand the maximum available fault current.

During all operating conditions with all electrical power distribution equipment in service (e.g., no tie breakers closed) other than during the starting of large motors, the voltage at motor terminals will be maintained between 90 percent and 110 percent of motor rated voltage. Temporary voltage drops during motor starting will not extend below 80 percent of the motor rated voltage at the terminals of the largest motor on the buses being started, and non-starting motors on the same bus will not have a bus voltage of less than 90 percent of rated voltage.

The Project will perform short circuit and load flow studies on the electrical system and will be provided to the Owner for review and approval. A preliminary study will be done before any equipment is purchased or procured. A final study will be performed when complete data on furnished equipment is available.

All electrical ac auxiliary systems (medium & low voltage) must adequately mitigate arc-flash hazards as addressed in NFPA 70E and meet the following minimal requirements:

- All breakers, starters, and cables in medium and low voltage switchgear, MCCs, switchboards, load centers, and panel boards must be able to have maintenance performed solely in a de-energized state, without unacceptable impacts to the rest of the plant (i.e. critical equipment must still be able to run);
- Systems will be designed to limit maximum arc-flash hazard to 40 cal/cm^2 at 18 inches from any live parts;
- On circuit breakers that requiring racking, remote racking devices will be provided;
- Other devices/schemes such as maintenance switches and zone protection will be explored in addressing these hazards; Arc flash hazard calculations will be made for all

medium and low voltage ac electrical systems down to the 120V level per SDG&E calculation guidelines and labeled per SDG&E labeling standards;

- The Project will comply with SDG&E's "Arc Assessment Modeling Guideline".

3.3 SYNCHRONOUS GENERATORS

The engine generators will be a synchronous wye-connected generator designed for direct connection to the engine. The generator design and construction will include damper windings and will conform to the applicable standards for synchronous generators, salient-pole type. Global VPI generators are acceptable.

The generators will be furnished with the protective relays and metering systems.

The generators will be of a proven design and will comply with the ANSI/IEEE standards; their design electric output will match or exceed the nominal output of their engines throughout the whole range of loads, operating power factors and voltages, and over the full range of ambient temperatures. The insulation of the generator stator and field windings will be non-hygroscopic, Class F type, complying with ANSI/IEEE standards, but having a rated load operating temperature not exceeding that of Class B under any operating condition within the specified output. Coils will be of the B stage type individually cured before insertion into the generator.

The generators will be designed and manufactured according to IEC 60034 standards. Testing will be in accordance with NEMA/IEEE standards.

The continuous operating voltage range of a generator will be of ± 5 percent at any load up to full load. The operating power factor range will be of 0.80 lag to 0.95 lead as a minimum. The generators will be able to provide full output at the lowest continuous operating voltage and lowest power factor within the specified range.

The generator rotational speed will be determined by the supplier The generator will be designed to withstand momentary overspeed conditions arising from a full load rejection, without damage or abnormal vibrations.

Where IEEE or NEMA standards are specified below, equivalent international standards may be used.

3.3.1 Construction of the Generator

The construction of the generator will use proven and modern technology. Filtered open air-cooled generators will be supplied.

3.3.1.1 Stator Construction

The stator frame will be fabricated bar and plate steel construction. It is to be machined to tolerance to provide alignment with the rotor. The stator core will be built of thin, high permeability, low-loss, non-oriented, silicon steel segmental punchings and or laminations. These laminations are deburred and plated with insulation on both side providing a high interlaminar resistance, which reduces the core losses caused by the eddy currents and temperature rise in the machine and to improve efficiency.

Winding overhang on the stator will be insulated between coils and phases. Surge rings will be used to support the winding overhang. The windings will be braced to withstand without major damage single phase and three-phase fault conditions at the generator terminals.

The stator will include six 100-ohm platinum resistance detectors (RTDs) fitted in the stator windings.

3.3.1.2 Stator Insulation

All insulation materials used in the stator have a minimum temperature rating of Class 155°C (Class F) per IEEE 1. The coils will be of a formed coil construction using magnet wire meeting NEMA MW Specifications. Multi-turn coils will have dedicated tape turn insulation of the same material used in the ground wall insulation.

Turn to turn testing will be performed on all stator windings per IEEE 522 prior to impregnation. A high potential test will be conducted on the stator prior to impregnation per IEEE 115. Insulation strength will be 3.5pu @ 1.2 microseconds per IEEE 522.

The epoxy resin will be held within a ground wallpaper made of woven glass fabric with mica paper. No Mylar film backing is allowed on the mica tape. All mica tape backing will be pervious to the bonding resin.

The final cured epoxy will need a Dissipation Factor of less than 0.2 percent in accordance with ASTM D150.

3.3.1.3 Rotor Construction

The rotor will be fully laminated, salient pole type. Low resistance amortisseur bars will be inserted through slots in the field polls and braised/welded to a continuous shorting ring to complete the damping circuit.

Cooling fans will be an integral part of the rotor assembly.

The rotor body will be built from a solid block and machined to accept the rotor windings whose ends must be held securely by 18 Mn - 18 Cr alloy steel rings.

The rotor will have assessable provisions for bolt-on balancing weights. After assembly, the rotor will be dynamically balanced. The vibration displacement will be per IEC 60034.

All insulation materials used in the rotor will have a minimum temperature rating of Class F (155°C) per IEC 60034.

3.3.1.4 Drive Configuration

The generator will be of the independent to bearing design type. It will have a shaft extension suitable for a direct drive

3.3.1.5 Bearings

The bearings will be of a self aligning, sleeve design; bracket mounted, with self-contained oil lubrication and dual oil rings. They will be serviceable without any need to either move the generator from the base or disconnect the coupling from the engine.

If forced lubricated bearings are required, then an AC pump will be provided for lubrication to each engine.

The bearing on the exciter end of the generator will be insulated to prevent circulating currents. The drive end bearing will have a thrust capacity adequate for maintaining rotor and stator alignment. Each bearing will include one 100-ohm platinum resistance temperature detector.

Due to high ambient temperatures, a bearing cooling system will be supplied to ensure the generator bearings are maintained at temperatures not to exceed manufacturer's limits. The bearings are sleeve bearings that are self lubricated by oil rings per manufacturer's standard.

The system will be connected such that it operates automatically when the generator is in operation.

3.3.1.6 Fans and Blowers

Fans and blowers will be made of steel, extruded aluminum or polypropylene, unless otherwise approved by the Owner.

3.3.1.7 Main Terminal Box

The generator main terminal box will be top mounted. It will be of IP44 construction, which means that it will be protected against solid bodies greater than 1 mm and splashing water.

Terminal box size will accommodate six generator leads and mounting of differential and ground fault current transformers, lightning arresters, potential transformers, etc. as required by vendor design. It will include rigidly mounted copper busbars and one neutral busbar shorting the neutral leads, and tinned copper terminals all suitable for the termination of the incoming power cables. The busbar will be drilled for terminal lugs heading two holes, with NEMA drilling. All bus bar connections and connecting hardware will be silver plated.

3.3.1.8 Generator Air Filtration

The generator air filters will be provided to ensure filtered air is utilized for generator cooling. The filters will be removable for cleaning. Generator air inlet differential pressure alarm with "dry" contacts will be provided for annunciation on "plugging" filters at the engine local control panel, in turn to the control panel.

3.3.2 Accessories

All generators will be provided with all required accessories for an efficient and continuous operation within its whole range of operation, including closed circuit water-air coolers (if required), bearing oil coolers, lubrication oil pump, RTDs for thermal protection relays, etc.

Current transformers for instruments and relays will be provided as needed for all the protection, metering, and indication functions.

3.3.3 Generator Neutral Grounding

The preferred method for grounding several generators operating in delta configuration that are connected to a common bus at same nominal voltage as generators is to connect each generator to the bus as an ungrounded three-phase, three-wire device, and create a single grounding point at the bus via a zigzag transformer. A zigzag transformer is a specially wired transformer used to create a neutral grounding point for a three-phase ungrounded delta system. A properly sized resistor will be added between neutral and the ground. This arrangement is used to limit the total magnitude of fault current in the system during a ground fault. Due to its electrical configuration, the impedance of the zigzag transformer has no impact on the system during normal operation or non-ground faults. Since the electrical distribution system for facility contains two main electrical buses capable of operating independently, one zigzag transformer with the grounding resistor per main bus will be provided.

3.3.4 Brushless Excitation System, AVR, and Pilot Exciter

The exciter will be a high-frequency, direct-connected, rotating brushless type, three phase, full wave rectified, and will be matched with the generator rotor and control system.

The rotating part of the exciter, including the rectifier assembly, will rotate together with the generator rotor as a complete assembly on one shaft.

Both the armature and field windings will not be vacuum-pressure impregnated (VPI) with epoxy resin.

The exciter leads will be terminated at a terminal strip located in a secondary low-voltage terminal box.

The brushless exciter will be compatible with the voltage regulator.

The voltage regulator will be solid-state, three-phase sensing, volts-per-hertz regulation, and will include the following:

- Adjustable stabilizing network
- Solid-state circuitry, with no moving or arcing contacts
- All silicon semiconductors
- Fuse protection
- Paralleling capability
- Silicon resin-coated circuit board
- Under excitation limiters
- Under excitation protection
- Over excitation limiters
- Over excitation protection

- Loss of field relay
- Volts/Hz limiter
- Power system stabilizer

The generator permanent magnet alternator (PMA) type pilot exciter (if used) will be included to provide power to the voltage regulator as follows:

- The PMA will rotate on the same shaft as the brushless exciter and generator rotor.
- The stator winding will not be VPI with epoxy resin.
- The PMA stator will electrically connect to the voltage regulator and have the ability to provide a nominal 300 percent (at 60 Hz) of the designed rise rated three-phase short circuit for 10 seconds at the generator terminals.

Static excitation system in lieu of PMA pilot exciter is acceptable.

3.4 GENERATOR MAIN POWER CONNECTIONS

The connection between the individual generators and the Medium Voltage Switchgear will be made via cable or nonsegregated-phase bus ducts, with a voltage rating equal or higher than the corresponding generator terminal voltage.

The cable connection between the generators and the MV Switchgear will be via either XLPE or EPR insulated cables from the generator to the generator breaker cubicles and between the outgoing main breaker cubicles and the associated low voltage winding of the GSU Transformer.

If nonsegregated-phase collector bus ducts are used, the nonsegregated-phase bus will be fabricated with copper and will satisfy the requirements of IEEE C37.23.

Nonsegregated-phase bus duct conductors will be copper insulated with a thermosetting material. The nonsegregated-phase bus duct will be a self-cooled design. The bus will be rated to carry the maximum nameplate output of the equipment it serves +10 percent continuously under the maximum temperature rises specified by ANSI C37.20.

Vapor barriers or fire stops must be supplied at all building wall/floor entrances to prevent the transfer of indoor and outdoor air as well as maintain the fire rating of any penetrated walls or floor.

For cables or buses, they will be of the continuous type. The continuous current capacity of the cables or buses will be adequate to carry the full output of the unit at the lowest operating voltage (95 percent) and power factor, at all ambient temperatures under direct solar radiation.

The momentary (peak) current and thermal (3 second) withstand capabilities of the cable and buses will exceed the maximum generator contribution during the sub-transient period and will also exceed the maximum system contribution limited by the impedance of the proposed transformer, at the maximum transient voltage of 120 percent of the rated value.

Each generator will have its own generator breaker and will be provided with current transformers and voltage transformers, as required in the Contractor's design.

All outdoor bus will be provided with space heaters.

3.5 MEDIUM-VOLTAGE SWITCHGEAR

The switchgear shall be indoor, metal-clad, draw-out, vacuum stored energy type circuit breakers, electrically operated meeting IEEEC37.04, C37.06, C37.09, C37.010 and C37.54.

Two line-ups of 13.8 kV metal clad switchgear will be located in the plant electrical room. One switchgear bus will collect outputs of six (6) individual generators and the second switchgear bus will collect outputs of five (5) individual generators. The summed power at each bus will be transmitted by the main breaker of the line up to a separate low voltage winding of the Generator Step-up Transformer via nonsegregated-phase bus duct. Each switchgear bus will also supply power to a station service transformer which supports the plant auxiliary distribution system and loads.

Each 13.8 kV switchgear line-up shall be fully rated for the maximum expected short circuits current and continuous current and shall consist of one or more vertical sections, each of which shall have a main bus compartment and one or two vertically stacked equipment cells ("two-high" type construction). The cells shall be arranged for circuit breakers, or auxiliary devices, or shall be blank as required. The enclosure vents, if provided, shall be screened. All switchgear will be from the same manufacturer.

Breaker compartments shall be complete with removable circuit breaker elements, silver plated copper contacts, and grounded metal or insulated safety shutters to isolated primary connections when breaker is withdrawn.

The bus will be copper, insulated and rated for continuous duty in accordance with ANSI standards of temperature rise. The buses shall be installed with rigid, non-tracking, fire-resistance, non-hygroscopic insulating supports capable of withstanding the mechanical forces imposed by short-circuiting currents and shall be accessible through removable front panels. All joints will be silver plated with a minimum of two bolts per joint and insulated. A ground bus shall extend the entire length of switchgear.

Each power circuit breaker will be a 3-pole, single-throw unit utilizing vacuum interrupter technology. Surge suppressors will be provided on the line side of each breaker.

Electrically charged, mechanically and electrically trip-free stored-energy operating mechanisms will include provisions for manual charging of the mechanism. Circuit breaker charging and trip/close mechanisms will operate from a 125 VDC system.

Circuit breaker compartments shall have self-aligning, manually operated mechanisms, which shall positively rack the breaker between positions unless its contacts are in the open position. Interlocks shall also cause automatic discharge of operating springs when breaker is moved into or out of the compartment or the connected position. Switchgear arrangement will employ 2-high construction where possible.

Provisions will be included for padlocking the breaker in either the operating or the disconnected position.

Switchgear control voltage will be 125 VDC. Control power for each line-up of switchgear assembly shall be provided with control power monitoring capability and its loss shall be alarmed at plant DCS. The switchgear manufacturer shall provide all internal switchgear wiring required to distribute control power to each switchgear unit. Each breaker shall be furnished with a 2-pole control power disconnecting and protective device in the closing circuit, and with a 2-pole control power disconnecting and protective device in each tripping circuit. The control power disconnecting and protective devices shall be enclosed fused pullouts (range type). In addition, each circuit breaker compartment shall be provided with a manually-operated knife or toggle switch to disconnect power to the spring charging motor while racking in the breaker.

Local control at the switchgear, for the breakers shall be provided for testing purpose only. Normal operation for the switchgear breakers shall be remote operation from the DCS system. If required for DCS control interface, two interposing relays shall be provided inside the DCS I/O termination cabinets or at the switchgear, one for tripping function, and one for closing function. Breaker closing shall occur only when the trip source is available.

Indicating lights on the switchgear shall be LED type, or the manufacturer's standard indicating lamp, depending on availability. A test station operating from the same type of power supply (dc or ac) that controls the switchgear shall be provided at each area of the plant where such switchgear line-ups are located.

All breakers shall have a test position in which auxiliary contacts and other devices shall function normally (umbilical provided where required).

All current transformers shall have shorting terminal blocks provided for all CT's in the circuit breaker assembly and for CT's, which are exterior to the switchgear but feed devices in the switchgear.

All potential transformers shall have an accuracy rating of 0.3 percent through burden Z and be drawout type equipped with current limiting primary fuses for each PT unit. Current transformer mechanical and thermal limits shall be coordinated with the momentary and short time ratings of the circuit breakers with which they are used.

All control wiring shall be UL Type SIS synthetic, heat-resistant wire; #14 AWG minimum. Both ends of each wire shall be numbered. They shall be terminated with crimp-type insulated flange spade or ring tongue lugs on terminal blocks numbered to correspond with wire numbers. Wiring for CT's shall be #10 AWG minimum, and shall employ insulated ring tongue terminals.

Nameplates shall be provided for each device, selector switch, meter and relay in each unit, including all internally mounted relays, fuses, terminal blocks, etc. Also, descriptive nameplates shall be provided for each compartment or section.

Switchgear relays shall be utility grade, suitable for the indicated applications with flush or semi-flush mounting and 125 VDC control voltage rating. Protective functions included shall be phase and ground overcurrent, GE type SR750, SR735, MIF, or approved equal. All protective relays shall be daisy chained for serial communication link with DCS.

Each lockout relay circuit shall have its own fuse protection in a pull-out type fuse holder. The integrity of the lockout relays shall be supervised, and any failure shall be indicated locally and alarmed in the plant DCS. Each lockout relay shall also provide a contact for trip sequence of event/alarm logging to the plant DCS.

Metering shall be Electro Industries Nexus 1250 device for each main breaker with communications capabilities to plant DCS and remote P40N monitor. Auxiliary power to Nexus 1250 shall be provided via 125 VDC control bus. All 13.8 kV feeder breakers shall be provided with a local ammeter.

Thermostatically controlled cubicle heaters shall be included.

3.6 GSU TRANSFORMER

The GSU transformer will be oil-filled, single tank, three-phase, three-winding, 60 Hz unit and designed for generator step-up voltage operation according to the IEEE C57.12.00. The generated power collected at each 13.8 kV Switchgear is delivered to a separate low voltage windings of the GSU Transformer. The high voltage windings will transmit the power at the transmission line voltage (230 kV) to the interface point on the SDG&E Grid.

The transformers will be designed to IEEE and ANSI Standards and will be rated with a capacity that allows total output of all the individual units through the operating range of power factors and voltages at all ambient temperatures at the Project site, but in no case at a power factor less than 0.9. The rated capacity of the transformer will be stated for a 65°C winding temperature rise over average 30°C ambient. The GSU Transformer will be capable of carrying the full station output at its highest fan-cooled rating.

The GSU Transformer rating will be selected with a continuous capacity at 65°C rise for ONAN/ONAF/ONAF cooling, on the basis of delivering to the high voltage system the maximum output (total generation from all 11 units) of the facility less the transformer losses and reactive requirements.

The rated voltage of the transformer windings will be based on the generator voltage and the transmission system voltage. The Contractor shall perform studies to verify that the selected voltages and voltage ratio will permit Owner to transmit full capability of the generators to the grid system and satisfy the requirements of the Interconnect Agreement with utilities. The low voltage windings will be delta connected and high voltage winding will be wye connected with solidly-grounded neutral. The Basic Impulse Levels (BIL) for transformer windings will be based on column 1, Table 4 of IEEE C57.12.00. The windings will be made of electrolytic copper, and the core will be made with grain-oriented high-permeability low-loss magnetic steel.

The lowest available standard impedance for the specified high and low voltage windings BIL without cost penalties will be specified, unless the results of the studies for the optimization of the electrical system will indicate a specific impedance value for the transformer.

The impulse test level and power frequency withstand voltages will be in accordance with IEEE C57.12.00 for the range of operating voltages.

The transformer will be mineral-oil-filled, conservator type, and oil inside the transformer will be isolated from the atmosphere by means of an elevated expansion tank with an enclosed air cell. The oil-filled transformers will be installed such that they will not present a hazard to any surrounding equipment in case of a fire, through the use of physical separation or firewalls. If firewalls are required, adequate space to allow sufficient airflow for proper transformer cooling will be provided, and NFPA 850 will be adhered to.

GSUT will be equipped with a no-load tap changer capable of operation from ground level, with visible indication of tap position, and capable of being padlocked. Manual tap changers will be provided with two 2.5 percent taps above and two 2.5 percent taps below rated voltage (five tap positions total). All tap positions will be fully rated for the highest transformer MVA rating.

Transformers will have standard accessories including but not limited to fault pressure relays, mechanical pressure relief devices, magnetic liquid level gauge with alarm contacts, top oil temperature indicator with alarm contacts, winding temperature indicator with alarm contacts and a combustible gas device. A transformer incipient fault monitoring system HYDRAN type 201Ri with isolated 4-20 mA output to DCS, or equal will be provided. The transformers will be designed, manufactured and tested in accordance with ANSI, IEEE, and NEMA standards.

Surge arresters will be supplied for each high-side bushing. Those arresters will have ground conductor brought to grade on insulators to facilitate monitoring of leakage current. Surge arresters for main power transformers will be station class rated and will coordinate with the BIL of the transformers.

Cooling equipment controls will be arranged so that no single fault in the control circuitry can cause a loss of more than one half of the cooling system capability. The transformer cooling equipment controls will be arranged so that a single remote contact can shut down all pumps and fans, regardless of the mode of operation selected. Manual control switches will be provided in the control cabinet to allow testing and maintenance of the cooling fans and pumps. Controls will provide for changing the sequence of cooler groups.

3.7 AUXILIARY POWER DISTRIBUTION SYSTEMS

The design criteria for configuration, size and rating of components of the auxiliary power distribution system from the station service transformer low voltage terminals are as follows:

- A single contingency (either a planned or forced outage of a piece of equipment) shall not cause the loss of total generation (11 engine-gen set), but may lead to reduced output of the plant.
- For 480 volts systems, it shall be possible to safely transfer manually, or automatically as applicable, any switchgear power supply from one source to the alternate source, under normal operating conditions, without having to “black-out” the switchgear. This should include the normal operating activities for switching power sources, and for off-loading transformers.

The following redundancies shall be applied:

- Except as stated below, loss of a transformer (other than the Generator Step-up Transformer) should not lead to an output reduction of the plant.

- Loss of a 480 volt switchgear bus section normally fed either directly or indirectly from a station service transformer may cause loss of few engine-gen sets whose auxiliary loads are supported by it, but should not cause a total output loss of the plant.

Fault current calculations shall be based on the maximum available per-unit contributions, and maximum system voltages. Voltage regulation calculations shall be based on the minimum available per-unit contributions, and minimum system voltages. Conductor impedances for the short circuit calculations shall essentially be assumed to be zero, and the proper considerations and adjustment for the maximum X/R ratio at each fault location shall be included. Impedance tolerances of two winding and three winding transformers shall be within ±7.5 percent and ± 10 percent respectively, at a nominal voltage tap. Maximum fault contributions shall be based on auxiliary loads of the plant connected or fed from the one station service transformer source.

3.7.1 Voltage Regulation

The auxiliary power system shall be designed to maintain voltage levels for the electrical equipment, at the respective ratings, as closely as possible during all modes of operations. All voltage variations on the distribution system shall be limited as follows.

Under steady-state conditions, voltages at the motor terminals shall be maintained between the range of 90 percent (minimum) and 110 percent (maximum) of rated motor voltage. Under all plant operating conditions, the steady-state voltages on any motor terminal shall not exceed 110 percent of its rated voltage or fall below 90 percent of its rated voltage.

During starting of the largest motor, the minimum supply voltage at the motor terminal shall not be less than 80 percent of the rated motor voltage for medium voltage motors, and not less than 90 percent of the rated motor voltage (or 80 percent of rated motor voltage as determined by studies) for low voltage motors. At these times, bus voltages shall be maintained such that all operating load requirements will be maintained with continuous supply (without dropout) to all required motors and equipment in the plant.

3.7.2 Bus Voltage

The bus voltage ratings shall be selected so that they meet the voltage regulation criteria above. Breakers and motor controllers connected to the buses shall have interrupting capacities that exceed (by 10 percent) the maximum available fault current calculated for that system.

3.8 STATION SERVICE TRANSFORMER

The Project will include two factory tested station service transformers as described below.

Each station service transformer will be sized to cover the auxiliary load for 11 engines plus 100 percent plant load.

Each station service transformer will be fed from a breaker at the 13.8 kV (MV) Switchgear Bus which is also connected to group of the generators (6 or 5). Each transformer will have primary windings delta connected rated at 13.8 kV and a secondary winding wye connected rated at 480 volts with neutral solidly grounded.

Each transformer will be mineral-oil-filled, outdoor type, with a no-load tap changer capable of operation from ground level, with visible indication of tap position, capable of padlocking. Tap changers will be provided with two 2.5 percent taps above and below rated voltage. Transformers will have standard accessories including but not limited to fault pressure relays, mechanical pressure relief devices, magnetic liquid level gauge with alarm contacts, top oil temperature indicator with alarm contacts.

The Transformer rating will be selected with a continuous capacity at 55°C/65°C rise for ONAN/ONFA/ONFA cooling, on the basis of supplying all auxiliary loads at the highest rating at 55°C rise and the extra capacity for 65°C rise rating to be utilized for the future loads. The average winding temperature rise at full load capability of each stage will be 65°C over 40°C ambient.

The transformers will be sized such that the failure of one transformer will not shut down or limit the output of the station. Each transformer's output will feed one 480V bus so if a station service transformer fails, its bus will be automatically picked up by the circuit breaker that connects the two busses. Station Service transformer losses will be minimized at full load operation.

The Station Service Transformers will be identical to each other, and sized to support the loads as follows:

- During normal operation with the full-rated tie-breaker open, both transformers will support the individual loads on the respective buses they feed.
- During one source operation with one main breaker open and the full-rated tie-breaker closed, either transformer will support the combined loads on both buses without exceeding its highest fan cooled capacity.

The plant auxiliary loads will be divided in a logical fashion. Any multiple units (two 100 percent pumps, fans, battery chargers, etc.) will be fed power from two different sources.

The oil-filled transformers will be installed such that they will not present a hazard to any surrounding equipment in case of a fire, through the use of physical separation or firewalls. If firewalls are required, adequate space to allow sufficient airflow for proper transformer cooling will be provided, and NFPA 850 will be adhered to.

3.9 LOW-VOLTAGE SYSTEM

The low-voltage auxiliary system will distribute power to low-voltage Project electrical auxiliaries during normal operation, startup, and shutdown. The main components are the station service transformers, 480V switchgear, and MCCs.

3.9.1 System Configuration

The low-voltage system consists of a 480V system powered from station service transformers. Each station service transformer is fed from the medium-voltage switchgear. The impedance of the station service transformers will be a standard value and will be selected to allow the use of commercially available power center breakers, molded case breakers, and combination starters while limiting voltage drop on the bus during the starting of the largest motor to 90 percent of the

nominal bus voltage. The low-voltage system will be designed to avoid the need for current limiting reactors.

3.9.2 Secondary (LV) Switchgear

The secondary switchgear shall be indoor, metal-enclosed type power circuit breakers meeting ANSI C37.13, C37.16, C37.17, C37.20.1 and ANSI C37.51.

The low voltage switchgear shall be bus duct connected to the station service transformer. The switchgear buses will be connected in a double-ended arrangement with a normally open tie breaker.

Draw-out 480 volt, power circuit breakers shall be supplied as needed to feed large motors, MCCs , and non-motor loads (electric boiler, distribution panel, etc.) ranging from 150 kW through 300 kW. Breakers that feed motors shall be electrically operated. Breakers that feed MCCs or other equipment with integral switching shall be manually operated. Main and tie breakers shall be electrically operated. All electrically operated breakers will typically be controlled remotely from the DCS/PLC CRT console.

The low voltage switchgear equipment shall be mounted in compartmented vertical sections, fabricated of steel in standard pieces, and assembled to provide a rigid self-supporting structure. Doors with door latches having concealed hinged construction shall be provided on the front of each compartment. Access to rear compartments shall be provided by removable bolted steel covers. Ventilating openings on ventilated enclosures, as required by the switchgear manufacturer's standard design, shall be louvered and screened.

Switchgear phase bus bar material shall be copper bar. The bus shall be installed with rigid, non-tracking, non-flammable, non-hygroscopic insulating supports capable of withstanding the mechanical forces imposed by short-circuit currents. All joints shall have silver-to-silver contact surfaces with minimum contact resistance.

An uninsulated copper ground bus shall be furnished through the entire length of each switchgear. All switchgear equipment requiring grounding shall be connected to this ground bus.

Cubicle space heaters with guards shall be provided and shall be controlled by an adjustable thermostat, factory set to maintain the internal temperature above the dew point for the required site conditions.

The power circuit breakers in metal enclosed cubicles shall be 3-pole, single-throw air circuit breakers of standard drawout type design. Each power circuit breaker shall be provided with a sufficient quantity of auxiliary contacts to provide the appropriate interlocks for proper operation of the breaker. A breaker position switch shall be furnished with each electrically operated breaker to by-pass all "b" auxiliary contacts in remote interlocking circuits when the breaker is in the test or disconnected position. All power circuit breakers in the power plant shall be from the same manufacturer.

Voltage transformers shall be capable of withstanding a secondary short circuit for not less than one second and shall have an ANSI standard accuracy classification. Each voltage transformer shall be fixed and provided with dead-front pull-out primary and secondary fuses. Current

transformer mechanical and thermal limits shall be coordinated with the momentary and short time ratings of the circuit breakers with which they are used.

The low voltage switchgear control wires, wire markers, lugs, control power distribution, etc. shall comply with the similar requirements defined in the Section 3.5. In addition, the control philosophy for the electrically operated breaker shall be similar to the ones defined in Section 3.5.

Traveling type circuit breaker lifter, rail-mounted on top of switchgear shall be provided. One circuit breaker lifting yoke shall be provided per each unit of the plant.

The circuit breakers shall include short time ground fault protection. Circuit breakers that feed MCCs and other devices with downstream instantaneous protection shall have short time and long time overcurrent protection. Circuit breakers that feed devices with no downstream instantaneous protection (such as motors) shall have instantaneous and long time overcurrent protection. The 480-Volt switchgear bus shall include two time delayed undervoltage protection if the switchgear has breakers feeding any motor.

Current transformers shall be supplied for metering and instrumentation as required by Owner. The circuit protection shall be a solid state device providing selective phase and ground fault protection by utilizing short time/long time over current trips.

3.10 MOTOR CONTROLLERS & MOTOR CONTROL CENTERS

3.10.1 Single-Phase Motor Controllers (less than ½ HP motors)

In general, controllers for single phase motors shall be combination type with thermal magnetic circuit breaker and motor starter. Starter enclosures shall be suitable for the area classification in which they are installed.

3.10.2 Three-Phase Motor Controllers (½ HP to 250 HP)

Controllers for three phase low voltage motors shall be the combination type consisting of a molded case air circuit breaker and magnetic starter, excepting vacuum starters shall be used for 150 to 250 HP motors. Minimum starter size shall be NEMA size 1. Fractional horsepower motors may be single phase if they are part of a vendor supplied package.

- Each starter shall have three ambient compensated thermal overload relays and a control power transformer. Both the primary leads and one secondary lead shall be fused, while the other secondary lead shall be grounded.
- Motor controllers for indoor, nonhazardous, clean, dry installations shall be grouped, metal-enclosed, free-standing, dead-front, NEMA 1A gasketed type motor control centers (MCC) with NEMA Type1, Class B wiring. All starters NEMA size 1 through size 4 shall be “plug-in” type and NEMA sizes 5 and 6 shall be bolted type. NEMA sizes 5 and 6 starters shall utilize vacuum contactors.
- Red and green indicating lights shall be provided at each starter.
- Circuit breakers in combination starters shall have adjustable magnetic instantaneous only type trip units.

- Circuit breakers for feeders shall have ambient compensated thermal-magnetic type trip units.
- All 480 volt circuit breakers shall have 65,000 amps symmetrical interrupting rating.
- Spare starters shall be provided in each MCC, as follows: two (2) size 1, one (1) size 2, and space for one (1) size 4 starter; all FVNR.
- Main process pump and fan starters shall include CT's and ammeter/transducers with outputs taken to the DCS for monitoring.
- MOV controllers shall include space heaters and red & green indicating lights with class 10 protection. Three-phase motor operated valves and damper operators shall be furnished with reversing starters built into the operator housing IEC starters rated for the application with a 12 amperes minimum rating shall be acceptable for the motor operated valves and damper operators.
- The MCC equipment shall consist of vertical sections, each approximately 20 inches wide, 90 inches high and not less than 20 inches deep joined together to form rigid, free-standing, completely enclosed, dead front control assemblies.
- Each vertical section shall accommodate no more than six Size 1 or Size 2 combination magnetic starters. All individual units shall be isolated from each other by barriers.

  Manual circuit breaker operating handles shall be furnished on the access doors of starter units and feeder tap units to operate the circuit breakers. Provisions shall be made for padlocking each handle in the open position. Each operating handle shall indicate when the breaker has tripped. Additionally, the access doors shall be interlocked with the operating handles to prevent opening the doors normally when the circuit breakers are in the closed position.

  Gasketed hinged doors shall be provided on the front of each starter unit and feeder tap unit. Doors shall be designed to allow easy maintenance or replacement of starters, disconnecting and branch circuit over-current protective devices, and similar devices from the front. A separate hinged and gasketed full height door shall be furnished on the front of each vertical section to allow access to the vertical wire trough without opening any other door.

  Each starter/contactor unit shall be equipped with a control transformer, adequately sized to support the load. The minimum control transformer size shall be 50 VA. Both the primary leads and one secondary lead shall be fused, while the other secondary lead shall be grounded. The contactor coil shall have a pick-up voltage of 85 percent or lower, and a drop-out voltage of approximately 60 to 65 percent of the rated voltage of the coil.
- MCC phase bus bar material shall be copper or aluminum. The phase arrangement and bus support materials shall be the manufacturer's standard design. However, the bus shall be installed with rigid, non-tracking, fire-resistant, non-hygroscopic insulating supports capable of withstanding the mechanical forces imposed by short-circuit currents. All joints shall be specified to have silver-to-silver contact surfaces with minimum contact resistance.

  An uninsulated copper ground bus with a continuous current rating, as required, shall be furnished through the entire length of each motor control center. All motor control center equipment requiring grounding shall be connected to this ground bus.

- Vertical section space heaters shall be provided and shall be controlled by an adjustable thermostat, factory set to maintain the internal temperature above the dew point for the required site conditions.
- All control wiring shall be 600 volt type SIS, 90ºC and power wiring shall be 600 volt XHHW-2, 90ºC wet or dry with thermoset CPE, neoprene jacket or approved equal.

3.11 MONITORING AND CONTROL SYSTEM

The power plant monitoring and control system will encompass control and monitoring for power plant engine generator sets, utility tie, station services and plant control. The monitoring and control system must communicate with SDG&E in the form of an Ethernet bus with OPC protocol.

The control system includes all instrumentation, fault and status annunciation, control switches, push buttons, voltage regulator devices, engine electronic governor modules, manual synchronizing devices, programmable logic controller devices and system auxiliary relays as needed to provide a fully functional monitoring and control system.

The power plant monitoring/control system will be NEMA 1 (or equivalent IEC) metal enclosed for indoor service. The control console will be appropriately sized to contain the instrumentation and control components required for operation. Each circuit breaker switch would include positions for lockout, trip, close, manual close plus open/close position indicating lamps activated breaker auxiliary switch contacts.

Each engine generator set control and monitoring section, unless otherwise specifically indicated, will be comprised of the following components:

- One Digital instrumentation package, microprocessor based, to display generator voltage and current; with a selector to read voltage of each phase to phase in current in each of the three phases, power (kW), reactive power (kVAR), power factor, frequency and kilowatt-hours.
- Control switches, push buttons and adjustment devices for circuit breaker operation, engine starting/stopping, annunciation lamp test, emergency stopping, manual synchronizing, speed control, voltage control and loading control.
- Circuits to interface with the local engine panel and permit plant personnel to start/stop the engine from either the local engine panel or from the engine generator set monitoring and control console. Project personnel at the local control panel will have priority to start the engine or “transfer” starting to the engine-generator set monitoring and control console. Interlocks will be provided to allow station personnel at either location to inhibit engine starting from the opposite location and to shut down the engine from either location.

The utility tie control and monitoring section will be generally comprised of the following components:

- One Digital instrumentation package, microprocessor based, to display plant power output variables such as voltage and current; with a selector to read voltage of each face-to-face and current in each of the three phases, power (kW), reactive power (kVAR), power factor, frequency and kilowatt-hours.

- Annunciation of status, alarm and fault conditions.
- Control switches, push-buttons and protective relays for gen-tie circuit breaker operation, annunciation lamp test and automatic/manual synchronizing.

3.12 AUTOMATIC GENERATION CONTROL TERMINAL

The DCS/PLC will include an automatic generation control terminal (AGCT) or Remote Intelligent Gateway ("RIG" as defined by the California ISO), which will support remote dispatching of the Project by the California ISO. Redundant MODBUS data-links between the AGCT and plant DCS/PLC, and between the AGCT and the SCADA/EMS RTU will be provided. (In lieu of MODBUS, Contractor may provide Profibus and Ethernet with a redundant Ethernet link between the PLC and AGC system, provided the RTU interface to the CAL ISO communication link is included.) The AGCT must comply with the California ISO's "Generation Monitoring and Control Requirements for AGC/Regulation Units", as found on their web page at http://www.caiso.com/ thegrid/operations/gcp/requirements.html. Additional capabilities may be allowed, as approved by the California ISO.

The CALISO requirements regarding certification of the designer, installer, and testing will be met (CAL ISO certification requirements).

Following is an example of an AGCT system description. The Project will include a system that will contain similar features. The Automatic Generation Control Terminal (AGCT) will be equipped as follows:

- One communications port – DNP 3.0 protocol
- One configuration and maintenance terminal
- One V.32, 9600 baud (DNP 3.0 port)
- One remote programming port with the fastest available dial up modem (supervised by SCADA signal to enable remote access capability)
- Analog input points, solid-state multiplexors, and precision scaling resistors (as required)
- Analog reference power supply (as required)
- Contact input points, MCD status (as required)
- Analog output points, ±1 mA or 4-20 mA (as required)
- 8-position sliding link terminal blocks (as required)
- Service and maintenance manuals (for Owner's use)
- Power input 120VAC
- NEMA 1 Enclosure with full height doors front and rear The AGCT also has the following additional requirements:
- Additional communications ports will be provided to directly input watt/VAR hour and watt/VAR instantaneous input information from all meters. This information will be relayed via Modbus port to Project control system.
- Two communication ports, one master and one slave, will be provided for communications with the Local Utility RTU.

- Two communication ports, one master and one slave, will be provided for communications with the Project control system.
- Additional communications ports with modems as necessary for the applicable PG&E or California ISO requirements.

In general, the following signals will be provided:

- MW, MVAR, MWh, MVARh, for each generator
- Substation frequency and voltage
- NOx emissions from each source
- Breaker status for each generator set breaker
- Breaker status and alarms for all switchyard breakers
- MW, MVAR, and line voltage for each transmission line
- Total fuel flow, high side fuel pressure, fuel Btu content, and fuel specific gravity
- AGC high limit, AGC low limit, AGC plant load (total all generators), AGC in remote
- AGC remote demand
- Remote programming enabled
- Other analog and digital inputs and outputs may be required by the California ISO to meet current standards.
- Dedicated telecommunications circuits meeting the requirements of the California ISO will be installed to allow control and monitoring via the AGCT or RIG.

The Contractor will consult with Owner regarding the compatibility of the new AGCT system with the requirements of the Dispatcher and/or SCADA/EMS.

Contractor will provide a California ISO certified Data Point Gateway (DPG) in accordance with the requirements of technical standard “Monitoring and Communications Requirements for Units Providing Only Energy and Supplemental Energy” (“Technical Standard”).

Contractor will provide a CAISO certified revenue metering system. In accordance with the requirements of Technical Standard

3.13 SYSTEM PROTECTION

The Project will incorporate the values required based on the Insulation Coordination Study and the equipment supplier recommendations, and the final design will provide an adequately protected safe and reliable system.

The protection of the individual generator sets will be provided by the manufacturer’s standard relay protection package. The relay package for the individual generator sets will be subject to approval by the Owner. The Contractor will coordinate with Owner regarding the relay coordination and protection requirements.

In addition, the protection design will include, but not be restricted to, the following:

- Lockout Relays, 86 (Quantities will be determined during detailed design phase)
- Generator Step Up Transformer
  - Transformer differential relay (87T1) –Zone HV Breaker to LV Windings
  - Transformer differential relay (87T2) –Zone HV Winding to MV Switchgear Main Breakers
  - Transformer neutral overcurrent relay (51TN)
  - Transformer phase overcurrent relays (51/50)
  - Transformer fault pressure relay (63)
  - Oil level switch (71Q)
  - Oil temperature (26Q)
  - Winding temperature (49)
  - Lockout relays (86T1 & 86T2)
- Medium and Low Voltage (load center) buses
  - Bus undervoltage relaying for alarm
  - Bus differential (only for MV buses)
  - Medium-voltage loads will have zero sequence ground detection
  - Incoming phase and ground time overcurrent
  - Feeder phase timed and instantaneous overcurrent and ground overcurrent
- Medium Voltage Motors (if required)
  - Phase overcurrent (instantaneous and timed)
  - Ground instantaneous overcurrent
  - Undervoltage and loss of voltage (motor protector)
  - Stator overtemperature
- 460 V motors fed from MCCs
  - Phase overcurrent (instantaneous and timed)
- Panels, transformers, heaters, and miscellaneous loads fed from MCCs
  - Phase overcurrent protection

3.13.1 Major Interlocks

To be determined in detailed design.

3.13.2 Lockout Relay Actions

To be determined in detailed design.

3.13.3 Protective Relays

All protective relays will be digital-type with industry standard communications port provided with external targets to show relay operation to assist operator in determining which relays have operated.

3.14 ESSENTIAL SERVICE SYSTEM

The essential-service AC system will provide clean, 120V AC, single-phase, 60-hertz power to essential control, instrumentation, and equipment loads that require uninterruptible AC power.

The following items discussed below will be included in the essential service system. Since Supplier of the Engine Generator Sets and all associated equipment utilizes 24 VDC battery backed up system for starting and power the PLC controls, no plant uninterruptible AC power is provided. However, a small packaged, off-the-shelf UPS will be provided for the CEMS system.

3.15 DC BATTERY SYSTEM

The DC system provides a reliable source of power for critical control and power functions during normal and emergency Project operating conditions. The DC systems will be grounded for genset control power systems and ungrounded for the switchgear control power system.

A DC system will be supplied by Owner for the switchyard independent of the station DC systems.

The station battery room will be located indoors in a climate-controlled area in compliance with battery supplier requirements. Battery room floor will be treated with an acid-resistant floor sealant. Batteries will be rated by industry standards on the basis of a nominal 24 hour average temperature of 77°F. Curbed areas without drains will be provided surrounding the battery cells for the containment of acid spills in the event of a cell crack or rupture. An eye wash and shower facility will be provided for rinsing eyes and skin in the event of acid contact. A monorail or other means will be included in the design of the battery rooms to assist in removing or replacing cells.

The following items discussed below will be included in the essential service system.

3.15.1 Batteries

The Project will include a minimum of one (1) 24-Vdc battery system for genset controls and one (1) 125-Vdc battery system for switchgear control. The storage battery will be provided with a heavy duty type battery rack. Battery racks will have the appropriate seismic rating per building codes (CBSC, and local).

Battery cells will be the sealed type. The number of cells will be 60 for 130V systems. The minimum cell voltage at the end of the duty cycle will not drop below 1.751 volts/cell so that the minimum battery terminal voltage does not drop below 105V.

The duty cycle will include a minimum of 60 minutes of power for the UPS system at the inverter rating, the time for DC motor loads and breaker operating power at the end of the 4-hour duty cycle. In addition to the required duty cycle, batteries will be sized to include a 25 percent aging

factor, a 20 percent design margin, and temperature correction factor based on expected battery room temperature limits. Battery bank and charge system designed to support two full load trips within a 3 hour duration. Batteries will have a 20-year life.

3.15.2 Battery Accessories

Two sets of the standard battery accessories will be provided:

3.15.3 Battery Chargers

The 125-Vdc Battery system will include a 125-Vdc battery charger system, and a 24-Vdc battery system which will include a 24-Vdc battery charger. These chargers, feeding the battery system, will be powered from two separate sources of AC power. DC systems' redundancies are achieved by using an N+1 charger design (providing redundant rectifiers/chargers installed in the same cabinet). The chargers will include a temperature compensation feature.

Each battery charger system will be sized to furnish 100 percent of the current required to recharge the battery from discharge condition to the fully charged condition in 24 hours while maintaining the continuous normal steady-state loads. The chargers will be capable of regulated and filtered voltage operation with the battery disconnected (battery eliminator type), with a maximum ripple of 100 mV rms under these conditions. Battery chargers will have load sharing features and temperature compensation feature.

The battery charger will have a voltage regulation of ±0.5 percent from no load to full load with a ±10 percent supply voltage variation. It will operate properly over ±5 percent supply voltage frequency variation. It will be provided with an automatic load limiting feature that will limit the output current to 110 percent of its rated load without tripping the AC or DC breaker or blowing fuses. It will also be capable of picking up a discharged battery without tripping.

The power supply for each charger will be 480V, 60 Hz, three-phase. The battery charger will be designed to prevent the battery from discharging back into the charger in case of AC power failure or other charger malfunction.

The battery charger will be equipped with standard generating station accessories, including undervoltage relays, ground detectors, overload protection, adjustable float and equalize charger settings and timers.

Thermal magnetic circuit breakers of suitable current carrying and interrupting capacity will be used.

3.16 MOTORS

All motors will be designed for direct across the line starting and will not exceed a class B insulation system temperature rise as defined by ANSI C50.41. All motors 30 hp and above will be provided with motor space heaters unless otherwise mutually agreed. Motors will be of the highest efficiency available for the specified application. Motors will be ANSI C50.41 compliant. All stator windings will be copper. Motors associated with engine or related accessory systems are the manufacturer's standard design and comply with IEC standards. Contractor will furnish Owner a copy of the IEC standard for motors designed to IEC.

3.16.1 Low-Voltage Motors

All motors 250-hp and smaller will have the following characteristics:

Type	Horizontal or vertical as required, single-speed, squirrel-cage induction, energy efficient, mill and chemical duty type. Cast iron frames and copper windings only.
Voltage rating, phase, frequency	460 volts, three-phase, 60 Hz, for all motors rated at ½ hp through 250 hp, 115 volts, single-phase, 60 Hz, for all motor ½ hp and smaller.
Horsepower rating	The nameplate horsepower rating will be equal to, or greater than, the requirements of the driven equipment when operating at design conditions and motor will be able to handle the maximum capability of the driven equipment within their service factor rating. This relation will be provided for all operating speeds and conditions.
Service factor	1.15
Ambient temperature range	Site specific-40°C ambient indoors.
Nameplate	Will state the service factor and comply with NEMA MG-1.
Enclosure	TEFC totally-enclosed, ventilation, and cooling as applicable to the environment. Explosion-proof motors will be provided only where necessary to meeting the hazardous location requirements.
Class of Insulation	Class F
Heaters	Heaters will be provided on all motors 30 hp and larger, they will be derated for extended life and be sized to prevent condensation at the ambient conditions at the specific site. Heaters will be rated for 240 volts and operated on 120 volt 60 cycle ac single phase.
Grounding	Where the motor size allows one drilled and tapped hole suitable for attaching a NEMA grounding lug will be provided. Motors that are too small for a tapped hole in their base will be grounded through the conduit flex (jumpered) and the fitting attached to the terminal box.
Temperature rise of windings (maximum by resistance)	In conformance with NEMA MG-1 standards for Class B insulation.

3.16.2 13.2 kV Motors (NOT USED)

3.17 MISCELLANEOUS

3.17.1 Plant Communications System

The communication system will be protected from onsite and offsite radio and electrical interference including use of two-way radios. Two-way radios and cell phones will be used in the control room. The DCS/PLC and electrical components will be capable of proper operation when cell phones and two way radios are operated in close proximity of DCS/PLC system components.

One telephone and one LAN communications will be provided in each of the offices, file room, kitchen area, lunch area, conference room, communications room control room operator consoles, DCS/PLC room, I&C shop; and machine shop. A minimum of 8 additional phones will be located strategically throughout the plant

Project communications will be comprised of voice/data/video systems. The system will include a plant wide paging system, gate and security cameras, gate card readers, internet and LAN

connections, emergency siren/horn, DCS/PLC communication, phone system and the appropriate communications links between the generating plant and the California ISO for revenue meter data and plant control/data via the AGCT/RIG. The Contractor will design, install, test, and prove systems based on the current standards, codes, and industry guidelines related to the V/D/V systems as listed, but not limited to the following:

- NEC including articles 640, 645, 725, 760, 770, 800, 830 and any other applicable articles specific to the situation.
- NECA guide to low-voltage and limited energy systems.
- NFPA including NFPA 70, 72, 75, 101, 780.
- NESC containing ANSI/IEEE C2, as they relate to single building systems and their integration into the entire power plant building integration.
- ANSI/IEEE standards including 142-1991 or later, 1100-1999 or later and any other applicable standards specific to the situation.
- ANSI/TIA/EIA standards including latest of 568A, 569A, 570A, 606, 607, 758, and any other applicable standards specific to the situation.
- NEIS – National Electrical Installation Standards.

3.17.2 Plant Security System

The Project will furnish and install a security system as described below, which includes security requirements for gate, including signal raceway (video, intercom, card reader, etc.), power, lighting, gate operators, and concrete pedestal for card reader.

A station security system will be provided and will conform to the requirements of the Owner-supplied design criteria, including card reader access control, color low-light, remotely-operable pan-tilt-zoom multi-camera closed-circuit TV, intercom system, independent automatic gate control for Project site and switchyard, and selectable frame rate video recording system. Sufficient cameras will be provided to allow view of entire site perimeter.

The Project will include moveable (remote actuated) security cameras around the perimeter fence and entrance gate(s), which will be connected to close-circuit TV (CCTV) equipment for viewing in the central control room. In addition, a security camera will be placed for viewing the control room. The CCTV equipment will be arranged to view the complete plant site. The security cameras will be remotely accessible from Owner's offsite general offices. The CCTV system will not be integrated with the plant DCS alarm system.

The security system will include CCTV video matrix/switcher, and recording Project will be located in the central control room. The CCTV system will be integrated with the plant DCS/PLC alarm system.

3.17.3 Grounding and Lightning Protection System

Soil resistivity will be determined by implementation of the Wenner 4-probe method at several locations on the job site. The soil resistivity testing will be performed immediately after the site is graded and before burying pipes, ducts, grounding cables, etc. at the site. The soil resistivity

testing will be performed by the Corrosion Specialist as identified under Section 10D-3.17.4 – Cathodic Protection System.

Grounding will be provided to ensure safety to personnel and equipment in case of electrical equipment failures and to prevent fires and damage from lightning and/ or electricity. Additionally, the grounding system design shall provide a low impedance ground-fault current path, minimize ground potential rise and noise interference in instrumentation systems, minimize the effect of lightning surges on equipment and structures and maintain safe step and touch potentials within plant structures.

The design of the grounding system will be coordinated with any cathodic protection provided. Large equipment enclosures will be connected to the plant ground loop. The ground loop shall consist of buried #4/0 AWG or larger copper ground wire with driven ground rods located strategically throughout the plant. The splices and taps to the buried grounding conductor shall be exothermic type. If the compression type connections are proposed then it shall be Burndy Hyground type or approved equal. Taps from the ground loops to individual equipment will be #2/0 AWG or larger. All other connections to the grid will be #4/0 AWG. Motors will have minimum of two ground connections.

The grounding grid design will be coordinated with the design by the switchyard grid designer. This is to provide safe levels of step and touch potential and acceptable level of ground potential rise. Contractor will run as a minimum of three ground pigtails from the plant grid and connect it to the switchyard grounding grid using test well. Ground resistance values shall be designed to achieve acceptable GPR with the available ground fault current on the 230 kV systems at the switchyard.

Fences shall be grounded for 50 ft on either side of HV overhead line crossing points, and also at underground pipes and motorized gates. These sections shall have air gaps (isolated and insulated) with the adjacent fencing. The switchyard fence grounding shall be by others.

Power cable shields will be grounded at both ends. Instrument shields will be grounded at one point only, normally at the DCS or control panel. Separate, insulated, ground connections shall be made to the grid for instrumentation grounding.

Electrical system neutral grounding shall be as shown on the one line diagram. Grounding shall be in accordance with IEEE80 and IEEE 142.

Lightning protection will be provided for the plant to protect equipment and structures from the damaging effects of lightning. The lightning protection design shall be coordinated with the ground grid design to dissipate lightning caused surges and protect plant electrical and electronic equipment from hazardous overvoltages. Lightning protection will be determined based on compliance with the guidelines covered in IEEE 665, IEEE 142 and chapter 7 of IEEE 141. Lightning protection shall be designed and installed to meet the requirements of ANSI/NFPA780, IEEE 665, IEEE 1100, UL 96 and UL 96A.

The Project will furnish and install the grounding system meeting the requirements described above.

All structures, conduit, cable tray, and electrical equipment will be grounded per the NEC or applicable state and local standards.

Grounding and lightning calculations will be provided to the Owner.

The Project will comply with the applicable SDG&E grounding requirements.

3.17.4 Cathodic Protection System

The Project will hire an independent subcontractor having NACE accredited "corrosion specialist" to perform necessary site investigations to determine whether the cathodic protection system (CPS) is required for the effective corrosion control of the buried structures and equipment at the site. The subcontractor will also collect the additional soil resistivity data required for the plant ground design mentioned in Section 3.18.4. The subcontractor will submit a written report to the Project with the results of the testing, the method used, any recommendations resulting from such investigation, and the basis of such recommendation. The subcontractor report shall be signed and certified by NACE accredited "Corrosion Specialist" and a Registered Professional Engineer.

If required, the Project will include an impressed current cathodic protection system for all underground metallic components. This system will be completely isolated from the electrical ground grid. A study survey and calculations will be provided to the Owner.

The cathodic protection system will be designed, installed, and tested in accordance with the latest issue of NACE International, ICEA, NEMA, ANSI, and Applicable Standards.

A cathodic protection survey is required before turnover to verify complete equipment protection.

3.17.5 Lighting Systems

The Project lighting system will provide illumination for the Project operation under normal conditions, and emergency egress lighting to safely evacuate the site during outage of the normal power source, and include all equipment specified herein.

The work will be performed in accordance with the National Electrical Code (NEC) and applicable local codes in a manner consistent with Prudent Utility Practices.

Interior lighting will be high-power-factor fluorescent, or high-power-factor hp sodium, or high-power factor metal halide depending on the area.

Exterior and road lighting will be high power-factor, high-pressure sodium. Outdoor lighting will be designed to minimize transmission of light beyond the plant boundary through the use of directed lighting, guarded luminaries, etc. Lighting fixtures will be located and adjusted for the maximum useful light output. Accessibility for maintenance will be considered.

All indoor fixtures will be controlled at the lighting panel/switches located at the entrance areas. Photo-cells will control outdoor lighting circuits and will include bypass switches.

Control room general area lighting will be provided by using recessed fluorescent fixtures with reflective parabolic louvers (extra low brightness reflectors) and lamp dimming ballasts. The intensity of the general area lighting will be controlled by fluorescent dimmers. Incandescent light fixtures for emergency lighting will be installed. The incandescent emergency lighting fixtures powered from the 125V DC battery will normally be off and shall automatically illuminate upon loss of normal AC lighting power source. A few battery packs will also be strategically located in the main control room.

Power for the lighting systems will be obtained from dry type transformers and panel boards at 480/277V and 208/120V, 4-wire voltage levels. Lighting circuits will be designed to balance the loads on 3 phase panels. Lighting, receptacle, and miscellaneous loads shall be separated from process equipment related loads.

Lighting panels will be sized with a minimum of 20 percent future spare capacity. Lighting panels will be provided with a variation of spare breakers and blank spaces.

Circuits at the distribution panel will be wired in such a manner that they are balanced within ±5 percent between the phases.

For normal unit operation, the lighting system will provide illumination in all Project areas to the levels required by ANSI/IES RP-7 and utilizing a maintenance factor of 0.7. The foot-candle values listed in the standard are the average minimum maintained levels as measured at ground level for outdoor areas and 30 inches above the floor for indoor facilities.

3.17.5.1 Lighting Transformers

Transformers will be sized as required for the connected and future loads, and will be dry-type, three- phase, 60 Hz, self-cooled. Dry type transformers shall be class H insulation with an allowable winding temperature rise of 115ºC.

Lighting transformers will be rated on the basis of full load of the lighting panel including the future spares/spaces with a margin of +10 percent.

3.17.5.2 Receptacles

480-Vac, 3-phase, 60A welding receptacles with integral on/off switches will be located, as a minimum, one for every two engines, at grade, and in all remote equipment locations and maintenance areas, and will not be located in hazardous areas.

Single-phase 120-Vac convenience outlets will be 20A duplex. They, will be, as a minimum, located for convenient access in all buildings and control cubicles and will not be located in classified areas. Ground fault interrupter (GFCI) type outlets with watertight covers are required for all outdoor convenience receptacles. In shop areas, 50A, and 20A single-phase receptacles are required. In addition, the 480-volt 3-phase 60A welding receptacles will be provided in the shop area.

3.17.5.3 Emergency Lighting

Emergency exit signs will operate continuously. Exit signs will identify all exits and will be visible from all directions of the access route. Exit signs with an arrow indicating the direction of travel will be used as necessary to direct personnel to the nearest appropriate exit. Exit sign placement will be such that no point on the exit route is more than 100 feet from the nearest visible exit sign.

Emergency lighting is required as per Applicable Laws and Applicable Standards. The emergency lighting systems primarily consists of self contained battery powered units located throughout the plant. Light sources for emergency lighting will be either incandescent or fluorescent. The self contained battery pack units will be 90 minute rated with nickel cadmium cells.

3.17.6 Panelboards

Panelboards will be UL-listed and conform to the latest issues of the NEC and NEMA PB1. Panelboard will be used to distribute power at 3-phase, 4-wire, 480Y/277V or 208Y/120V, and shall be provided with circuit breaker padlock devices. Panelboards will be equipped with copper bus and molded case type circuit breakers (MCCB). Circuit breakers in 208Y/120V panelboards shall have 10,000A minimum interrupting capacity. Panelboards shall be furnished with main circuit breakers. Ground bus shall be supplied in each panelboard. A completed directory card and frame will be provided on the inside of the door.

Panelboards shall be provided with approximately 20% spare breakers for future use.

3.17.7 Cable Systems

All cable will conform to, and tested in accordance with, the latest applicable standards of American National Standards Institute (ANSI), Underwriters' Laboratories (UL), the Insulated Cable Engineers Association (ICEA), the Institute of Electrical and Electronics Engineers (IEEE), and the National Electrical Manufacturer's Association (NEMA), unless otherwise stated herein.

All cables will meet or exceed flame test requirements of UL 44, Section 56. All cable will be "sunlight resistant" and for use in cable trays ("for CT use"). Cable with PVC insulation is not allowed.

Instrumentation and thermocouple cable will be twisted with a minimum twist frequency of 3 inches, or 4 twists per foot.

Voltage transformer and current transformer leads will be #12 & #10 AWG minimum respectively.

All control and instrument leads for the external connections will be brought out to terminal blocks mounted in terminal boxes, control boards, or panel in an accessible location, including all spare contacts.

Cable will be identified with identification markers at both ends after cables have been permanently routed, positioned, and terminated.

Cable will be installed in compliance with the cable manufacturer's recommendations on minimum pulling temperatures and maximum pulling tension. All cable ends will be sealed from contamination during the pulling operation and during storage on cable reels.

A thermal calculation will be performed and provided to the Owner where large concentrations of power cables occur in the duct runs to ensure the temperature does not exceed the maximum cable temperature.

Splicing of cables will not be allowed. The Contractor will receive approval from Owner for any cable that needs to be spliced before the cable is pulled.

Cables will, at a minimum, meet regulatory requirements and the following specifications.

3.17.7.1 Requirements for Medium Voltage Cable:

Voltage Class	15,000 volt
Conductors	Copper, Class B stranded, annealed. Conductors shall be sized such that the maximum magnitude and duration of the short circuit current experienced by the cable does not result in damage to its insulation.
Insulation material	Ethylene-propylene-rubber (EPR), 133% insulation level
Jacket	For single conductor or multiplexed cables: Per NEC and UL listed as type MV-90 suitable for use in cable tray. Jacketing material shall be thermoset chlorinated polyethylene (CPE), or neoprene
Conductor shield	Extruded semi-conducting thermosetting compound
Insulation shield	Extruded conducting thermosetting compound
Metallic insulation shield	Nonmagnetic copper tape, 5 mil minimum

3.17.7.2 Requirements for Low Voltage Power Cable:

Voltage Class	600 volt
Conductors	Copper, Class B stranded, annealed, (with a tin or lead-alloy coating if required), minimum #12 AWG minimum
Insulation material	Ethylene-propylene-rubber (EPR), 90°C or cross-linked polyethylene (XLPE) rated 90°C
Jacket	For single conductor or multiplexed cables: per NEC and UL listed as type TC

3.17.7.3 Requirements for Low Voltage Control Cable:

Voltage Class	600 volt
Conductors	Copper, Class B stranded, annealed, (with a tin or lead-alloy coating if required), #14 AWG minimum
Insulation material	Ethylene-propylene-rubber (EPR) or cross-linked polyethylene (XLPE), rated 90°C

Jacket	For multiconductor cables: per NEC and UL listed as Type TC (No PVC)
Wire colors	NEC Table E-2 for multiconductor cables

3.17.7.4 Requirements for Instrument Cable:

Voltage Class	300 volt
Conductors	Copper, stranded, #18 AWG minimum
Insulation material	≤ 90°C, fire retardant XLPE
	> 90°C, TFW Teflon tape and Kapton tape over the Teflon
Jacket	Over each twisted pair or triad: per NEC and UL listed as Type PLTC (No PVC)
Shield	Each pair individually shielded, overall shield is 1.5 mil aluminum or copper-mylar laminate tape
Drain wire	Copper, One per shield

3.17.7.5 Requirements for Thermocouple Cable:

Voltage Class	300 volt
Conductors	ANSI Type E, chromel-constant, or ANSI Type K, chromel-alumel, #18 AWG for single pair, #22 AWG for multi-pair
Insulation material	< 90°C, fire retardant XLPE; > 90°C, TFW Teflon tape and Kapton tape over the Teflon
Overall Jacket	Per NEC and UL listed as Type PLTC (No PVC)
Shield	Each pair individually shielded, overall shield is aluminum or copper-mylar laminate tape

3.17.8 Raceway Systems (Conduit & Tray)

Underground conduit will be a minimum of 2-inch PVC. PVC conduits will be Schedule 40.

Embedded (in concrete mats) conduits will be run as directly as possible from point to point with a minimum of crossing or bending. Embedded conduits shall be separated by 2½" to 3" to accommodate proper filling of concrete.

Galvanized steel conduit in any underground construction, whether as a single duct or in duct banks, shall be encased in a minimum of 3 inches of concrete for protection against corrosion.

Above grade conduit shall be rigid, hot dipped galvanized steel, or aluminum in corrosive atmospheres. Above grade conduit shall be ¾ inch trade size minimum. Flexible conduit shall be PVC-coated, liquid tight, metal type and suitable for the hazard classification of the area in which it is installed, where applicable.

Cable tray shall be used for raceway wherever physically feasible and economically desirable. All trays shall be galvanized steel or aluminum, open rung type installed with all supports and fasteners recommended by the tray manufacturer and required by NEMA VE-1 Standards.

All exposed conduits shall be rigid steel, hot-dip galvanized inside and outside in accordance with UL6 and ANSI C80.1.

Pull boxes, junction boxes, and terminal boxes shall be NEMA 4 in outdoor or wet areas and NEMA 12 in indoor areas (Vendor skid equipment may be NEMA 1 indoors). Covers of terminal boxes shall be hinged and fasten with latches.

There shall be maximum of three 90 degree bends, or the equivalent thereof, in one conduit run.

The underground duct systems shall be concrete encased PVC excepting all bends 30 degrees or greater shall be galvanized steel conduit. Minimum concrete envelope coverage shall be 3 inches. Duct bank crossing roads and the high maintenance areas shall be reinforced. The reinforcement shall extend 5' beyond the road. Manholes or handholes shall be provided as required to conform to the cable manufacturer's cable pulling tensions.

Underground conduit penetrating foundation above or below ground shall be rigid, hot dipped galvanized steel. The steel conduit penetrating foundation below the grade shall be terminated in the half coupling flush with the wall for the future extension of the duct bank. The first five feet of the duct bank joining this wall shall be rigid, hot dipped galvanized steel. It shall also be reinforced with steel cage to a distance of eight feet from the foundation wall.

The maximum number of ducts in a duct bank shall be limited to avoid congestion in manholes and application of high derating factors. In the case of power cables, the effective loading shall be in accordance with the latest edition of ICEA P-46-426, or NEC. For applications not covered by the above standards, loading shall be calculated using the NEC-approved Neher-McGrath approach. If Neher-McGrath method is utilized in determining power cable ampacity ratings, then the appropriate study with duct banks details (sections, elevations, etc.) shall be submitted to Owner for approval and concurrence.

Duct banks shall be installed with a minimum slope of 6 inches per 100 feet to provide proper drainage. This slope may be provided from termination to termination or from a point along the duct bank to each termination.

Duct bank routes shall be identified at 100 feet minimum intervals by means of a 4 inch by 4 inch concrete marker set flush with grade, and with the letter "E" and an arrow cast in the top. Markers shall not be physically connected to the duct bank.

Duct banks shall be assembled using non-magnetic saddles, spacers and separators as recommended by the duct manufacturer. Separators shall provide 3 inches minimum concrete between the outer surfaces of the conduits.

Joints or couplings for the duct runs shall be of the same materials as the ducts.

Underground ducts which are less than 20 feet in length between ends shall be rigid galvanized steel conduit.

Approximately 20 percent spare duct capacity shall be provided for future expansion.

Ground cables shall be laid with each underground electrical duct run (not encased in the concrete), and shall be connected with ground cables from other duct runs at each manhole. All hardware including cable splices shall be bonded to these ground cables.

Conduits entering the manholes and handholes shall be rigid, hot dipped galvanized steel to a distance of five feet. The ten feet of the duct bank entering the manholes and handholes shall have reinforcing steel. The minimum size of handholes and manholes shall be 4 X 4 feet and 4 X 6 feet respectively. Manholes shall have cable pulling devices cast in place. All openings in the manholes and handholes shall be closed by concrete poured in the field.

Cable trays for power and control cables shall be aluminum ladder type with 9 inch rung spacing, with width and depth as required. Aluminum cable tray shall be manufactured of heat treated ASTM B221 6063 aluminum alloy for extruded parts and of ASTM 109 5052 alloy for parts fabricated from sheets.

Cable tray for instrument cables (low level signals) shall be steel, solid bottom with covers. Steel cable trays shall be hot dip galvanized after fabrication in accordance with ASTM 123.

All cable trays shall meet the requirements of NEMA VE1. Cable tray design will be based on the loads to be carried, plus the dead weight of the tray system. For this loading condition, the safety factor shall be 2.0, based on the ultimate capacity of the tray as determined by load test in accordance with NEMA VE1, Section 4. In addition to and concurrent with the load mentioned above, the tray shall be designed to withstand a concentrated load of 200 lbs. applied at the mid-span, at the center of the rung or on either side rail. The safety factor for this load condition shall be at least 1.5, based on the ultimate capacity of the tray or any of its components as determined by load test in accordance with NEMA VE1, Section 4.

“Peaked” covers shall also be provided on trays installed outdoors or where required for mechanical protection, e.g. where passing through floors in non-electrical areas or accessible to walkways and platforms and cover shall be extended approximately 3 feet beyond the extremity of the area. Flat cable tray covers will be furnished and installed on all instrument trays. Covers on power trays will be raised covers.

Cable trays shall be spaced a minimum of eighteen inches apart vertically, and the sizing of bends shall take into account minimum cable bend radius. Fire stops shall be used when passing through fire rated walls.

A four-tray cable segregation system will be furnished that will include medium-voltage power (if required), low-voltage power, control, and instrumentation. The instrument tray will be solid bottom while other trays will be ladder type.

Cable trays will be identified before the installation of any cables. Cable trays will be identified in a distinct, permanent manner with identification numbers at reasonable intervals in accordance with the Owner’s customary standards.

Wires will not be run unprotected in the Project. Wire not run in cable trays will be run in conduit. The proper size of all conduits will be determined in accordance with the National Electric Code (NEC). All trays will be sized in accordance with the number of cables and total fill area of

cables that they will contain in accordance with the National Electric Code. Junction and pull boxes will conform to UL Standard UL 50.

Inner duct will be provided with each run of fiber optic cable over its entire length.

Manholes and handholes will be placed at distances that facilitate cable pulling without exceeding permissible cable pulling tensions and/or side wall pressures.

3.18 GENERAL CONTROL PANEL WIRING REQUIREMENTS

Terminal blocks will be rated 600 volt, 20 amps. A permanent marking strip, identified in accordance with Contractor's wiring diagrams, will be furnished on each terminal block. At least 20 percent (two per 12-point terminal block) spare terminal points will be furnished. All current transformers will be provided with shorting blocks.

All control wiring internal to panels will be 600V, Type SIS, #14 AWG minimum, copper conductors with Class B stranding. Class D stranding will be provided where wiring is subject to flexing, such as across hinged panels.

All power wiring internal to panels will be 600V, #12 AWG minimum. Power cable #8 AWG and larger will have copper conductors, with 90°C, heat, moisture, and flame-resistant XLPE insulation and jacket. Power cable internal to panels which is #10 AWG or #12 AWG will be Type SIS with copper conductors and Class D stranding.

All wiring internal to panels will be capable of passing the flame test requirements of UL 44, Section 56.

Wiring will be terminated using compression-type insulated terminals that firmly grip the conductor. Both ends and at each terminating point of each wire will be uniquely identified with permanent, heat-shrinkable wire markers.

Splicing of wiring is prohibited. No more than one wire plus one jumper will be connected to any one terminal point.

All 480V wiring will be segregated from other control wiring and low-voltage devices by means of an insulated barrier.

Only one ground connection will be provided for each instrument circuit. Ground connection for shield wiring will be nearest the power source.

Wiring will be neatly arranged and clamped securely to panels to prevent movement or breaking. A maximum of 12 wires will be in a bundle in order to facilitate tracing of wires. Wiring clamps and supports at hinge transition points will be properly sized to prevent chafing of insulation when the cubicle door is opened and closed. Nonmetallic clamps are preferred.

3.19 PROTECTIVE RELAY PANEL FUNCTIONAL REQUIREMENTS

The Protective Relay panel will be located in a conditioned space and will contain all protective relaying not integral to the switchgears or the reciprocating control panels.

3.20 WORKSTATIONS

PC-based workstations (DCS/PLC, CEMS, etc.) should be based on current hardware offerings and latest software releases and will be furnished and installed with all necessary furniture. No less than three (3) workstations will be provided for plant control.

3.21 TESTING AND CHECKING OF ELECTRICAL EQUIPMENT

Testing for each piece of equipment will be conducted to ensure normal and safe operation of the Project. All tests will be in accordance with applicable ANSI, IEEE, and NEMA standards.

3.22 EMBEDDED WORK

All conduits embedded in floors, walls, foundations, duct, etc., will be hot-dipped galvanized rigid steel conduit, which will conform to ANSI C80.1, “Rigid Steel Conduit-Zinc Coated”. Electrical metal tubing (EMT) can be used for indoor lighting circuits, in and out of walls, but not in concrete.

3.23 METERING REQUIREMENTS

3.23.1 Power Metering

If Applicable. Revenue-quality metering systems will be designed, installed and certified in accordance with the latest conformed California Independent System Operator tariff as can be found on their web site at http://www.caiso.com/clientserv/metering/. The revenue metering systems will be capable of collecting and processing real-time data from the generating plant, and transmitting it to the California ISO’s Meter Data Acquisition System (MDAS). The revenue-quality metering system will consist of the following, unless otherwise approved by the California ISO:

Voltage transformer will meet the requirements of the California ISO as specified in Section 10 of the tariff and the Metering Protocol (including Appendices A-G).

Current transformer will meet the requirements of the California ISO as specified in Section 10 of the tariff and the Metering Protocol (including Appendices A-G).

Polyphase solid-state revenue quality meters will be installed to collect and process data, and will be capable of transmitting the data to the California ISO’s MDAS. Each meter will meet the requirements of the California ISO as specified in Section 10 of the tariff and the Metering Protocol (including Appendices A-G and Appendix J). The quantities to be collected and processed by the metering system are identified in the California ISO’s tariff and Metering Protocols.

Alternatively, a combined CT & PT metering unit containing potential and current transformer elements under one porcelain bushing may be installed in place of separate voltage and current transformers on the high side of the generator step-up transformers. The electrical, mechanical and accuracy characteristics of combination metering units will be the same as individual VTs and CTs.

3.23.2 Non-Revenue Metering

Shorting-type terminal blocks will be provided to allow instruments to be removed without disrupting current transformer circuits.

The accuracy of the switchgear/panel type metering current transformers will be in accordance with ANSI/IEEE C37.20.1 for low-voltage switchgear, and in accordance with ANSI/IEEE C37.20.2 for medium-voltage switchgear consistent with current transformer ratio, burden, mechanical, and thermal duty. The accuracy of voltage transformers will be ± 1.2 percent or better.

The following indications will be provided on the DCS/PLC or on the engine control/relay panels or local panels (The list is tentative and will be finalized during detail design phase):

For Each Generator	**Location of Indications**
Generator Meters/Transducers:	
1 - Watt-hour Meter	Control Panel, DCS/PLC
1 - Watt Transducer	
1 - Digital Monitor w/Serial Link:	
1 - Generator Watt Output	Control Panel, DCS/PLC
1 - Generator VAR Output	Control Panel, DCS/PLC
1 - Generator Power Factor Output	Control Panel
3 - Generator Current Output	Control Panel
3 - Generator Voltage Output	Control Panel
1 - Generator Frequency Output	Control Panel, DCS/PLC
1 - Digital Monitor w/Serial Link	
3 - System Voltage Output	Control Panel, DCS/PLC
1 - System Frequency Output	Control Panel, DCS/PLC
1 - Digital Meter w/Serial Link	
1 - Exciter Field Voltage	Relay Panel, DCS/PLC
1 - Exciter Field Current	Relay Panel, DCS/PLC
Automatic Voltage Regulator	**Location of Indications**
1 - Status	DCS/PLC
1 - Power System Stabilizer (PSS)	DCS/PLC
Automatic Synchronizer System:	Relay Panel
1 - Synchroscope and Lights	
1 - Automatic Synchronizer, 25A	
1 – Manual Synchronizer, 25M	
Non-revenue metering at the High Voltage switchyard W/serial link	Relay Panel, DCS/PLC
Project auxiliary power	
Total real power usage of auxiliary loads (watts)	MV switchgear
Total reactive power usage of auxiliary loads (VARs)	MV switchgear
The following for 15 kV and 480 V load center buses	Local indication
Bus voltage, all phases (switched)	
Incoming current, all phases (switched)	
Current through feeder breakers, one phase	
Phase current for motor feeds, three-phase	
480 V motor control centers	No metering provided
The following 125 V dc system (Project battery)	Local indication
Battery amperes	at dc switchboard
Bus voltage	at dc switchboard
Negative-to-ground voltage	at dc switchboard

For Each Generator	Location of Indications
Positive-to-ground voltage	at dc switchboard
Blown fuse	at each fused switch in dc switchboard
Bus undervoltage	at dc switchboard
Charger output volts and amperes	
Charger alarms	
Common trouble alarm for the 125 V dc system	DCS/PLC

3.24 230 KV PLANT SWITCHYARD

The plant switchyard will be an air-insulated, low-profile structure, utilizing rigid buses supported on post insulators on steel structures to connect high voltage air switches, circuit breakers, metering CT's & PT's, surge arresters, etc. The Master Layout Plan (Drawing QB-SP-2) locates the plant switchyard on the site and depicts its physical arrangement.

The switchyard will utilize a radial switching scheme (single circuit breaker isolates the plant from SDG&E Grid) to transmit total output power to the Point of Interconnection (POI) at the SDG&E Switchyard. The key one line diagram (Drawing QBPP-E001) provides conceptual switching arrangement for switchyard using high voltage air switches, high voltage circuit breaker, metering CT & PT, surge arresters, dead-end towers, etc. The design and components will meet the requirements of associated ANSI/IEEE and NEMA standards (e.g. ANSI C2, IEEE 605, NEMA SG6, ANSI C37.30, etc.).

One small, prefabricated control building will be provided and located in the plant switchyard to accommodate battery, battery charger, protective relay panels, RTU, etc. required to control and protect the switching station, and will communicate with SDG&E and CAISO.

3.25 STABILITY STUDY AND DESIGN STUDIES

A stability study will be performed to ensure that the generators are capable of operating without damage during transient conditions in the switchyard.

Design studies shall include protective relay coordination, short circuit, load flow and voltage drop analysis employing "Easypower" or E-Tap software. Grounding grid analysis shall be performed using "SES Multiground's" or equivalent software. Equipment sizing studies shall be performed manually or using approved packaged softwares.

APPENDIX B.5

CONTROL ENGINEERING DESIGN CRITERIA

APPENDIX B.5
CONTROL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

The Project will be constructed in accordance with the industry standard practices and project developed specifications; its implementation will include an orderly sequence of the following project execution phases:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Testing and checkout, start-up
- Project completion

This appendix summarizes the codes, industry standards and practices, and general design criteria that will be used in the design and construction of the Project's control equipment and related systems. More specific design criteria will be developed during the project's detailed design phase. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general description and design criteria for instruments, modulating type control systems, and motor controls.

2.0 DESIGN CODES, STANDARDS, LAWS AND REGULATIONS

The design specifications for all work will be in accordance with the applicable laws and regulations of the federal government, the State of California, and applicable local codes and ordinances. A summary of codes and industry standards applicable to design and construction follows:

- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- The Institute of Electrical and Electronics Engineers (IEEE)
- Instrument Society of America (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)

- Scientific Apparatus Makers Association (SAMA)
- American Society for Testing and Materials (ASTM).

Other recognized standards will be utilized as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

3.0 INSTRUMENTATION AND CONTROL DESIGN CRITERIA

The instrumentation, control systems, UPS system, and electrical power circuits for critical equipment will be designed in such a way that no single control system, instrument failure, controller failure, fuse, or circuit breaker will interrupt the operation of more than one piece of redundant equipment. The plant will be designed to eliminate common mode failures.

The Contractor may propose to use PLC based control system for the Balance of Plant (BOP) equipment/systems and the Reciprocating Engines. The PLC based control system will be acceptable provided it meets all of the applicable requirements specified for the DCS/PLC.

The number of different control systems will be minimized as much as practical. The intent is to simplify maintenance and operation of the plant control systems. All control consoles will be of the same manufacturer for the plant main control room.

The DCS/PLC and reciprocating engine control systems will be provided with the following features furnished by the supplier:

a. A remote control console/workstation for the reciprocating engines (1 LCD for up to 4 engines) will be located in the plant main control room. In addition, Contractor provides two extra work stations. This console will provide all the functions of the local control consoles for each reciprocating engine. In addition, it will be possible to perform all necessary workstation functions (programming, graphic display changes, etc.) from this console.

b. Two color printers will be mounted in the main control room. These printers will print all alarms, logs, historical data, graphic displays, etc.

c. The Reciprocating Engine control packages will be linked to the Project DCS/PLC by Profibus. This link will be used for data acquisition and monitoring of the Reciprocating Engines. In addition, critical control functions will be hardwired from the Reciprocating Engine control systems to the Project DCS/PLC to allow critical functions to be performed from the Project DCS/PLC.

d. All transmitters and indicators will be capable of being maintained while the unit is on line and will be provided with root valves. Root valves are required for critical trip instrumentation. Certain transmitters on the engines have to be maintained while the unit is stopped. Balance of plant transmitters and indicators can be maintained while operating.

e. Factory Acceptance Testing (FAT) of the complete control package will be performed using Vendor's standard testing procedures. All software logics, hardware, graphics, and alarming will also be verified during the FAT. The tests will be performed before shipment. Owner approval of information displayed on control screens is required. See Section 4.4 for additional information on FAT.

f. The failure of any transmitter or switch will not shutdown more than one engine.

g. Each Reciprocating Engine has its own control system and a failure of the DCS/PLC system power supplies will not shutdown more than one unit.

h. Mechanical equipment on standby status will automatically start upon a trip of the operating equipment.

Local control and key engine indication will be provided at each engine. All instrumentation and systems will be designed to provide safe and reliable operation of each Unit in accordance with all applicable codes and standards.

Main and redundant process transmitter inputs will be provided for critical control loops. Inputs will be brought into different I/O modules for integrity.

Current-to-pneumatic (I/P) converters will be used to provide the interface between the electronic control signals and pneumatically actuated control valves. The converters will be responsive to the basic control signals for the system and will have a 3-15 psi output. Feedback from I/P converters mounted on control valves will be sent to the DCS/PLC for control system tuning purposes. Actual Line valve position feedback will be from position transmitters provided for split range control valve applications only, to provide LCD indication for the operators.

The control system will be designed to require a minimum of operator action. The control system will include all necessary logic to change the operating mode for selector stations safely under various operating conditions.

The control system will be designed to ensure transfer from manual to automatic and vice versa with no operator balancing or upset in the individual control loops.

All backup pumps should be able to auto-start from the DCS/PLC on primary pump trip, low suction pressure, and low discharge pressure, at a minimum.

The Contractor will provide Owner with a master set of the Contractor's and vendor's wiring drawings; reciprocating engine and BOP DCS/PLC control system configuration, cabinet arrangement, and power distribution drawings; instrument index; instrument and control valve data sheets; and P&IDs marked with all commissioned changes. All as commissioned changes will be incorporated into the final drawings, documents, etc., which are to be submitted to the Owner before Substantial Completion.

Project control system will be capable of day-ahead programming of key events (i.e. turning over unit to California ISO remote dispatch). The Contractor will be fully responsible for the interface design with the California ISO remote dispatch system.

The Project will be operable from the control room by a single operator under all normal conditions from minimum to full load. The Project will also be remote started, operated, and shutdown and will be under AGC control.

3.1 Distributed Control System

A microprocessor-based distributed control system (DCS/PLC) will be provided for controlling, monitoring, indication, alarm, and historical functions. LCDs located in the main control room will serve as the primary operator interface. This system will monitor, alarm, and provide limited control of the engine. Remote LCDs will be provided in the main control room for detailed controlling, alarming, and monitoring of the reciprocating engines. A MODBUS or Ethernet communication link for data acquisition will be provided between the engine controls and the DCS/PLC for each engine. Control functions between the DCS/PLC and engine control systems will be via hardwired signals.

The DCS/PLC will be as manufactured by a reputable DCS/PLC supplier.

Any normally operating auxiliary systems during normal startup and shutdown operation of the Project will be controlled through the DCS/PLC. The DCS/PLC will be capable of allowing control and data to be passed between the CALISO and the plant's AGCT or RIG system. The interfacing allows using Ethernet with OPC protocol that will interface with Owner's equipment.

The microprocessor-based DCS/PLC will be complete with design, engineering, materials, manufacture and assembly, optimization, documentation, testing, and field services.

The DCS/PLC will include automatic control and monitoring of the startup, shutdown, and normal operation of the Project systems through redundant Project communication loops.

The DCS/PLC will provide automatic and manual control of all major subsystems.

The Project will include a master clock system synchronized with satellite (GPS) complete with antenna, accessories, and equipment. This master clock system will provide time synchronization signals for all control systems for the plant requiring time synchronization.

3.1.1 Performance Requirements

The system will be properly protected from voltage surges that normally occur in a power plant. Inputs, outputs, and other connections will meet the surge withstand requirements of ANSI C37.90a.

The devices will have input to output isolation, shielding, separation of circuits, surge suppression, and other measures to meet these provisions.

The system will operate satisfactorily without air-conditioning and with ambient temperatures from 40°F to 110°F at a relative humidity of 20 percent to 95 percent, non-condensing.

3.1.2 Functional Requirements

Remote I/O and logic cabinets may be used within the Project. Data highways must be used and must be physically separated from each other and routed in different raceway systems between the remote I/O and logic cabinets and the control room operating consoles. Redundant communication loops are not included. All engineering functions must be able to be performed remotely via an engineering console located in the control room equipment area.

The operating staff at the Project will be kept to a minimum. Therefore, a high level of automation and reliability is required. Each system will be capable of operating on full automatic. Fail-in-place lock-up features upon loss of air or signal will be provided as appropriate for the application. The DCS/PLC will alarm all abnormal process and operating conditions, system component failures, loss of air on critical control valves, etc., to ensure safe and efficient operation of the Unit. Alarms will also be provided to meet the requirements of all Applicable Laws and Applicable Standards. The operator will have the ability to tag out equipment (fans, pumps, valves, dampers, etc.) from the LCDs for work performed by maintenance personnel. When a piece of equipment is tagged out by the operator, the operation of that device by the control system will be inhibited in the system logic. The graphics displays will indicate when a device is tagged out.

3.1.3 Console Design

The control system will be designed to allow Project operation by a minimum number of operators. All Project systems will be operable from the console to be located in the main control room. The console will consist of, but not limited to, the following:

- Six DCS/PLC LCDs (two per workstation)
- Three keyboards
- Sequence-of-events recording
- Engine control - 1 LCD for up to 4 engines
- Accessories as required (keyboards, printers, etc.)

3.1.4 Hardware Requirements

The following paragraphs define the general requirements for the hardware and software for the DCS/PLC and other microprocessor-based control systems:

3.1.5 DCS/PLC Partitioning

The DCS/PLC and reciprocating engine control systems will be divided into subsystems according to the Attachment 12, Preliminary Automation Layout. The logic hardware for each subsystem will be independent from the other subsystems. Critical safety-related communications between subsystems will be through hardwired I/O. All other communication will be by data-highway. The failure of a processor will not shutdown more than one engine.

Any portion of the control system whose failure could shutdown more than one engine must have installed redundancy.

3.1.6 Power

The failure of a power feed will to the DCS/PLC control systems will not shutdown more than one engine. The primary feed will be 24-Vdc for the control system, and 120-Vac with UPS for the WOIS system.

A failure of a power supply will not affect system operation. Failure of any power supply will be alarmed on the LCDs on the main control room and Project maintenance personnel will be

capable of replacing power supplies with the system on-line. Modular power supplies may be provided as a substitute for 100 percent power supplies provided they are supplied on an N+1 configuration per cabinet. In addition, loss of any battery backup power should be alarmed in the DCS/PLC.

3.1.7 System Failure Protection

No single hardware or software failure will affect normal control of the Plant. Any portion of the control system whose failure could shutdown more than one engine must have installed redundancy.

System programs and configurations will reside in nonvolatile memory. Any volatile memory will be easily re-installed.

System failures will be alarmed and logged on a printer.

3.1.8 DCS Communication Network

The Project's DCS/PLC communication network will consist of a single data-highway loop, to which the DCS/PLC will be connected. DCS/PLC will be connected to the data-highway loop with communication hardware. The communication hardware will have automatic loop transfer capability to provide protection against a single loop failure. Loss of the data-highway loop will be alarmed. The data-highway will permit all devices in each system to interface with one another.

Individual points will be scanned, system communications completed, and control signal outputs updated at least once every 1/3 second. All data on LCD displays will be updated at least once every second. LCD graphics displays will be fully displayed with all current live data within 2 seconds after the request for the display has been initiated.

3.1.9 Printers

The system will include color graphics-capable quiet printers. Three printers and stands are required. One printer will be dedicated to alarms. Alarms will be printed in red. Cleared alarms will be printed in black. The other printer will be for logs and graphic displays printing.

3.1.10 Computing Hardware and System I/O

To the maximum extent possible, redundant process equipment (pumps, fans, etc.) will have its control located on different I/O cards. Process status data from an individual piece of equipment will be wired to the same input card, except for signals from redundant transmitters, which will be wired to different input cards. Contractor will identify where redundancy is not possible.

The meaning of "contact" within the scope of this specification will be an electro-mechanical relay contact, or a solid-state switch, such as a triac, transistor, or semiconducting rectifier. Contact ratings will be compatible with the controlled loads.

Each subsystem will be shipped with a minimum of 10 percent spare I/O installed. This I/O will be wired out to terminals. The loading of all system controllers will not exceed 60 percent continuously.

Sufficient spare rack and cabinet space will be available at shipment to expand the logic capacity and I/O capacity of each subsystem by at least 10 percent by adding the appropriate modules and equipment.

3.1.11 System Cabinets

Cable entry into system cabinets will be through the top or bottom. Cable supports will be provided in each cabinet. Cables will not block access to any cabinet hardware for equipment inspection, maintenance, or removal and replacement.

A high-temperature alarm for each logic cabinet will be provided and displayed on the console LCDs.

Terminations from the field will be terminated on vendor's standard termination unit.

Not more than one wire will be connected to one terminal block point except where jumper wires are necessary, in which case two wires may be connected for internal wiring.

Each I/O point including spares will be provided with vendor's standard terminals. No more than one wire will be connected to one terminal, except where jumper wires are necessary.

3.1.12 Electrical Design Criteria

All control devices and components will be heavy-duty type suitable for operation at 120 Vac, 24Vdc, or 125 Vdc. To the maximum extent, insulation of coils will permit continuous operation at a temperature of 130°C. If this temperature rating cannot be met with commercially available products, the Contractor will identify such components to the Owner.

Contacts for external control circuits will be heavy-duty type. The contacts will have an AC interrupting capacity of ten times their normal rating and will not exhibit excessive arcing or contact bounce.

Relays with exposed contacts will not be used.

The voltage for contact interrogation is 24 Vdc for the DCS/PLC and reciprocating engine control system.

All limit switches will be heavy-duty snap-action types.

The DCS/PLC and reciprocating engine control system cabinets will include the following:

- Cabinet ground bus: Bus for grounding cabinet, rack, and equipment grounds
- Insulated or common ground bus: Bus for grounding instrument and control cable shields

All cabinet ground buses will be grounded to building steel.

Wire markers on both ends of each wire that is longer than 12 inches will be provided with indelible designations in accordance with the DCS/PLC supplier's wiring diagrams.

3.2 Software Requirements

3.2.1 Data Acquisition

A data acquisition system (DAS) will be provided as part of the DCS/PLC and will include a performance and monitoring package to track the unit and plant performance. The system will average, weight average, and integrate pressures, temperatures, flows, calculated values, etc., as required for the performance calculations, logs, etc. The Contractor will provide WISE workstations, which can interface to PG&E via Ethernet and OPC network.

The DAS will, as a minimum, perform the following functions:

- Time-stamp and store all data point at user-specified level of accuracy to common database
- Redundant hard drive storage of at least 365 days of data
- Archive storage on optical or other remotely accessible storage system
- Provide for direct transfer of files in MS Windows software. Contractor's system must communicate with Owner's OSI PI system.

3.2.1.1 Sequence of Events Recording

The DCS/PLC will provide scanning of not less than 150 digital (contact) inputs for the sequential events recording (SER) system. These inputs will be scanned to discriminate between contact operations, which occur a minimum of one millisecond apart, and print them in their proper sequence when they are opening and closing. Each event will be printed on the log printer as an individual event. The complete time will be parted out in hours, minutes, seconds, and milliseconds with each sequential event contract status change.

Contractor will provide its standard SER system in the form of its WISE system. The controls cycling time is limited by the processor cycling time which is between 10 - 50 m-seconds. The actual events reporting occurs in time intervals of maximum of 2 seconds.

The DCS/PLC will include sufficient buffer storage in the data acquisition system memory structure for the SER programs to ensure that the system will not fail to detect a contact operation due to storage or print buffer filling.

The DCS/PLC will include the SER program to permit storage of the sequence of events log in the Historical Storage and Retrieval (HSR) system in addition to printing the information on the log printer. The HSR will be sized large enough to store all sequence-of-events logs.

3.2.1.2 Logging

The system will log pre-selected variables at one hour intervals beginning at 1:00 AM. Values will be printed at the end of each 24-hour period at midnight on the log printer. The variables will consist of calculated values, averaged values, integrated values, instantaneous values, weight-averaged values, or the maximum value for the time period.

The variables and the exact format of the log will be agreed to by the Parties. Data will be logged on sheets in column form with data for any given variable tabulated in one vertical column.

The data currently being accumulated for the log will be protected in case of system failure. The log program will automatically re-initiate the accumulation of data following a system fail over without loss of data.

3.2.1.3 Historical Data Collection, Storage, and Presentation

A historical data collection, storage, and presentation (HCSP) system will be provided that will fully automate the collection, storage, retrieval and presentation of plant data. The HCSP will provide a centralized collection of information, a real-time database and a historical data archive. The HCSP will interface with all of the plant real-time systems

(i.e. reciprocating engine control system, BOP, DCS/PLC, etc.) simultaneously and will be capable of reading and writing to these systems. The HCSP will be complete with server, monitor, RAM, hard drive, CD backup, CD ROM drive, etc.

3.2.1.4 Graphics Displays

The graphics displays for use by the operators on the LCDs will be developed in accordance with the Contractor's standard utility format. Information displayed on the graphic displays are subject to approval by Owner. The DCS/PLC will include spare capacity of 20 percent for the number of graphic pages for future additions.

3.2.2 DCS/PLC Interfaces

The DCS/PLC will be designed to interface with other Project systems, specifically the reciprocating engine control system, the chemical feed system, gas metering system, power electronics monitoring/control system, and data acquisition system.

Except as noted, packaged systems including the demineralized water treatment will be programmed into the DCS/PLC. The continuous emissions monitoring system (CEMS), the gas compressor system controls, and the fire protection system will be stand-alone systems. Where programmable logic controllers (PLC) are used, these control systems will be a Siemens S7-400 or Siemens S7-300 with a data highway type connection to the DCS/PLC.

The DCS/PLC will be configured by the DCS/PLC supplier with information and coordination provided by the Contractor. A consistent control and instrumentation philosophy will apply throughout the plant to minimize diversity of equipment type and equipment manufacturer. Either 48 Vdc or 24 Vdc will be used for the digital input wetting voltage.

3.2.3 Reciprocating Engine Control Interface

The DCS/PLC will be designed to control by feed forward action, with system calibration and final correction provided by feedback action. The engine controls will be the manufacturer's standard, including the degree to which the use of feedback/feed forward control logic is employed. Engine controls are the Contractor's standard, including the degree to which the use

of feedback/feed forward control logic is employed. The control equipment furnished will include all feed forward devices and other equipment to provide complete stability under all conditions of dynamic load changes. Feed forward demands will be developed for Reciprocating Engine demand, fuel flow, etc. The system will control the operation of the Reciprocating Engine cylinders, main gas admission valve duration and timing through the Reciprocating Engine control systems.

The DCS/PLC will be fully interfaced with the Reciprocating Engine control system. Critical control and protection/trip functions will be hardwired between DCS/PLC and Reciprocating Engine control system. The communication interface to the Reciprocating Engine control system will be provided in accordance with Reciprocating Engine manufacturer's requirements for DAS functions and non-critical control signals. The Contractor will be responsible for complete interface between the DCS/PLC and the Reciprocating Engine control systems.

The DCS/PLC will interface to the Reciprocating Engine control system to manage the following analog and digital Reciprocating Engine control functions:

- Startup sequencing through synchronization.
- Speed and load control.
- Safety control including:
  - Automatic safe shutdown (ramp down)
  - Selected shutdown (ramp down).
  - Emergency shutdown (fuel shutoff).

The Contractor will provide sufficient manual control capability for Reciprocating Engine speed, generator voltage, and excitation such that a single operator can control the Project from the main electrical panel.

Inputs for fuel gas flow to each Reciprocating Engine will be provided.

3.3 Testing

A standard factory acceptance test (FAT) of the complete control package including all software, hardware, graphics, and alarming will be provided.

The FAT will be performed in the factory by the Contractor and witnessed by the Owner or

Owner representative before shipment. See Section 4.4 for additional information on FAT.

3.3.1 Tools

One complete set of all special tools, software, and appurtenances required for maintenance and operation will be furnished with each system. The Contractor will itemize the special tools and software that will be furnished. If no special tools and software are required, the Contractor will make a clear statement to this effect before Substantial Completion. Any such tools required will become the property of the Owner.

3.3.2 Installation and Operating Instructions

System logic diagrams, configuration drawings, and schematics will be bound in a separate volume of the instruction manual and shipped within two months of system shipment. Drawings will be 11" x 17."

The installation and operating instruction books will be complete to provide necessary details for the installation, operation, and maintenance of all control systems and equipment furnished for the Project. Refer to section on Documentation for the detailed requirements for the Instruction Books and Operating Manuals.

3.4 Continuous Emissions Monitoring System

The Project will include a continuous emissions monitoring system (CEMS) for the Project fully compliant with all Project permits. As a minimum, a CEMS will consist of a continuous duty, remote type analyzer subsystem with an extractive probe sampling system for each of the common stack for grouped generating units and a common data acquisition system. A maximum of two analyzer subsystems may be installed in one CEMS shelter.

The CEMS will be complete in all respects while meeting the requirements of this section. The Contractor will develop the EPA and any local monitoring plans, which will be subject to Owner's review.

The system will be designed to comply with the Quality Assurance Procedures of 40 CFR Part 75, Appendix B. In addition, the system will be designed to comply with all applicable EPA installation, performance, testing, quality assurance procedures, and requirements set for the in 40 CFR Part 60, as well as all applicable requirements of state and federal air quality permits.

The CEM system will be a complete and tested system ready for reliable commercial operation. Failure of any system component or control will be alarmed at the data logger in the control room.

Contractor will provide one analyzer/data logger for a maximum of 3 engines. In addition, one spare analyzer/data logger will be included (not installed) for the entire plant. Data loggers can all feed one data acquisition system (DAS). Contractor will provide a backup CEM server/DAS PC, and a separate CEMS workstation to provide data to operations in the control center. Contractor will locate the DAS PC near the CEMS data loggers. Data loggers will store 4 days of 1-minute data and 7 days of hourly data.

3.4.1 Analyzer Subsystem

Each generating unit's analyzer subsystem will consist of one sample transport system and one set of continuous emissions monitors for the following flue gas constituents. The Project will include all analyzers in accordance with Applicable Laws, which include the following:

- Nitrogen oxides (NOX) – dual range (low and high level)
- Oxygen (O2)
- Carbon monoxide (CO)

The system will be sized and constructed to provide a transit time from the stack probe to the analyzer no greater than 6 minutes. This transit time will including the time the analyzer requires to achieve a stable reading after a 95 percent step change in sample value in both the upscale and downscale directions (re: 40 CFR Part § 75, App. A § 6.4 Cycle Time Test criteria).

All of the analyzers, data logger, and manual control switches for each unit will be housed in a single standard 19-inch rack. Rack space will not be shared between generating unit systems. The space for pumps, filters, chillers, and other items may be shared between unit systems, but each item must be clearly identified by unit.

In addition, the CEMS shall monitor and report urea and fuel gas flows.

The CEMS will be complete with analyzers, data logging, calibration gases, etc. At Substantial Completion, the Contractor will furnish a 6-month supply of certified gases in rechargeable cylinders for each flue gas constituent to be monitored. This includes calibration gases for the daily zero and span calibrations, and the low, medium and high range linearity gasses. Each gas cylinder will be supplied with an appropriate two-stage regulator and will be connected to the sample transport system. All tubing on the exterior of the CEMS building will be 316 stainless steel tubing or tubing with a stainless steel jacket. These cylinders will become the property of the Owner and remain on the Project site. Spare parts for both CEMS and Data Acquisition System will be provided.

3.4.2 Sample Transport System

Separate sample transport systems will be provided for each generating unit that would have emissions. A separate umbilical bundle will be provided for each unit. This umbilical bundle will be self-limiting heat traced and contain all cable and tubing required to connect the stack probe to the CEMS. Each umbilical will be long enough to reach from the probe to the termination point in the CEMS shelter without splicing.

The heat tracing for each umbilical bundle will be the temperature-controlled type and will be an integral part of the umbilical. A temperature controller will be provided inside the CEMS shelter for this heat tracing.

Sample probes will have a sufficient length to meet EPA requirements and to obtain a representative sample. Heated probes and the necessary provisions to prevent failure due to moisture or other flue gas constituent will be supplied. If required by the equipment manufacturer, automatic probe cleaning will be furnished. Automatic probe cleaning will be controlled through the CEMS data logger.

Provisions for source testing will be provided including test ports, test platforms, ladders and test probes.

3.4.3 Stack Gas Monitoring Equipment

Stack gas analyzers will have a proven track record in meeting EPA requirements on multiple units.

3.4.4 CEMS Data Logger

CEMS will include all hardware, software, and configuration needed to provide a system that meets all requirements of 40 CFR Part 75 and local air district regulations and permit conditions.

The Dataloggers must be Ethernet capable and accessible via a Local Area Network.

3.4.5 CEMS Enclosure

The Project will include sample conditioning system, analyzers, power supply system, and lighting in a CEMS enclosure/shelter. The enclosure/shelter will be sturdy and suitable for power plant application. The enclosure/shelter will be walk-in, dust-tight, and weather-tight and built in accordance with the local building code requirements.

The CEMS enclosure/shelter will have one HVAC system as defined in the Mechanical HVAC section.

The analyzers and data-loggers will be connected to the plant UPS.

A maintenance switch will be provided to allow manual calibrations. The maintenance switch will provide a signal to the Data Logger as being in 'Maintenance Mode.' Only when the maintenance switch is active will the manual calibration valves and switches be energized.

3.4.6 Documentation

Installation, operating, and maintenance instructions will be provided by the Contractor for each item in the CEMS system and building. These instructions will be provided both in hardcopy and on a CD-ROM. Hardcopy manuals may be scanned into Adobe Acrobat 3.0 or later and then included on the CD-ROM. Classroom and hands-on training will be provided.

3.4.7 Shipping

The complete CEMS will be shipped to the site assembled with all the CEMS apparatus, analyzer subsystem, sample transport system, and interior shelter features mounted in place.

3.4.8 Factory Checkout

The Contractor will check the CEMS at the factory before it is shipped to the site to ensure that the CEMS meets all EPA requirements before shipment.

3.4.9 Data Acquisition System

The Contractor will provide a complete data acquisition system (DAS) with software and hardware. The DAS, which will fully comply with all applicable requirements of 40 CFR Part 75 as well as local air district regulations and Project permit requirements, will be capable of being located in the Project's main control room, or at other location on-site as specified by Owner. It will be capable of interfacing with the data logger on that Project site. The system will collect, store, calculate, edit, display, and print out data and other information as set forth in the requirements that follow.

A second operator workstation computer capable of accessing the polling computer data will be required.

3.4.10 DAS Hardware

The polling computer will include the following items at a minimum:

- A current Intel Core II Duo or equivalent processor, with a minimum 2 GB RAM, 32X CD ROM, 4 mm tape backup, 250-GB hard drive, CD RW drive, 64MB AGP video, Ethernet card, and 56K modem.
- 19-inch video display terminal, high-resolution color flat screen monitor (VGA or superior - 1600 x 1200 at 75 Hz-26mm dot pitch).
- Report printer
- All interconnecting cables.
- Full duplex Ethernet connectivity/capability for Project LAN connection.

The workstation computer will include the following items at a minimum:

- A current Intel Core II Duo or equivalent processor, with a minimum 2 GB RAM, 32X CD ROM, 4 mm tape backup, 250-GB hard drive, CD RW drive, 64MB AGP video, Ethernet card, and 56K modem.
- 21-inch video display terminal, high-resolution color monitor (SVGA or superior - 1600 x 1200 at 75 Hz-26mm dot pitch).
- Report printer
- All interconnecting cables.
- Full duplex Ethernet connectivity/capability for Project LAN connection.

The workstation computer, LCD, printer and other equipment will be mounted on a workstation/desk with an accompanying printer stand. This workstation will be in its own space in the Project control room.

3.4.10.1 Software

The system program will provide the following features:

- Multi-task operation such that data can be collected in background mode allowing report generating or data editing in foreground mode.
- Printer backup such that a printer failure will not cause the program to stop. All printer output is to be stored, so that when the printer is ready, the system will print in sequence all reports generated during the time the printer was unavailable.
- Auto-restart such that should a system failure occur, it would automatically restart itself when the failure is cleared. This feature eliminates the need for any manual reloading of the system program.
- Editing of all data on reports such that the revised data will be included in any requested report, unless otherwise specified.

- Internal clock/calendar with automatic leap year and operator-controllable daylight savings time adjustments.
- Keylock feature to limit access to program parameters using multi-level passwords.
  - One level for operators to call up reports
  - One level for engineers to edit report
  - One level for technicians for diagnostics, etc.
- Ability to download data in ASCII format.
- Capability of expanding if other emission monitoring points or types is added.
- Program backup on a CDROM for reloading should the system fail. The actual source code should be supplied in hard copy format.
- Software with standard REASONS CODES
- Video display terminal, to provide
  - Real-time view of all measured and calculated parameters
  - Engine (each) monitor status
  - Visual alarm indication of potential emission standard violations, excessive monitor calibration drift, or monitoring system failure
  - Graphics & trending
- Hourly data transfer to the non-volatile memory or C hard drive and then daily transfer to the D hard drive.
- Software to support remote interrogation by modem
- Users Manual based on Owner specific software
- Calculations, record keeping, reporting, bias adjustment, automatic data substitution procedures, and other requirements set forth in 40 CFR Part 75.
- CEM's Data Acquisition System software will be the Contractor's standards and will, to the maximum possible extent, comply with the requirements of this specification.

3.4.10.2 Data Communications System

Fiber optic cable will be used between the polling computer and each data logger. This cable will be installed in its own conduit. Communication cables may be coax cable.

The Contractor will provide all fiber optic modems and telephone connections required for the Project to interface with Owner's data communication system at the designated connection points.

3.4.10.3 Reporting and Recordkeeping Requirements

The data acquisition system will automatically compute and cause to have printed all information required pursuant to Applicable Laws and Applicable Standards.

3.4.10.4 Quality Assurance and Quality Control Data

The data acquisition system will be required to record and maintain data pertaining to daily and periodic monitor calibrations and checks and all other monitoring data quality assurance and quality control procedures. The records generated and maintained will be sufficient to satisfy all applicable quality assurance and quality control provisions of 40 CFR Part 75 and 40 CFR Part 60.

Data will be recorded daily for each gaseous pollutant, dilutent, and flow monitor, as applicable.

Periodic testing and certification procedures are required to assure monitoring data quality. The data to be recorded periodically for each gaseous pollutant, dilutent, and flow monitor, as applicable, will meet all applicable requirements of 40 CFR Part 75 and 40 CFR Part 60.

At requested intervals, such as quarterly, the CEMS will be capable of producing reports based on edited and unedited data. The data acquisition system will compute and cause reports to be printed, when requested by the operator. The data processor will be designed to store sufficient data to produce these reports. Power supply failure will not erase the stored data or the program.

The data acquisition system will be capable of compiling and generating quarterly reports pursuant to the requirements of 40 CFR Part 75, and 40 CFR Part 60, as applicable, and of any applicable state regulations, and as required by Owner's air quality permits. The data acquisition system will be capable of producing these reports in printed and electronic format suitable for submission per the Project reporting requirements.

3.5 Balance-of-Plant Instrumentation Installation Criteria and Installation Details

3.5.1 Scope of Specification

The following criteria cover the general requirements for the installation of instrumentation and control systems.

The scope of work covered by this specification includes, but is not limited to, installation and support of field instruments, instrument impulse lines, pneumatic signal lines, sample lines, and local instrument cabinets.

The use of eyewash stations and showers will be alarmed in the DCS/PLC.

No primary sensor full-scale signal level, other than thermocouples, will be less than 10 mV or greater than 125 V.

To the extent practical, instrumentation will be standardized.

Instrument analog signals for electronic instrument systems will be 4 to 20 mA dc. Instrument analog signals for pneumatic instrument systems will be 3 to 15 psig.

Use of pneumatic controls will be limited to applications where sub-supplier standard designs cannot be provided without them.

The following units of measurement will be used in process measurement and control. English units are preferred, but metric units may be used when in common practice:

Parameter	Units of Measurement
Temperature	degrees Fahrenheit (^{o}F)
Pressure	pounds per square inch gauge (psig) inches of water column (in wc) or (inH_2O) pounds per square inch absolute (psia) inches of mercury absolute (HgA)
Level	
General	Percent
Tank Gauge	Gallons
Deviation from normal level	
Flow	
Liquids	gallons per minute (gpm) pounds per hour (pph or #/hr)
Gases and Vapors	Standard cubic feet per minute at 60 ^{O}F (SCFM) Standard cubic feet per hour at 60 ^{O}F (SCFH)
Solids	pounds per hour (pph or #/hr) tons per day (tpd)
Water Sampling	
pH	pH (pH Units)
Specific conductivity	µS/cm
Cation conductivity	µS/cm
Degassed cation conductivity	µS/cm
Dissolved oxygen	parts per billion (ppb)
Silica or sodium	parts per billion (ppb)
Oxygen scavenger	parts per billion (ppb)
Sulfate, phosphate, chloride	parts per billion (ppb)

Permanently attached stainless steel tags will be purchased with all major instrument equipment. Each tag will carry the item tag number. This tag is in addition to the nameplate, which provides the manufacturer's model number and other data.

Thermocouple and test wells will have the material of construction stamped on the well. If tag numbers are assigned to these wells, the number will also be stamped on the well.

Instruments in vapor or gas service will generally be mounted above the sensing point. Instruments in liquid, steam, or condensable vapor service will generally be mounted below the sensing point. If accessibility, visibility, or clearance requirements preclude either of these situations, provisions will be made in the instrument piping configuration to ensure proper operation of the instrument. Close-coupled line-mounted pressure and temperature gauges are mounted above the sensing point and are excluded from the aforementioned.

Instrument root valves at piping or equipment connections will be accessible from grade, platform, stairway, or permanent ladder. Indicating instruments that must be visible for automatic control adjustment or manual operation will be visible from the adjustment or operating point. If plot or piping arrangement precludes this, other provisions will be made for indication at the adjustment or operating point. Indicating instruments not in the above category will be visible from operating aisles or passageways.

Instruments will be located so that required clearances are maintained for walkways, accessways, and operation and maintenance of valves and equipment.

Blind transmitting instruments will generally be line-mounted as near the sensing point as practical. Instruments will not be line-mounted when temperature or vibration from hydraulics or operating equipment will affect the operation of the instruments or cause damage to instrument piping.

Local recording and/or control instruments, except displacer-type level controllers and flange-mounted transmitters, will generally be remote mounted at grade or outside platform handrails.

When practical, remote-mounted instruments will be grouped and have common supports. Instrument piping will generally be routed through pipeways and areas provided for the routing of plant piping, and the piping will be routed such as to protect it from damage during plant operation and maintenance. Routing of instrument piping will be controlled by the Field Control Systems Supervisor or Engineer.

Instrument piping will be supported from pipe supports, pipe, and any other permanent structure, except as follows:

- Instrument piping will not be supported from uninsulated hot (125°F and above) or cold (40°F and below) pipes.
- Instrument piping supports will not be welded to stress-relieved equipment or internally lined equipment. Instrument piping supports will be sufficient to maintain the piping in a neat manner. Instrument process piping having horizontal runs greater than 5’-0” or combined horizontal and vertical runs greater than 10’-0” will be supported. The maximum length of unsupported tubing at a bend will be 4’-0”.

All instruments and instrument process lines subject to freezing will be heat traced, filled with seal fluid, and purged or otherwise protected from freezing. Preference will be given to heat-traced sensing lines and heated enclosures. The instruments and process lines will be identified on the P&IDs.

3.5.2 Instrumentation Electrical Requirements

Enclosures for electrical instruments will comply with requirements of the Electrical Area Classification in which they are installed. If the manufacturer of certain instruments cannot provide enclosures suitable for the area, purging of the enclosure with inert, dry air or gas will be given consideration. Cases for locally mounted instruments and devices will be weatherproof as a minimum.

Terminals for electrical interconnections including thermocouple wire will be clearly identified to indicate polarity, electrical ground where applicable, and test connection. Terminals for purchased items will normally be identified in accordance with manufacturer’s standard marking.

Electrical conduit connections for locally mounted instruments will normally be internally threaded, where available as manufacturer’s standard option. Connections will be suitable for the Electrical Area Classification in which the instrument is installed.

3.5.3 Pressure Instruments

Main process pressure gauge case sizes will be 4.5 inches; Standard OEM gauges may vary from 4.5 inches.

Connections will normally be 0.5-inch MNPT for 4.5-inch locally mounted gauges. Receiver gauges and 1.5 to 2.5-inch gauges will be 0.25 inch NPT.

Wherever necessary for Project operation, either industrial-type, 4.5-inch diameter pressure gauges with white face and black scale markings or indicating pressure transmitters will be provided.

Dials will be white, non-rusting metal or plastic with black figures. Manufacturer's standard dial faces will be provided. Dials or pointers will be field adjustable for zero alignment. These requirements do not apply to 1.5-inch and 2-inch gauges.

Pressure gauges on process piping will generally be visible 10 feet from an operator's normal stance at floor level and will be resistant to Project atmospheres.

Main pressure gauge accuracy will be ±0.5 percent of full range per ANSI Specification.

B40.1, Grade 2A. Standard OEM gauges may vary from these requirements. Pressure devices on pulsating services will be equipped with pulsation dampers.

Pressure devices subject to shock during equipment starts, stops or transient conditions will be installed on an isolated gauge panel.

In general, pressure instruments will have linear scales with units in psig.

Fire protection system pressure gauges will be designed in accordance with Underwriters Laboratories (UL) standards.

Pressure test points will be equipped with isolation valve and cap or plug.

Pressure gauges will be provided with either a blow-out disk or a blow-out back. Alternately, separate safety valves may be used.

Pressure gauges will have acrylic or shatterproof glass faces.

Differential pressure instruments will normally be of the manometer type, either liquid-filled, bellows, or force-balance type according to requirements.

Pressure gauge elements in contact with process fluid will normally be 316 stainless steel, except where the process requires a special material. Elements above 1,000 psig will be bored instead of drawn with threaded and backwelded connection to the socket and tip. Bronze elements will normally be used for air service.

Sockets and tips will be stainless steel for stainless steel bourdon tubes, and brass for bronze bourdon tubes, in accordance with manufacturer's standards.

Overpressure protection will be 1.3 times the maximum tube rating to prevent permanent set or loss of calibration from continuous overpressures. For services of 0 to 60 psi and below, wide bourdon tubes will be furnished with external gauge protectors. Gauges will be vacuum protected.

Ranges will be so specified that the gauges normally operate in the middle third of their scales. Gauges on pump discharges will be specified for over-range protection beyond the pump shut-in pressure or relief valve setting. Gauges on vessels will be specified for overrange protection not less than 1.2 times the vessel design pressure.

Cases for gauges in the process area and in process service will be solid front, phenolic with a screwed ring, or plastic turret type with a snap ring. Outdoor cases will be weatherproof, and metal cases will be protected with weather-resistant black paint. Indoor instruments (inside buildings) are not required to have weatherproof cases.

Weep holes will be provided on the case bottom of all gauges located in humid areas unless the case already has sufficient ventilation.

Diaphragm protectors will be used where necessary to protect gauges from corrosive fluids. They will have 0.5-inch NPT screwed or flanged connections in accordance with piping specifications.

3.5.4 Temperature Instruments

Temperature elements and dial thermometers will be protected by thermowells except when measuring gas or air temperatures at atmospheric pressure. Temperature test points will be equipped with thermowells fitted with caps or plugs.

Dial thermometers will have 5-inch diameter (minimum) dials and white faces with black scale markings and be every-angle type and bimetal actuated. Dial thermometers will generally be visible 10 feet from an operator's normal stance at floor level (viewing area) and be resistant to Project atmospheres.

If a thermocouple is inaccessible, the leads will be brought to an accessible junction box. Thermocouples (if used) will be dual-element, ungrounded, spring-loaded, Chromel-Constantan (ANSI Type E) or Chromel-Alumel (ANSI Type K) for general service.

Thermocouples general application will normally be magnesium-oxide insulated sheathed type. Thermocouple will be constructed with a 316SS sheath of 0.25-inch diameter.

Thermoelectric properties, temperature limits, and limits of error of thermocouples and thermocouple extension wires will conform to ANSI Standard MC 96.1.

Identification of thermocouples will be by a wired-on metal tag indicating the code or tag number.

Thermocouple heads will be the cast aluminum type with an internal grounding screw. Conduit connection will be 0.75-inch. Connection to the thermocouple assembly will be 0.5-inch NPT.

In general, temperature instruments will have scales with temperature units in degrees Fahrenheit. Exceptions to this are electrical machinery resistance temperature detectors (RTDs) and transformer winding temperatures, which are in degrees Celsius.

RTDs will be either 100-ohm platinum type or 10-ohm, copper, three-wire circuits (R_{100}/R_0-1.385), and ungrounded. The element will be spring-loaded, mounted in a thermowell, and connected to a cast aluminum head assembly.

Thermal-filled system instruments will be gas or liquid filled stainless steel capillary type. Material will be a minimum of ANSI Type 304 stainless steel machined from bar stock in a tapered configuration. Other materials may be specified as required by the piping specifications. The alloy used will meet the process metallurgical requirements.

The temperature process connections will be 1-inch NPT where screwed connections are allowed by the piping classification. Where flanged connections are required by the piping classification, they will be designed to mate against a 1.5-inch raised face or ring joint flange in accordance with the piping specifications. Weld in thermowells will be at least 1-inch diameter.

Special protecting tubes for high temperature applications of chrome iron, incoloy, or other special materials will be used as required by the temperature and the process materials.

Thermowells in combining streams will be a minimum of 10 pipe diameters downstream of the junction for liquid services and 30 pipe diameters for vapor services.

Brass plug and chain will be provided with all test wells.

Thermowells will be designed to avoid root stress failure due to vibrations induced by wake vortices. Where the standard thermowell is designed to withstand the maximum fluid velocity permitted in the piping design standards, individual wake frequency calculators are not required.

Dials of 3-inch diameter may be used in mechanical equipment lube and seal oil service or other auxiliary service.

Installation of thermocouples, thermowells, test wells, and thermometers will be in accordance with utility and good engineering practice unless otherwise specified.

3.5.5 Level Instruments

Reflex-glass, liquid-free, or magnetic level gauges (Penberthy or equal) will be used. Sump pump motors will be controlled by displacer or float-type level switches supplied by the sump pump manufacturer.

Level transmitters for measuring the level in storage tanks vented to atmosphere will generally be the flange-mounted differential pressure type flush diaphragm and will be equipped with local indication as well as central control room indication.

Differential pressure type level instruments will normally be used for all services except for vacuum services. When differential pressure type instruments are to be mounted at or below the taps, they will be furnished with zero elevation or suppression adjustment.

External displacement type instruments will normally conform to the following:

- Material will normally be fabricated carbon steel, with stainless steel displacer and Inconel torque tube. Where vessels are of alloy construction, body material will be equivalent or better.
- Air fins or heat insulators will be used at operating temperatures above 400°F and below 0°F for displacers with pneumatic pilots. Where displacers with electronic transmitters are used, they will have air fins or heat insulators above 250°F and below 0°F.
- Connections will normally be 1.5-inch flanged with bottom-side and top-side connections. Flange ratings will be in accordance with vessel trim specification.
- Rotatable heads will normally be specified. Transmitter Output will be 4 to 20 ma dc.

Direct operated type level controls (e.g. ball float, mechanically linked valve) will be used on utility service only.

Special level problems will arise periodically and will require special level measuring devices such as internal displacers or floats, bubblers, and electronic types (capacitance, ultrasonic, nuclear, conductive, or electrical resistance).

3.5.5.1 Liquid Level Columns (Bridles)

Liquid level bridles will be used to minimize the number of vessel nozzles where numerous level instrument connections are made to the same vessel

The bridle upper connection will be flooded with process fluid for interface measurements

The top and bottom connections of the bridle will be made directly to separate nozzles that are not connected to vessel inlet or outlet nozzles.

The bottom connection of the level bridle will be located a minimum of 2 inches higher than the top of the vessel outlet when vessel discharges from the bottom.

Level bridle piping will not have bends that will trap dirt or water.

3.5.5.2 Storage Tank Instruments

Tape gauges will be provided.

Water tanks will be equipped with flange-mounted level transmitters with local indication. Fuel tanks will be equipped with flange-mounted smart transmitters and a servo-controlled displacer gauge or approved equal.

Tanks containing fuel and hazardous material will have instrumentation that can be tested without draining of contents.

3.5.6 Level Gauges

Typically, magnetic follower-type level gauges will be provided except for steam drum and supplier skids. Supplier skids will use the supplier's standard devices where suitable for heavy

industrial use. Where glass gauges are provided by skid suppliers, gauge and ball checks will be provided.

All vessels other than storage tanks, where actual level or interface level is measured for indication or control, will have a level gauge.

Alloy construction (normally 304 stainless steel) will be used for all wetted parts where the application requires it, and on applications below 20°F.

Frost protection will be provided where operating temperatures are below 32°F.

Visibility will cover the operating range of the level instrument(s). In alarm and shutdown service, the visibility will normally cover the range of all level instruments including the shutdown point. Level glasses will be visible from grade, platform, or the related instrument.

Connections of gauge glasses will normally be 0.5-inch or 0.75-inch NPT female top and bottom. Other connection orientations may be used where required.

Where necessary, level glass cocks will meet vessel trim specifications and will be considered a combination block valve and safety shut-off cock. They will have a 0.75-inch solid-shank NPT male inlet with 0.5-inch or 0.75-inch NPT female spherical union gauge connection. A ball check will be furnished.

Where standard gauge valves do not comply with the applicable piping standard, gate valves and ball check valves will be substituted. The gate and check valves will be installed in the horizontal line to the vessel, with tees provided for vents and drains.

3.5.7 Flow Elements – Flow Nozzles and Venturis

Flow transmitters will be the differential pressure type with the range matching (as closely as practical) the primary element.

Linear scales and charts will be used for flow indication and recording.

Differential-pressure-type instruments will normally be used for flow measurements where suitable for the application.

Flow transmitters will be the essentially zero volume displacement differential pressure type. Bodies will normally be carbon steel with stainless steel internal trim, unless other materials are required for the particular services. Overrange protection equal to the body rating will be provided.

Wherever possible, the maximum differential range in inches of water will not exceed the static absolute pressure in psia in a compressible fluid application. Span will be continuously adjustable over at least a 5:1 ratio.

Variable area flow meters may be used for small flow rates where local indication is required. They may also be used where rangeability, nonlinearity, viscosity, or the hazardous nature of the fluid makes the differential-pressure-type instrument unsatisfactory. They will normally be the armored type with magnetic pick-up, except for water and air below 200 psig and 1-inch-or-

smaller lines where glass tubes may be used. All glass tube area meters will have front and rear plastic guard plates.

Positive displacement meters will be used to measure those flows where a highly accurate integrated flowing quantity is desired.

3.5.8 Flow Elements – Orifice Plates

Orifice plates of the square-edged concentric type will be specified except where unsatisfactory for the application. Plate dimensions will conform to ASME MFC-3M. Weep holes will be provided in steam and gas flow installations where there is possible condensation or in liquid flow where there is possible gas entrainment. Materials will normally be Type 304 stainless steel unless special materials are required for the service.

For gas and vapor service, the differential pressure range in inches of water normally will not exceed the static absolute pressure in psia.

Orifice bores will be calculated using ASME MFC-3M and ISO 5167.

Flange taps will normally be used in accordance with ASME MFC-3M. For special alloys and 14-inch-and-larger pipe sizes, in 150-psi classification, throat taps may be used.

One-half-inch NPT is the normal tap size for 300 psi through 600 psi flange rating.

Three-quarter-inch is the tap size for 900 psi through 2,500 psi flange rating. Where threaded connections are not permitted by the pipe class, socket weld connections will be used.

The minimum orifice flange rating will be 300 psi ANSI except for lines 14 inches and larger, where 150 psi ANSI is the minimum. The use of higher rated flanges, or of facing type, will be as called for in piping specifications.

Ring-type plate holders will be manufacturer's standard plate mounting. Ring facing will be oval ANSI standard unless otherwise required by piping specifications.

Orifice taps for horizontal pipe runs will normally be oriented horizontal for clean liquids and steam, and vertical-up for gases.

Venturi tubes, low-loss tubes, and flow nozzles will be used where high-pressure recovery is necessary and/or where only low inlet pressure is available.

Averaging pitot tubes will be used where the pipe diameter is too large for acceptable orifice plate design in applications such as pump minimum flow bypass control, or where normal straight pipe requirements are not met. The element may have two pipe diameters of straight pipe upstream and downstream mounted in a plane parallel to the maximum disturbance.

Other types of flow elements should be considered where their use is desirable and the above-mentioned elements are not applicable.

Integral orifice meters (combination primary element-measuring device) will normally be used for meter runs of less than 1.5 inches with a suitable strainer upstream of the meter.

Eccentric type orifice plates will be used for fluids containing two phases. The eccentric-type orifice plates will have the bottom of the orifice bore flush with the bottom ID of the pipe. Eccentric orifice plates will be used only in horizontal runs.

3.5.9 Annunciators, Alarm Switches, and Electrical Devices

Annunciator design will be in general accordance with ISA RP-18.1 “Specifications and Guides for the Use of General Purpose Annunciators.”

Switches and shutdown for alarms and interlock systems will be used for on-off applications only. When outdoor installations are required, they will meet the area classification and be weatherproof. Switches in equipment shutdown service, where practical, will be directly connected to the process. Wiring for switches will be two conductors and will not use the common wire technique.

Switch contacts will be specified as two single-pole double-throws (Form C) wherever the double mechanism does not induce unacceptable dead band. However, only one function per enclosure will be specified (i.e., alarm only or interlock only). On shutdown circuits, the second contact on the enclosure may be used for alarm, but proper signal separation will be maintained in the conduit system.

Switch action for alarms, shutdowns, and interlocks will normally be closed circuit at normal operating conditions and open circuit for abnormal condition.

Level switches will normally be the external float cage type with 1-inch NPT socket weld or screwed connections. Body material and rating will conform to piping specifications. Internal trim will be stainless steel unless other materials are required for the service. Level switches in alarm services may be receiver switches when there is a level transmitter as part of the system.

Pressure switches for direct connected process and utility service will normally be diaphragm or bourdon-tube type with materials suitable for the service. They will meet the required electrical classification and will have micro switches. Connection sizes will normally be 0.5-inch NPT.

Temperature switches, locally mounted in Division 1 or 2 locations, will be filled system bulb type or expansion type. They will meet the electrical classification and will have micro switches. Separable sockets will be furnished. Temperature switches mounted in the central control room or on a local panel will normally be thermocouple actuated with cold-junction compensation and be completely adjustable.

Flow switches for direct operation by process fluids may be of the sight flow, rotameter, or paddle type for low accuracy requirements. Orifice plate and differential-pressure type will be used for high accuracy requirements.

Solenoid valves will normally be used as pilots to actuate other instruments directly connected to process fluids. Valve bodies for solenoid valves will follow the piping specifications when used in process lines. Manufacturer’s standard brass will normally be used on air service.

When outdoor installations are required, they will meet the area classification and will be weatherproof. Preferred voltage rating is 120 Vac. Coils for solenoid valves will be hi-temp

molded and encapsulated and specified for continuous duty at rated voltage and frequency. Coils for direct current will be supplied with internal spike suppressors.

3.5.10 Process Analyzers and Analyzer Systems

This section does not apply to CEM's.

All analyzers are to be completely piped, interconnected, and checked out for proper functional operating conditions.

Complex process stream analyzer systems will be installed in a waterproof cabinet, enclosed house, or shelter. These will include the following provisions:

- Enough working space will be allowed for proper maintenance of the analyzers within the house.
- Analyzer houses and cabinets will be of metal or fiberglass construction and equipped with a door, lock, and key.
- These enclosures will be located as close to the process sample points as practical. More than one analyzer measuring and sample system may be installed in a single enclosure if the sample line length is within the analyzer manufacturer's specifications.

All necessary calibration and operating gases will be provided including gas cylinders and regulators. CEMS equipment will be according to manufacturer's recommendations.

- Analyzers requiring gases for continuous operation will be provided with dual facilities for uninterrupted service.
- Calibration standards and facilities will be supplied for zero and span check where specified.
- Protected outdoor storage racks adjacent to the analyzer houses will be provided for the carrier and calibration gas cylinders (including inventory) and their associated regulators. Process sample regulators will also be located on the outside of the analyzer houses.

The sample systems will be designed to deliver clean, representative samples to the analyzers at the proper temperatures, pressures, physical conditions, and flow rates.

- All wetted components will be 316 stainless steel, or equivalent, unless other materials are required to minimize contamination and corrosion. Main line class pipe may be used in high-temperature samples.
- Appropriate measures will be taken to prevent plugging of sample lines due to freezing, condensation, or solids.
- Where sample recovery systems are required, provision for drains will be made in the building design.
- Transportation time from sample point to analyzer will be less than 2 minutes for chromatographs and less than 1 minute for other analyzer types. Fast circulating loops and/or bypass lines will be used to achieve fast response times except where such a design would cause EPRI guidelines to be violated or sample composition to be changed.

- For fuel gas samples, the pressure will be reduced at the sampling point to increase the velocity through the sample system and reduce time lag (except in CEMS equipment where the manufacturer's recommendation are to be followed).
- All sample and bypass lines will have flow indicators, such as rotameters.
- Bypass flows and discarded samples will be routed to chemical safe drains or vented safely to atmosphere.
- Adequate facilities will be provided to protect against unwanted backflow, overpressure, or other abnormal conditions.
- When sample conditioning components require heating, they will be located inside a heated and insulated cabinet or enclosure.

The analyzer and sample system will be vendor assembled and pretested in the vendor's shop before shipment, unless otherwise specified.

Electrical wiring of analyzers will conform to the National Electrical Code and applicable local codes. For large instruments such as analyzers that cannot be mounted in an explosion-proof box, air purging may be required. ISA RP-12.4 should be followed. If possible, the analyzer houses should be mounted in nonhazardous areas.

Process control loops that include an analyzer will normally be cascaded. In some cases where the analyzer output is continuous and not delayed, direct control may be provided.

- Holding circuits will be provided when the analyzer output is intermittent. The output of this device may be used for trend recording in addition to providing a signal for a control loop.
- Converters to provide a current or pneumatic output will be provided if required.

Reciprocating engine non-control measurements will be available through the DCS/PLC, if possible. Such information will include the following:

- Bearing metal thermocouples
- Bearing drain thermocouples
- Generator RTDs
- Non-contacting vibration probes

3.5.11 Pressure and Temperature Switches

Field-mounted pressure and temperature switches will be provided in either NEMA Type 4 housings or housings suitable for the environment.

In general, switches will be applied such that the actuation point is within the center one-third of the instrument range.

3.6 Instrument Air and Service Air Systems

Branch headers will be provided with a shutoff valve located at the takeoff from the main header. The branch headers will be sized for the air usage of the instruments served, but will be

no smaller than 3/8 inch. Each instrument air user will have a shutoff valve and filter located at the instrument. Each service air user will have a shut-off valve.

Instrument air of suitable quality will be provided for calibration of CEMS oxygen analyzers.

A minimum of 10 service air connections will be provided around the Project – locations will be coordinated with the Owner.

3.7 Field-Mounted Instruments

Where practical, field-mounted instruments will be grouped together. They will be mounted in areas accessible for maintenance and relatively free of vibration and will not block walkways or prevent maintenance of other equipment.

Field-mounted instruments will be of a design suitable for the area in which they are located. Freeze protection will be provided as required.

Individual instrument supports will be prefabricated, off-the-shelf, 2-inch pipe stand type. Individual field instrument sensing lines will be run in horizontal and vertical lengths that do not affect signal response.

In general, local control loops will use a locally mounted indicating controller (pressure, temperature, and flow).

In general, liquid level controllers will be the indicating, displacement type with external cages.

Instrument racks and individual supports will be mounted to concrete floors, to platforms, or on support steel in locations not subject to excessive vibration.

3.7.1 Instrumentation - General Design

All instruments and equipment will be installed in a manner that ensures reasonable protection against mechanical damage, wetting, and extremes of heat or cold. Instrumentation will be handled at all times so as to protect it from damage to the internal mechanisms. Instrumentation will be stored in accordance with the manufacturer's recommendations until installation. Final locations and orientations must be selected for accessibility, repair, and calibration in place, for easy access to the rear of the instruments

(if needed), and for disconnection without resorting to cutting, burning, or welding.

Instrument supports will not be mounted on or connected to handrails, stairways, or machinery or to any equipment subject to movement under load.

All pipe-mounted temperature and pressure indicators and bridle-mounted level gauges will be mounted so as to provide direct visual readings from operating decks and accessibility for maintenance. If pipe-mounted instruments are subject to freezing, they will be appropriately freeze protected.

Electronic process transmitters will be two-wire.

Temperature, pressure, and differential-pressure transmitters, switches, and transducers will be mounted on either stands or racks or in local instrument cabinets as long as instruments are properly protected, including environmental protection (heat traced). Instruments that can be logically grouped will be installed on racks or in local instrument cabinets. Instrumentation, accessories, and all other equipment will be located and mounted such that calibration, maintenance, and removal work can be performed on any one piece of equipment without disturbing another. Adequate clearance will be provided so that calibration, adjustments, and connections are easily accessible without need of instrument removal. All instrument covers will be provided with adequate clearance space for removal. Equipment will be arranged such that work can be performed easily, without need for special tools.

Instruments and manifold valves will be easily accessible for calibration. All pressure and differential-pressure transmitters will be installed with instrument manifolds. All differential transmitters will be installed with three-valve or five-valve manifolds. Two valve manifolds will be used for all static pressure transmitters.

Orifice flanges and flow nozzles or venturis will be oriented such that taps are horizontal, neither above nor below the centerline of the pipe. Flow orifice plates will be installed only after applicable piping has been flushed or blown down.

Each pressure connection, except for relief valves, will have a root valve. Double block and bleed valves are required for relief valves that would require an entire plant outage to service. Each temperature connection will have a well that will withstand the maximum system pressure and whose velocity rating to withstand vibration exceeds the maximum fluid velocity to which the well may be subjected. Thermocouple material will be compatible with the main process pipe material.

All external electrical connections of junction boxes and cabinets will be made to terminal blocks. The wiring and terminal blocks for different voltage classes will be physically separated in order to minimize electrical noise and hazard to personnel. Terminal blocks will be provided with marker strips.

Instruments will be mounted in a manner that prevents vibration effects. Snubbers or other suitable damping devices will be provided for pulsating services.

3.7.2 Instrument Cabinets and Local Control Panels

3.7.2.1 Local Instrument Cabinet Installation

Instrument cabinets will be secured to structural steel or to concrete. Cabinets will be electrically grounded. Bolting to bare or galvanized metal will be used for attaching a ground strap.

Instrument cabinets will have sufficient clearances for the required blowdown piping and headers, door swing radius, etc., and the cabinets will be completely accessible for maintenance.

The cabinets will be installed and anchored in place so that they are level, plumb, and properly aligned in accordance with the above mounting requirements.

Cabinets will not be supported by handrails. All instrument line penetrations into instrument cabinets will be through bulkhead fittings (couplings). Bulkhead couplings will be supplied on instrument cabinets for each instrument location. Top entry of instrument cabinets or instrument cabinet junction boxes is prohibited. Bottom entry is the preferred method for conduits.

3.7.2.2 Local Instrument Cabinets

Local instrument cabinets will be constructed of high-quality galvanized commercial 12 gauge sheet steel plate or stainless steel, flat and free of pitting. All cabinet sections will be continuous with no weld joints. Welding will join seams between assembled sections. Cabinet doors will have 3-point latches.

The cabinets will be provided with thermostatically controlled heaters and fully insulated for freeze protection and humidity control. The cabinets will be designed to maintain an inside temperature of 30°F with an ambient temperature of 0°F.

Each cabinet will contain an instrument air supply bulkhead. All instrument air supply lines will contain tubing valves for isolation purposes. Every air supply will contain a valved outlet for maintenance uses.

3.7.2.3 Cabinet Painting and Coating

All sheet steel used in the construction of the cabinets (except stainless steel) will be suitably painted.

3.7.2.4 Instrument and Control Wiring and Instrument Cabinet Wiring

Instrumentation and control wiring will be installed in accordance with the requirements of the Electrical section.

Both ends of each wire will be identified with labels that are indelibly imprinted on heat-shrunk plastic tubing. Wire identification will consist of a from-to device identifier.

3.7.2.5 Painting and Coating

Where galvanized coating has been removed or degraded due to cutting, welding, scratches, etc., it will be refinished to original manufacturer's specifications.

The Contractor will touch up all equipment finish paint coats damaged while under the control of the Contractor. The Contractor will use paint of the original specification color and finish.

3.7.2.6 Marking

The Project will include stamped stainless steel tags for process root valves, each instrument, and panel or cabinet.

3.7.3 Instrument Tubing and Piping

3.7.3.1 Instrument Tubing

Tubing usage will be permitted for the following applications:

- Inside local instrument cabinets
- At a pneumatically-operated final control element
- Sample lines
- When properly protected and supported from root valve to instrument

All tubing will be ASTM 213 type 316 stainless steel (except in acid service), both seamless and annealed and properly rated for temperature and pressure applications. Copper tubing will be ASTM B-75 and will be permitted only for instrument air service inside instrument cabinets and (individual) branch applications.

Tubing will be installed so that sags and low spots are avoided. All tubing cuts will be made with a roller-type tubing cutter and will be deburred. All tubing bends will be made with an approved mechanical bender to avoid flattening of the bends.

All tubing fittings will be compression type, Parker Hannifin CPI or Swagelok. The use of flared-type fittings will not be accepted and is strictly prohibited. Pipe dope or Teflon tape will not be used on the tubing-side threads of compression fittings.

Tubing runs requiring support will be run in Tube Track.

Each instrument sensing line will terminate with a main line class blowdown valve mounted adjacent to or below the instrument cabinet.

Instrument sensing lines for draft measurements and other very low-pressure and differential-pressure measurements will be 1-inch minimum O.D. Instrument sensing lines for other pressure and differential pressure measurements will be 0.5-inch minimum O.D. The length of the sensing lines will be kept as short as possible to minimize instrument sensing errors

Tubing used to connect instruments to the process line will be 3/8 inch OD x 0.049 WT seamless soft annealed copper ASTM B-75 (Instrument air service) or 3/8 inch OD x 0.065 WT SS seamless ASTM A-213 or A-269 Type 316 RB 80 Hardness as necessary for the process conditions.

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use and be standardized as much as practical throughout the Project. Differential pressure (flow) instruments will be fitted with three-valve manifolds, while two-valve manifolds will be specified for other instruments as appropriate.

Instrument installation will be designed for correct sensing of process variable. Taps on process lines will be located in such a manner that sensing lines do not trap air in liquid service or liquid in gas service. Taps on process lines will be fitted with a shutoff (root or gauge valve) close to the process line. Root and gauge valves will be main-line class type valves.

Instrument tubing, including freeze protection, will be supported in both horizontal and vertical runs as necessary. Expansion loops will be provided in tubing runs subject to high temperatures. The instrument tubing support design will allow for movement of the main process line.

3.7.3.2 Instrument Piping

Instrument piping, when required for proper protection, will be in accordance with the main process piping design. Instrument pipe wall thickness will be based on the main process pressure and temperature design.

Piping runs will be installed with continuous slopes to process connection or instrument connection as required.

Instrument line pipe will be bent whenever possible.

3.7.3.3 Instrument Tap Installation Criteria

Each instrument tap will have a main line class root valve. Instrument pressure taps in horizontal process piping should generally be mounted on the top centerline where the process is air or gas. When the process is steam or a liquid, instrument pressure taps should generally be mounted on the side centerline of the process pipe. There will not be any instrument taps on the bottom of process lines.

Instrument pressure taps will be located such that there is undisturbed flow in the area of the tap. Thus, there should not be any device or component that could cause flow disturbance for a distance of at least 10 pipe diameters upstream and downstream distances should be no less than one foot.

Thermowells should generally be mounted on the top center line of horizontal process piping. Thermowells should generally be located at least 5 pipe diameters or one foot (whichever is greater) downstream of any instrument pressure tap or flow tap.

3.7.3.4 Piping Supports

Hangers and supports will be located such that sags and low spots in piping are avoided. The design will consider the relative motion that may exist between pieces of equipment due to thermal expansion and/or vibration. The Project will include expansion loops where required.

3.7.4 Air Piping, Fittings, and Pneumatic Devices

All instrument air piping will have low point drains, and all vertical risers will have collection pots and drains.

Instrument air secondary branch headers for the supply of instrument air to analog control equipment will not be used to supply solenoid-valve-operated air cylinders.

An air filter pressure regulator with outlet gauge will be supplied for each individual instrument air user. The air filter pressure regulators will be mounted on the instrument air piping near the end user using a flexible hose connection between the regulator and the end user.

All instrument air piping and tubing will be purged of extraneous material by blowing clean, dry, oil-free air through the system before final connection.

All pipe-threaded fittings will use either Loktite, pipe sealant with Teflon, or Teflon tape to seal the connection. The use of lead-base pipe dope is not acceptable.

3.8 Sampling and Analysis

Grab samples will be used to monitor for any deviation from control limits so that corrective action can be taken.

3.9 Project Siren System

The Contractor will provide a plant siren system, which will provide a sound level minimum of 5dB above ambient levels throughout the plant.

Consideration will be given to which type of loudspeaker is more suitable for the environment to which it will be subjected.

3.10 Instrument Calibration

All field-calibrated instruments will be calibrated per manufacturer's specification after installation at the site. Calibration sheets will be completed and handed over to the Owner for records and for future use. All instrumentation used in testing will be calibrated within 60 days of a test.

3.11 I&C Maintenance Shop Requirements

An I&C shop in the maintenance area will provide for I&C maintenance.

The power feeds to the I&C Shop will not share a breaker with feeds to welding machines or to mechanical equipment in the machine shop.

APPENDIX B.6

CHEMICAL ENGINEERING DESIGN CRITERIA

APPENDIX B.6
CHEMICAL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the Project will be completed in accordance with various predetermined standard practices and project specific programs/practices. An orderly sequence of events for the implementation of the Project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Start-up, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes, standards and general engineering design criteria for the systems storing, handling or otherwise using of chemicals on the Project. These criteria form the basis of the design for these components and systems of the Project. More specific design information will be developed during detailed design to support equipment and erection specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general design criteria for design water quality, chemical conditioning, chemical storage, and waste water treatment.

2.0 DESIGN CODES AND STANDARDS

The design specification of all work will be in accordance with the applicable laws and regulations of the federal government, the State of California, and applicable local codes and ordinances. Codes and standards partially unique to chemical engineering design to be used in design and construction are summarized below.

- ASTM - American Society for Testing and Materials
  - ASTM D1888 - Referee Method B for TDS
  - ASTM D859 - Referee Method B for Silica as $Si0_2$
  - ASTM D888 - Referee Method A for Dissolved Oxygen
  - ASTM D313 - Referee Method D for C02.

- OSHA - Occupational Safety and Health Administration

Other recognized standards will be used as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

3.0 GENERAL DESIGN CRITERIA

3.1 Water Source and Treatment System

An adequate supply source of potable water will be available to support year round plant at full load operation. Source water quality and temperature will be within each application's specified requirements.

For fire protection, the dedicated fire water tank will be sized to meet NFPA requirements, State and Local Code Requirements and the requirements of the Authority Having Jurisdiction. The tank will be constructed of steel and will be coated for corrosion protection. Chlorine or other suitable biocide will be introduced into the tank on a periodic basis to control biological growth. Recirculation of the tank contents tank will be provided to ensure adequate mixing of the chlorine or other suitable biocide. The fire water tank will meet NFPA and local jurisdictional requirements.

A Potable Water Storage Tank will be provided to store Potable water for Plant usages. The Tank and associated water system will be meet all State and Local Code Requirements and the requirements of the Authority Having Jurisdiction.

Adequate chemical storage will be provided for 30 days of operation for all required water treatment chemicals.

3.2 Wastewater Treatment and Disposal

The wastewater system will be designed to collect all waste streams. Equipment drains and floor drains from the chemical feed and water treatment areas will be collected in Waste Water Tanks.

Wastewater containing hydrocarbons will be collected and stored in the Waste Water Tanks. Areas of potentially significant oil spillage will be contained within a curbed area (Also refer to the Civil section).

Periodically, the contents of the Waste Water Tanks will be removed by an approved waste contractor for offsite disposal. Disposal of these wastes will be in accordance with applicable environmental regulations.

The construction Contractor will dispose of all wastes from initial chemical cleaning of equipment and piping. Disposal of these wastes will be in accordance with applicable environmental regulations.

100 percent redundancy will be provided for all critical chemical treatment and wastewater processing pumps, motors and compressors.

Adequate chemical storage for 30 days of operation will be provided.

3.3 Chemical Injection Skids, Chemical Storage, and Bottled Gas Storage

The location of the chemical injection skids, distance to injection points, and line sizing will be considered to ensure appropriate addition of chemicals avoiding long transport times and gassing issues.

Appropriate location in buildings or sunshades will be provided based on the chemical requirements for the chemical storage areas, chemical skids, and transport injection lines.

Bottled gas storage areas will be provided with sunshade covers.

Sunshade covers will consider seasonal changes in solar exposure and daily exposure from sun movement.

APPENDIX B.7

GEOLOGIC AND FOUNDATION DESIGN CRITERIA

APPENDIX B.7
GEOLOGIC AND FOUNDATION DESIGN CRITERIA

1.0 INTRODUCTION

This appendix contains a discussion of site conditions and preliminary foundation design criteria for the Quail Brush Generation Project (Project) to support the Application for Certification (AFC). Geologic hazards discussed include surface faulting potential and seismic ground motions. Soil-related hazards addressed include soil liquefaction, hydrocompaction (or collapsible soils), and expansive soils. Preliminary foundation and earthwork considerations are based on general published information available for the Project area including the recent preliminary geotechnical investigation of the site parcel on which the plant and plant access road will be located, established geotechnical engineering standard of practices, and pertinent codes and regulatory requirements. Once site development details are complete, a final geotechnical investigation will be conducted in order to develop site-specific detailed design specifications.

Information contained in this appendix reflects the codes, standards, criteria, and practices generally used in the design and construction of site and foundation engineering systems for the facility. More specific project information will be developed during execution of the project design. This appendix contains a description of the site conditions, and preliminary foundation-related design, engineering, material procurement, and construction specifications for the Project site. The Project site in this discussion includes the power plant, switchyard and plant access road. Foundation-related design specifications for associated Project linear facilities, including the gen tie and gas lines, and offsite utility switchyard (designed and built by SD&E) will be addressed when details related to their precise location and design become available.

2.0 SITE CONDITIONS

Once constructed, the power plant, switchyard, and access road will permanently occupy approximately 11 acres within a 22-acre vacant parcel (Project site) The Project site is located adjacent to Sycamore Landfill Road approximately 0.35 miles northwest of the intersection of Sycamore Landfill Road and Mast Boulevard in the City of San Diego, San Diego County, California. The Project site is bounded by vacant land to the north with the Sycamore Landfill beyond, vacant land to the east, vacant land and Sycamore Landfill Road to the south, and the Sycamore Landfill Road to the west with a major south trending drainage canyon beyond. Topography within the Project site consists of southwest-trending ridgelines and tributary canyons. Onsite elevations range from a high of approximately 555 feet above mean sea level (amsl) within the northeastern portion of the site to a low of approximately 375 feet amsl within the southwestern portion of the site. The Project site is overgrown with thick, low to medium height weeds, native grasses and brush, and occasional small trees.

A site-specific preliminary geotechnical investigation was performed in June 2011 at the Project site. A copy of the Preliminary Geologic/Geotechnical Investigation Report (preliminary geotechnical report) is included as Attachment 1 to this appendix.

3.0 SITE SUBSURFACE CONDITIONS

Based on the preliminary geotechnical report, development of the Project site as proposed is considered feasible from a geotechnical point of view. The report states the site will be free of hazard from landslide, settlement, and slippage provided the report's conclusions and recommendations are incorporated into the facility design. The report also states the proposed grading and construction will not adversely affect the geologic stability of adjoining properties provided grading and construction are performed in accordance with the recommendations presented in the report.

3.1 Stratigraphy

The low-lying drainage areas of the Project site are underlain by Quaternary-age Alluvial Sediments consisting of layers of gravelly sands and silty clays. Hillside areas are underlain by Tertiary-age sedimentary units; the lower slope regions are underlain by the Eocene-age Friars Formation which consists of clayey siltstones and silty claystones, and the upper slopes and ridge areas are underlain by the Eocene-age Stadium Conglomerate consisting of gravelly silty sandstones. A more detailed discussion of the stratigraphy is presented in the preliminary geotechnical report included as Attachment 1 and in Section 4.16, Geologic Hazards and Resources.

3.2 Seismicity/Ground Shaking

A probabilistic seismic hazard analysis was performed for the Project site in order to determine the ground motions for the Design-Basis Earthquake (DBE). The DBE ground motion was determined by probabilistic methods and defined as having a 10 percent chance of exceedance in 50 years. Based on the DBE, the estimated peak ground acceleration at the site is 0.25g (of gravity). The Maximum Credible Magnitude for the nearby Rose Canyon Fault was chosen by taking one standard deviation above the mean magnitude (Table B.7-1).

Table B.7-1 Magnitude and Ground Acceleration

Maximum Credible Magnitude	Peak Horizontal Ground Acceleration
7.2	0.25g

Structures within the site will be designed and constructed to resist the effects of seismic ground motions as provided in Section 1613 of the 2010 California Building Code (CBC). Preliminary ground motion parameters were calculated for the Project site using a computer program, Earthquake Ground Motion Parameters Version 5.1.0, developed by the United States Geological Survey (USGS 2011). Table B.7-2 presents the seismic design parameters that may be used for design of the proposed structures where appropriate. On the basis of available information provided in the preliminary geotechnical report and proposed development plans, the Project site may be classified as site Class D, stiff soil (based on proposed site grading that will result in fill soils below proposed structures). A description of the local geology and relative location of major earthquake faults in the area are provided in Section 4.16, Geologic Hazards and Resources.

Table B.7-2 2010 CBC Seismic Design Parameters

Parameter	Value
Site Class Definition	D
Ss- Mapped Spectral Response Acceleration, (Ss) for 0.2 second	0.999 g
S1- Mapped Spectral Response Acceleration, for 1.0 second	0.357 g
Fa-Site Coefficient, Short Period	1.1
Fv-Site Coefficient, 1-second Period	1.686
SDs-Design Spectral Response Acceleration, Short Period	1.099 second
SD1-Design Spectral Response Acceleration, Long Period	0.401 second
SMs-Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter	0.574 second
SM1- Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter	0.602 second

Notes:
Calculated using USGS Program "Earthquake Ground Motion Parameters" Version 5.1.0 based on the coordinates latitude 32.85, longitude -117.03.

3.3 Ground Rupture

The Project site is not located within a State of California Earthquake Fault Zone designated by the Alquist-Priolo Special Studies Zone Act of 1972 (SD 2008), an area where the potential for fault rupture is considered probable. Additionally, no Quaternary or Sufficiently Active Faults are located under or near the Project site or the associated linears. Based on this information and engineering judgment, earthquake-induced ground rupture is not considered to be a significant hazard at the Project site.

3.4 Groundwater

Section 4.16 describes the geology of the Project region. The rock and sediment lithologies underlying the site control the occurrence and movement of local ground water. These units do not yield significant ground water (CDR 2003). Groundwater was not encountered in 13 exploratory trenches dug 6 to 12 feet deep during the preliminary geotechnical investigation. Groundwater levels can vary seasonally or with irrigation. With the non-water-bearing rock that underlies it, the Project is not located over any groundwater basin.

4.0 ASSESSMENT OF SOIL-RELATED HAZARDS

4.1 Liquefaction

Liquefaction is a soil condition in which seismically-induced ground motion causes an increase in soil water pressure in saturated, loose, uniformly-graded sands, resulting in loss of soil shear strength. As a result, the effects of liquefaction can include loss of bearing strength, differential settlement, ground oscillations, lateral spreading, and flow failures or slumping. Liquefaction occurs primarily in areas where the groundwater table is within approximately 50 feet of the surface. The City of San Diego Seismic Safety Study (SD 2008) indicates that the Project site is not located in areas prone to liquefaction. This was confirmed by the preliminary geotechnical investigation and supported by the fact that the Project site is underlain by dense bedrock. A small area of the associated Project linear is mapped as an area of low potential for liquefaction. This area is located in Little Sycamore Canyon where the Project linear crosses

over the canyon on the west side of Sycamore Landfill Road. Based on this information and engineering judgment, the potential for liquefaction hazard is considered negligible at the Project site and negligible to low along the Project linear. The potential for liquefaction will be further evaluated as part of the Final Geotechnical Investigation for the Project, and if necessary, design parameters to address identified conditions will be incorporated into the detailed project design.

4.2 Expansive Soils

Expansive soil is predominantly fine-grained and contains clay minerals capable of absorbing water in their crystal structure. It is often found in areas that were historically a flood plain or lake area, but can also be associated with some types of shale, volcanic ash, or other deposits, and can also occur in hillside areas. Expansive soil is subject to swelling and shrinkage, varying in proportion to the amount of moisture present in the soil. As water is initially introduced into the soil (by rainfall or watering), expansion takes place. If dried out, the soil will contract, often leaving small fissures or cracks. Excessive drying and wetting of the soil can progressively deteriorate structures that are not designed to resist this effect, and can lead to differential settlement under buildings and other improvements.

Based on lab data provided in the site-specific preliminary geotechnical report, materials associated with the Stadium Conglomerate exhibit very low to low expansion potential and the materials associated with the Friars formation exhibit a high expansion potential. Due to the potential for distress to building foundations due to the adverse effects of expansion and contraction, it is recommended that all building pads be underlain by soil materials that exhibit low to low expansion potential. Therefore, highly expansive Friars Bedrock Formation materials should not be placed or should be over-excavated within the upper 5 feet of proposed finish grade within building pad areas. The issue of expansive soils will be further evaluated as part of the Final Geotechnical Investigation for the Project, and design parameters to address identified conditions will be incorporated into the detailed project design. Expansive soils are further discussed in Section 4.14, Soil Resources.

4.3 Collapsible Soils

Soil collapse (hydrocompaction) is a phenomenon that results in relatively rapid settlement of soil deposits due to addition of water in arid to semiarid climates. This generally occurs in soils having a loose particle structure cemented together with soluble minerals or with small quantities of clay. Water infiltration into such soils can break down the interparticle cementation, resulting in collapse of the soil structure. Remedial grading recommendations presented in the preliminary geotechnical report include complete removal of soils with loose particle structure (Quaternary Alluvial Soils). Additionally, prolonged wetting of the onsite soils is not expected due to the nature of the proposed development. Therefore, the potential for soil collapse is virtually nil.

5.0 PRELIMINARY FOUNDATION CONSIDERATIONS

5.1 General Foundation Design Criteria

For satisfactory performance, the foundation of any structure must satisfy two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils under maximum design load. Second, settlements during the life of the structure

must not be of a magnitude that will cause structural damage, endanger piping connections or impair the operational efficiency of the facility. Selection of the foundation type to satisfy these criteria depends on the nature and magnitude of dead and live loads, the base area of the structure, and the settlement tolerances. Where more than one foundation type satisfies these criteria, then cost, scheduling, material availability and local practice will probably influence or determine the final selection of the type of foundation.

An evaluation of the information collected for the AFC indicates that no adverse foundation-related subsurface and groundwater conditions would be encountered that would preclude the construction and operation of the proposed structures. The site can be considered suitable for development of the proposed structures in consideration of the geotechnical investigation to support of the engineering design, and using the information to address the preliminary foundation and earthwork considerations discussed in this appendix.

5.2 Foundation Types

The various components of the proposed power plant facility will be supported on the types of foundations recommended in the detailed geotechnical investigations that will be performed for this project. The foundation types may include conventional spread foundations, either individual spread footings, or continuous wall footings, and pile foundations. The site preparation work and foundation selection will be engineered to mitigate any effects of soil shrinkage, expansion, and settlement and lateral spreading from liquefaction. Site preparation work will include, but not be limited to, the removal or mixing of expansive soils and liquefiable layers.

5.3 Corrosion Potential and Ground Aggressiveness

The preliminary geotechnical report indicates that ground water is not anticipated to impact the proposed Project. Subsurface soil material exhibits low sulfate and chloride contents and generally neutral pH. Therefore, special cement and reinforced corrosion prevention measures for concrete will not be required. Resistivity tests conducted to determine the severity of site soil corrosiveness to buried steel indicate that site soils are non-corrosive to buried steel.

6.0 PRELIMINARY EARTHWORK CONSIDERATIONS

6.1 Site Preparation and Grading

Based on the preliminary geotechnical report (included as Appendix K), development of the site as proposed is considered feasible from a geotechnical point of view. The report states the site will be free of hazard from landslide, settlement, and slippage provided the report's conclusions and recommendations are incorporated into the facility design. The report also states the proposed grading and construction will not adversely affect the geologic stability of adjoining properties provided grading and construction are performed in accordance with the recommendations presented in the report.

Site grading of the proposed building pad will require substantial cuts and fills. Maximum fill depths may be on the order of 80 to 90 feet in the canyons, while maximum cuts are expected to be on the order if 50 feet. Compaction standards will be increased from 90 percent to 93 percent relative compaction for all fills placed deeper than 40 feet from the design grade. Canyon cleanouts prior to fill placement may be a deep as 15 to 20 feet due to the presence of

collivium deposits and sidehill slumps in the Friars Formation along the canyon walls. Subdrains will be required beneath all canyon fills.

General structural foundation excavation fill work will be performed as detailed in Section 6.3 below. All soil surfaces to receive fill will be proof rolled with a heavy vibratory roller or a fully loaded dump truck to detect soft areas.

6.2 Temporary Excavations

All excavations will be sloped, or otherwise protected, in accordance with the Occupational Safety and Health Administration requirements.

6.3 Backfill Requirements

All fill material must be free of organic matter, debris, or clay balls, with a maximum size not exceeding 6 inches. Structural fill must also be well graded and granular. Granular material with similar specifications can be used for pipe bedding, except that the maximum size will not exceed 0.5 inch.

Structural fill will be compacted to at least 95 percent of the maximum dry density as determined by American Standard Test Method (ASTM) D 1557 when used for raising the grade throughout the site, below footings or mats, or for rough grading. Fill placed behind retaining structures may be compacted to 90 percent of the maximum dry density as determined by ASTM D 1557. Initially, structural fill will be placed in lifts not exceeding 8 inches loose thickness. Thicker lifts may be used pursuant to approval based on results of field compaction performance. The moisture content of all compacted fill should fall within 3 percentage points of the optimum moisture content measured by ASTM D 1557, except compact the top 12 inches of subgrade to 95 percent of ASTM D 1557 maximum density.

Pipe bedding can be compacted in 12-inch lifts to 90 percent of the maximum dry density as determined by ASTM D 1557. Common fill to be placed in remote and/or unsurfaced areas may be compacted in 12-inch lifts to 85 percent of the maximum dry density as determined by ASTM D 1557.

7.0 INSPECTION AND MONITORING

A California-registered Geotechnical Engineer or Engineering Geologist will monitor geotechnical aspects of foundation construction and/or installation and fill placement. At a minimum, the Geotechnical Engineer/Engineering Geologist will monitor the following activities:

- All surfaces to receive fill will be inspected prior to fill placement to verify that no pockets of loose/soft or otherwise unsuitable material were left in place and that the subgrade is suitable for structural fill placement.
- All fill placement operations will be monitored by an independent testing agency. Field compaction control testing will be performed regularly and in accordance with the applicable specification to be issued by the Geotechnical Engineer.
- All sources of imported fill must be approved by the Geotechnical Engineer.
- The Geotechnical Engineer must approve the foundation design.

8.0 SITE DESIGN CRITERIA

8.1 General

Site grading will be performed in accordance with the recommendations provided in the preliminary geotechnical report. The use of conventional shallow foundations, rigid mats, or structural slab foundations, or combinations thereof, are considered feasible for support of the various structural elements of the facility.

8.2 Datum

Onsite elevations range from a high of approximately 555 feet amsl within the northeastern portion of the Project site to a low of approximately 375 feet amsl within the southwestern portion of the site. The preliminary proposed plant site grade elevation is 465 feet amsl.

9.0 FOUNDATION DESIGN CRITERIA

9.1 General

Foundations (reinforced concrete spread footings, mats, continuous wall foundations, or piles) will be designed consistent with Appendices B.1 and B.2.

Geotechnical design parameters, e.g., allowable soil bearing pressures, lateral bearing, and lateral sliding, for foundation design will be in accordance with the recommendations from the site preliminary geotechnical investigation report (see Attachment 1) and subsequent final geotechnical investigation.

9.2 Groundwater Pressures

Hydrostatic pressures due to groundwater or temporary water loads will be considered.

9.3 Factors of Safety

The factor of safety for structures, tanks, and equipment supports with respect to overturning, sliding, and uplift due to wind and buoyancy will be as defined in Appendix B.2, Structural Engineering Design Criteria.

9.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with Appendix B.2, Structural Engineering Design Criteria.

10.0 REFERENCES

California Building Code, 2010.

California Department of Water Resources (CDR), 2003. California's Groundwater, Bulletin 118. Updated 2003. Available at http://www.water.ca.gov/pubs/groundwater/bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/bulletin118_entire.pdf.

City of San Diego (SD), 2008. Seismic Safety Element, Geologic Hazards and Faults, produced by the Development Services Department, Updated.

United States Geological Survey (USGS), 2011. Ground Motion Parameters Calculator, Available at: http://earthquake.usgs.gov/hazards/designmaps/javacalc.php

APPENDIX B.7

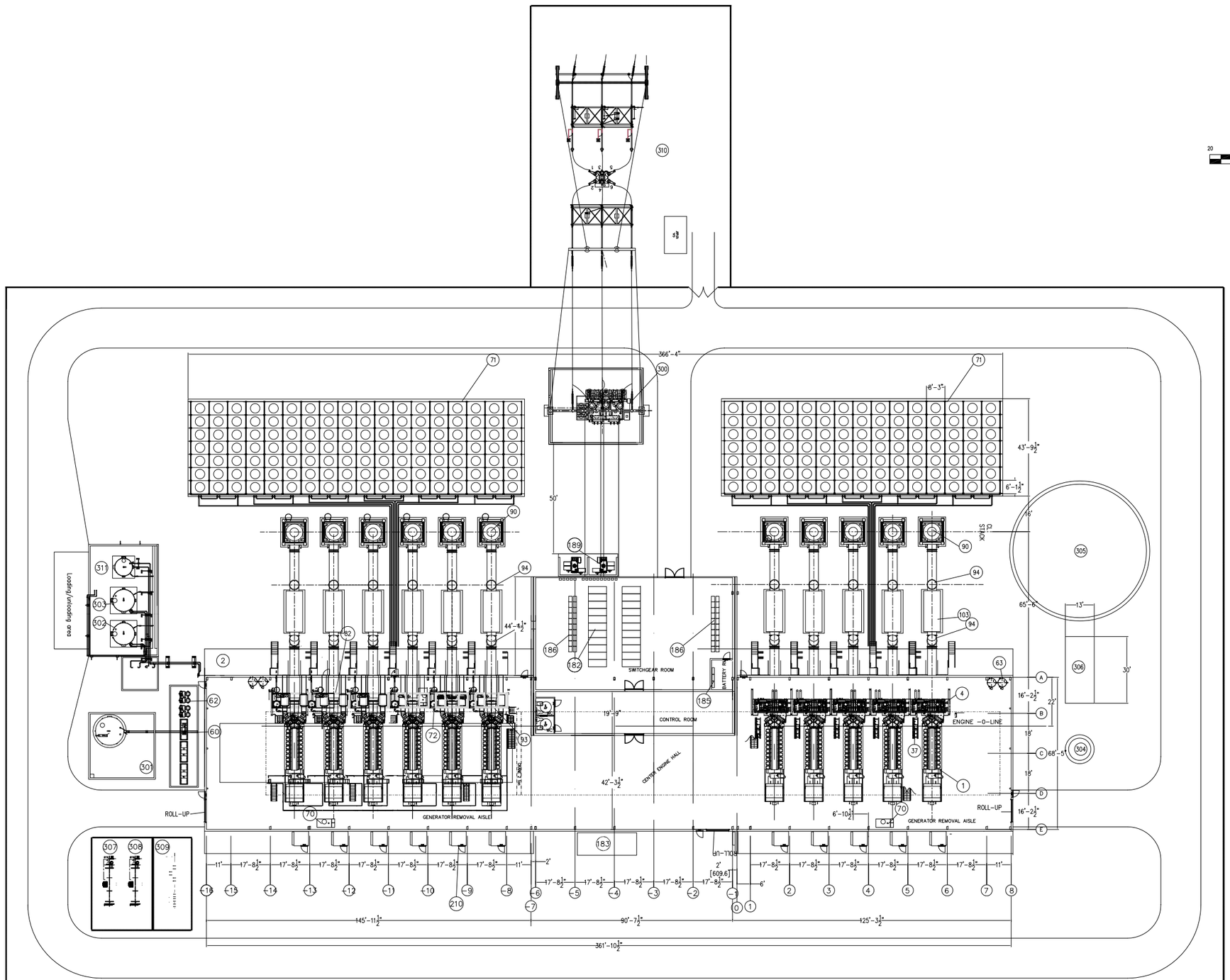
ATTACHMENT 1

PRELIMINARY GEOLOGIC/GEOTECHNICAL INVESTIGATION REPORT

(See Appendix K)

APPENDIX B.8

GENERATION PLANT DETAILS



ENGINE HALL & UTILITY BLOCK

Item No	Pcs.	DESCRIPTION	DESCRIPTION Dia.	Ht.	Cap. (G)
1	11	Engine generator set			
2	1	Engine Hall	–	24'	
4	11	Auxiliary module including:			
		– HT thermostatic valve			
		– LT thermostatic valve			
		– Preheating unit			
37	11	Gas regulating unit			
60	2	Working air unit			
62	2	Starting air unit			
63	10	Starting air bottle 3m3/790 gal			
70	2	Maintenance water tank 4m3/1060gal			
71	2	Radiator Sets		18' H	
72	11	Expansion vessel (Jacket Water) 600l/160gal			
80	22	Charge air filter			
82	11	Charge air & exhaust gas module			
90	11	Exhaust gas Stack	4' ø	100' H	
93	11	Exhaust gas ventilation unit			
94	22	Rupture disc			
103	11	DeNox (SCR)/Oxidation catalyst		25' H	
140	1	Oily water collecting pit			
182	–	MV Switchgear			
183	1	Neutral point cubicle			
185	4	DC-system			
186	–	LV switchgear			
189	2	Station transformer			
210	11	Ventilation unit (enginehall)			
300	1	Main Step-Up Transformer		30' H	
301	1	UreaTank	13' ø	22' H	20,000
302	1	Used Oil Tank	10' ø	20' H	10,000
303	1	New Oil Tank	10' ø	20' H	10,000
304	1	Potable Water Tank	10' ø	20' H	10,000
305	1	Fire Water Tank	60' ø	30' H	600,000
306	1	Fire Water Pumphouse		11' H	
307	1	Warm Start Gas Heater		21' H	
308	1	Cold Start Gas Heater		21' H	
309	1	Natural Gas Metering Station		6' H	
310	1	Facility 230kV Switchyard		52' H Mast	
311	1	Maintenance Oil Tank	8' ø	16' H	6,000

Rev No	Revision	Date	Dwn	Chkd	Approved Chief Engr
A	Initial Issue				
B	Engineering Review and Comments 6/14/11				
C	3rd set of Radiators per Engines Added 7/11/11				

Drawing Control				
Purpose	Approved By	Date	Released By	Date
For Information				
For Comment				
For Bid				
For Construction				

Engineering Review		
Disc	Engr	Date
Mech		
Elec		
Civil		
Arch		
I & C		

Dwn	Chkd	SI
HPK		

Reviewed By

Mgr – Drafting & Design

Cogentrix

Quail Brush
Master Layout Plan

App'd for Construction

Chief Engineer

Date 3/9/11

Scale

Work Order

Drawing No. QB-SP-2

Rev C

APPENDIX B.9

INTERCONNECTION STUDY AGREEMENT

ASSIGNMENT AND ASSUMPTION AGREEMENT

WHEREAS, ENPEX Corporation, a California Corporation ("ENPEX"), made an interconnection request to the California Independent System Operator Corporation a California nonprofit public benefit corporation existing under the laws of the State of California ("CAISO"), that was assigned queue position 565 in the CAISO queue ("Interconnection Request");

WHEREAS, ENPEX entered into a Large Generator Interconnection Study Process Agreement dated April 16, 2010, with the CAISO ("CAISO Study Agreement");

WHEREAS, ENPEX and Cogentrix entered into that certain Amended and Restated Agreement, dated as of February 25, 2011 (the "February Agreement"), which amended and restated that certain Agreement, dated as of February 9, 2011, pursuant to which, *inter alia*, ENPEX assigned the Interconnection Request and the related CAISO Study Agreement to Cogentrix;

WHEREAS, the CAISO consented to the assignment of the CAISO Study Agreement to Cogentrix on the date hereof;

WHEREAS, ENPEX and Cogentrix desire to enter into this Assignment and Assumption Agreement to better effectuate, implement and document the assignments which occurred pursuant to the February Agreement; and

WHEREAS, this Assignment and Assumption Agreement does not, and is not intended to, amend or modify in any respect the obligations, rights, representations and warranties of Cogentrix and ENPEX set forth in the February Agreement, which agreement remains in full force and effect;

NOW THEREFORE, for valuable consideration:

1. ENPEX hereby, to the extent not already assigned by the February Agreement, assigns to Cogentrix all right, title and interest of ENPEX in the Interconnection Request and CAISO Study Agreement.

2. This assignment is accepted by Cogentrix, which agrees, to the extent it has not already so agreed pursuant to the February Agreement, to perform and pay all obligations of ENPEX under, and comply with the terms of, the CAISO Study Agreement.

3. Cogentrix agrees to immediately notify CAISO that this Assignment and Assumption Agreement has become effective.

COGENTRIX ENERGY, LLC,
a North Carolina limited liability company

By: W. L. Felts 9P

Name: William L. Felts

Title: Executive Vice President - Development

Dated: August 12, 2011

THE ENPEX CORPORATION,
a California corporation

By: [signature]

Name: Richard H Hertzog

Title: President

Dated: August 12, 2011

LARGE GENERATOR INTERCONNECTION STUDY PROCESS AGREEMENT

THIS AGREEMENT is made and entered into this 16 day of April, 20 10 by and between ENPEX Corporation, a corporation organized and existing under the laws of the State of California, ("Interconnection Customer,") and the California Independent System Operator Corporation, a California nonprofit public benefit corporation existing under the laws of the State of California, ("CAISO"). The Interconnection Customer and the CAISO each may be referred to as a "Party," or collectively as the "Parties."

RECITALS

WHEREAS, the Interconnection Customer is proposing to develop a Large Generating Facility or generating capacity addition to an existing Generating Facility consistent with the Interconnection Request submitted by the Interconnection Customer dated January 28, 2010; and

WHEREAS, the Interconnection Customer desires to interconnect the Large Generating Facility with the CAISO Controlled Grid; and

WHEREAS, the Interconnection Customer has requested the CAISO to conduct or cause to be performed Interconnection Studies to assess the system impact of interconnecting the Large Generating Facility to the CAISO Controlled Grid and to specify and estimate the cost of the equipment, engineering, procurement and construction work needed on the Participating TO's electric system in accordance with Good Utility Practice to physically and electrically connect the Large Generating Facility to the CAISO Controlled Grid;

NOW, THEREFORE, in consideration of and subject to the mutual covenants contained herein the Parties agree as follows:

1.0 When used in this Agreement, with initial capitalization, the terms specified shall have the meanings indicated in the CAISO's FERC-approved Large Generation Interconnection Procedures in CAISO Tariff Appendix GG ("LGIP") or the Master Definitions Supplement, Appendix A to the CAISO Tariff, as applicable.

2.0 The Interconnection Customer elects and the CAISO shall conduct or cause to be performed Interconnection Studies, including any accelerated Interconnection Study, consistent with the LGIP in accordance with the CAISO Tariff.

3.0 The scope of the Interconnection Studies shall be subject to the assumptions set forth in Appendices A and B to this Agreement.

4.0 The Interconnection Studies will be based upon the technical information provided by the Interconnection Customer in the Interconnection Request, as may be modified as the result of the Scoping Meeting, subject to any modifications in accordance with Section 6.7.2 of the LGIP and modifications to the proposed Commercial Operation Date of the Large Generating Facility permitted by the LGIP. The CAISO reserves the right to request additional technical information from the Interconnection Customer as may reasonably become necessary consistent with Good Utility Practice during the course of the Interconnection Studies. If the Interconnection Customer modifies its designated

Point of Interconnection, Interconnection Request, or the technical information provided therein is modified, the Interconnection Studies may be modified as specified in the LGIP.

5.0 The Interconnection Study report for each Interconnection Study shall provide the information specified in the LGIP.

6.0 The Interconnection Customer shall provide an Interconnection Study Deposit, a Site Exclusivity Deposit, if applicable, and other Interconnection Financial Security for the performance of the Interconnection Studies in accordance with the provisions of Sections 3.5.1 and 9 of the LGIP.

Following the issuance of an Interconnection Study report, the CAISO shall charge and the Interconnection Customer shall pay its share of the actual costs of the Interconnection Study pursuant to Sections 3.5.1 and 7.8 of the LGIP.

Any difference between the deposits made toward the Interconnection Study process and associated administrative costs, including any accelerated studies, and the actual cost of the Interconnection Studies and associated administrative costs shall be paid by or refunded to the Interconnection Customer, in the appropriate allocation, in accordance with Section 3.5.1 of the LGIP.

7.0 Pursuant to Section 3.7 of the LGIP, the CAISO will coordinate the conduct of any studies required to determine the impact of the Interconnection Request on Affected Systems. The CAISO may provide a copy of the Phase I Interconnection Study results to an Affected System Operator and the Western Electricity Coordinating Council. Requests for review and input from Affected System Operators or the Western Electricity Coordinating Council may arrive at any time prior to interconnection.

8.0 Substantial portions of technical data and assumptions used to perform the Phase I Interconnection Study, such as system conditions, existing and planned generation, and unit modeling, may change after the CAISO provides the Interconnection Study results to the Interconnection Customer. Interconnection Study results will reflect available data at the time the CAISO provides the Phase I Interconnection Study report to the Interconnection Customer. The CAISO shall not be responsible for any additional costs, including, without limitation, costs of new or additional facilities, system upgrades, or schedule changes, that may be incurred by the Interconnection Customer as a result of changes in such data and assumptions.

9.0 **[NOT USED]**

10.0 The CAISO shall maintain records and accounts of all costs incurred in performing the Interconnection Study in sufficient detail to allow verification of all costs incurred, including associated overheads. The Interconnection Customer shall have the right, upon reasonable notice, within a reasonable time at the CAISO's offices and at its own expense, to audit the CAISO's records as necessary and as appropriate in order to verify costs incurred by the CAISO. Any audit requested by the Interconnection Customer shall be completed, and written notice of any audit dispute provided to the CAISO representative, within

one hundred eighty (180) calendar days following receipt by the Interconnection Customer of the CAISO's notification of the final costs of the Interconnection Study.

11.0 In accordance with Section 3.8 of the LGIP, the Interconnection Customer may withdraw its Interconnection Request at any time by written notice to the CAISO. Upon receipt of such notice, this Agreement shall terminate, subject to the requirements of Section 3.5.1 and 13.1 of the LGIP.

12.0 Pursuant to Section 4 of the LGIP, this Agreement shall become effective upon the date the fully executed Agreement is received by the CAISO. If the CAISO does not receive the fully executed Agreement and deposit or other Interconnection Financial Security pursuant to Section 3.5.1 of the LGIP, then the Interconnection Request will be deemed withdrawn upon the Interconnection Customer's receipt of written notice by the CAISO pursuant to Section 3.8 of the LGIP.

13.0 Miscellaneous.

13.1 Dispute Resolution. Any dispute, or assertion of a claim, arising out of or in connection with this Agreement, shall be resolved in accordance with Section 13.5 of the LGIP.

13.2 Confidentiality. Confidential Information shall be treated in accordance with Section 13.1 of the LGIP.

13.3 Binding Effect. This Agreement and the rights and obligations hereof, shall be binding upon and shall inure to the benefit of the successors and assigns of the Parties hereto.

13.4 Conflicts. In the event of a conflict between the body of this Agreement and any attachment, appendices or exhibits hereto, the terms and provisions of the body of this Agreement shall prevail and be deemed the final intent of the Parties.

13.5 Rules of Interpretation. This Agreement, unless a clear contrary intention appears, shall be construed and interpreted as follows: (1) the singular number includes the plural number and vice versa; (2) reference to any person includes such person's successors and assigns but, in the case of a Party, only if such successors and assigns are permitted by this Agreement, and reference to a person in a particular capacity excludes such person in any other capacity or individually; (3) reference to any agreement (including this Agreement), document, instrument or tariff means such agreement, document, instrument, or tariff as amended or modified and in effect from time to time in accordance with the terms thereof and, if applicable, the terms hereof; (4) reference to any applicable laws and regulations means such applicable laws and regulations as amended, modified, codified, or reenacted, in whole or in part, and in effect from time to time, including, if applicable, rules and regulations promulgated thereunder; (5) unless expressly stated otherwise, reference to any Article, Section or Appendix means such Article or Section of this Agreement or such Appendix to this Agreement, or such Section of the LGIP or such Appendix to the LGIP, as the case may be; (6) "hereunder", "hereof", "herein", "hereto" and words

of similar import shall be deemed references to this Agreement as a whole and not to any particular Article, Section, or other provision hereof or thereof; (7) "including" (and with correlative meaning "include") means including without limiting the generality of any description preceding such term; and (8) relative to the determination of any period of time, "from" means "from and including", "to" means "to but excluding" and "through" means "through and including".

13.6 Entire Agreement. This Agreement, including all Appendices and Schedules attached hereto, constitutes the entire agreement between the Parties with reference to the subject matter hereof, and supersedes all prior and contemporaneous understandings or agreements, oral or written, between the Parties with respect to the subject matter of this Agreement. There are no other agreements, representations, warranties, or covenants which constitute any part of the consideration for, or any condition to, any Party's compliance with its obligations under this Agreement.

13.7 No Third Party Beneficiaries. This Agreement is not intended to and does not create rights, remedies, or benefits of any character whatsoever in favor of any persons, corporations, associations, or entities other than the Parties, and the obligations herein assumed are solely for the use and benefit of the Parties, their successors in interest and, where permitted, their assigns.

13.8 Waiver. The failure of a Party to this Agreement to insist, on any occasion, upon strict performance of any provision of this Agreement will not be considered a waiver of any obligation, right, or duty of, or imposed upon, such Party.

Any waiver at any time by either Party of its rights with respect to this Agreement shall not be deemed a continuing waiver or a waiver with respect to any other failure to comply with any other obligation, right, duty of this Agreement. Termination or default of this Agreement for any reason by the Interconnection Customer shall not constitute a waiver of the Interconnection Customer's legal rights to obtain an interconnection from the Participating TO or CAISO. Any waiver of this Agreement shall, if requested, be provided in writing.

Any waivers at any time by any Party of its rights with respect to any default under this Agreement, or with respect to any other matter arising in connection with this Agreement, shall not constitute or be deemed a waiver with respect to any subsequent default or other matter arising in connection with this Agreement. Any delay, short of the statutory period of limitations, in asserting or enforcing any right under this Agreement shall not constitute or be deemed a waiver of such right.

13.9 Headings. The descriptive headings of the various Articles and Sections of this Agreement have been inserted for convenience of reference only and are of no significance in the interpretation or construction of this Agreement.

13.10 Multiple Counterparts. This Agreement may be executed in two or more counterparts, each of which is deemed an original but all constitute one and the same instrument.

13.11 Amendment. The Parties may by mutual agreement amend this Agreement by a written instrument duly executed by both of the Parties.

13.12 Modification by the Parties. The Parties may by mutual agreement amend the Appendices to this Agreement by a written instrument duly executed by both of the Parties. Such amendment shall become effective and a part of this Agreement upon satisfaction of all applicable laws and regulations.

13.13 Reservation of Rights. The CAISO shall have the right to make a unilateral filing with FERC to modify this Agreement with respect to any rates, terms and conditions, charges, classifications of service, rule or regulation under section 205 or any other applicable provision of the Federal Power Act and FERC's rules and regulations thereunder, and Interconnection Customer shall have the right to make a unilateral filing with FERC to modify this Agreement pursuant to section 206 or any other applicable provision of the Federal Power Act and FERC's rules and regulations thereunder; provided that each Party shall have the right to protest any such filing by another Party and to participate fully in any proceeding before FERC in which such modifications may be considered. Nothing in this Agreement shall limit the rights of the Parties or of FERC under sections 205 or 206 of the Federal Power Act and FERC's rules and regulations thereunder, except to the extent that the Parties otherwise mutually agree as provided herein.

13.14 No Partnership. This Agreement shall not be interpreted or construed to create an association, joint venture, agency relationship, or partnership between the Parties or to impose any partnership obligation or partnership liability upon any Party. No Party shall have any right, power or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as or be an agent or representative of, or to otherwise bind, another Party.

13.15 Assignment. This Agreement may be assigned by a Party only with the written consent of the other Party; provided that a Party may assign this Agreement without the consent of the other Party to any Affiliate of the assigning Party with an equal or greater credit rating and with the legal authority and operational ability to satisfy the obligations of the assigning Party under this Agreement; and provided further that the Interconnection Customer shall have the right to assign this Agreement, without the consent of the other Party, for collateral security purposes to aid in providing financing for the Large Generating Facility, provided that the Interconnection Customer will require any secured party, trustee or mortgagee to notify the other Party of any such assignment. Any financing arrangement entered into by the Interconnection Customer pursuant to this Section will provide that prior to or upon the exercise of the secured party's, trustee's or mortgagee's assignment rights pursuant to said arrangement, the secured creditor, the trustee or mortgagee will notify the other Party of the date and particulars of any such exercise of assignment right(s). Any attempted assignment that violates this Section is void and ineffective. Any assignment under this Agreement shall not relieve a Party of its obligations, nor shall a Party's obligations be enlarged, in whole or in part, by reason thereof. Where required, consent to assignment will not be unreasonably withheld, conditioned or delayed.

IN WITNESS THEREOF, the Parties have caused this Agreement to be duly executed by their duly authorized officers or agents on the day and year first above written.

California Independent System Operator Corporation

By _____

KEITH E. CASEY, PH.D., VICE PRESIDENT
MARKET & INFRASTRUCTURE DEVELOPMENT

Printed Name and Title

April 1, 2010
Date

ENPEX Corporation

By _____

Richard H Hertzberg
Printed Name

President
Title

April 16, 2010
Date

Appendix A

Large Generator Interconnection Study Process Agreement

ASSUMPTIONS USED IN CONDUCTING THE PHASE I INTERCONNECTION STUDY

The Phase I Interconnection Study will be based upon the information set forth in the Interconnection Request and agreed upon in the Scoping Meeting held on March 19, 2010, subject to any modifications in accordance with Section 6.7.2 of the LGIP, and the following assumptions:

Designation of Point of Interconnection and configuration to be studied:

- **Sycamore – Miguel 230kV Line**

Deliverability status requested **(please select one)**:

☒ Full Capacity RHH

☐ Energy Only

Appendix B

Large Generator Interconnection Study Process Agreement

DATA FORM TO BE PROVIDED BY THE INTERCONNECTION CUSTOMER PRIOR TO COMMENCEMENT OF THE PHASE II INTERCONNECTION STUDY

Generating Facility size (MW): _____

Provide two copies of this completed form and other required plans and diagrams in accordance with Section 7.1 of the LGIP.

Provide location plan and one-line diagram of the plant and station facilities. For staged projects, please indicate future generation, transmission circuits, etc.

One set of metering is required for each generation connection to the new bus or existing CAISO Controlled Grid station. Number of generation connections: _____

On the one line indicate the generation capacity attached at each metering location. (Maximum load on CT/PT)

On the one line indicate the location of auxiliary power. (Minimum load on CT/PT)

Will an alternate source of auxiliary power be available during CT/PT maintenance?
☐ Yes ☐ No

Will a transfer bus on the generation side of the metering require that each meter set be designed for the total plant generation? ☐ Yes ☐ No

(Please indicate on one line).

What type of control system or PLC will be located at the Interconnection Customer's Large Generating Facility?

_____

_____

What protocol does the control system or PLC use?

_____

_____

Please provide a 7.5-minute quadrangle of the site. Sketch the plant, station, transmission line, and property line.

Physical dimensions of the proposed interconnection station:

_____

Bus length from generation to interconnection station:

_____

Line length from interconnection station to the Participating TO's transmission line.

_____

Tower number observed in the field. (Painted on tower leg)*

_____

Number of third party easements required for transmission lines*:

_____

* To be completed in coordination with the Participating TO or CAISO.

Is the Large Generating Facility in the Participating TO's service area?

☐ Yes ☐ No

Local service provider for auxiliary and other power: _____

Please provide proposed schedule dates:

Environmental survey start: _____

Environmental impact report submittal: _____

Procurement of project equipment: _____

Begin Construction Date: _____

Generator step-up transformer receives back feed power Date: _____

Generation Testing Date: _____

Commercial Operation Date Date: _____

Level of Deliverability: Choose one of the following:

☐ Energy Only

☐ Full Capacity

April 1, 2010

Sent via Fedex

Mr. Larry Ellefson
ENPEX Corporation
1329 Stratford Court
Del Mar, CA 92014

Dear Mr. Ellefson,

Enclosed are two (2) partially executed original**s of the Large Generator Interconnection Study Process Agreement (Agreement) for the** San Diego Community Power Project 2 (SDCPP) between ENPEX Corporation and the California Independent System Operator Corporation (CAISO) for execution by ENPEX Corporation.

Please sign, date, and fill in the name and title of the signatory where indicated in the signature block on the signature page of each of the originals and **fill in the date of ENPEX Corporation's execution where indicated on the first line of the Agreement** to note the "entered into" date of the Agreement. You may then return one of the two fully executed and dated originals to my attention at **California ISO, 151 Blue Ravine Road, Folsom, CA 95630**. The 2nd original is for your records. Please submit the executed agreement no later than April 18, 2010, which is within 30 calendar days from the Scoping Meeting held on March 19th, 2010.

If you have any questions please feel free to contact Linda Wright by email at lwirght@caiso.com or by phone at (916) 351-4470

Sincerely,

Julie Balch
Technical Assistant
916-608-5873

Enclosures (2)

cc: Linda Wright, ISO
Cheryl Adler, ISO
Roni Reese, ISO

April 16, 2010

Sent by Internet to lwright@caiso.com and Fed Ex 859691433475

Ms Julie Balch, Technical Assistant
California ISO
151 Blue Ravine Road
Folsom, CA 95630

Dear Ms Balch:

Enclosed you will find one (1) fully executed original of the April 16, 2010 **Large Generation Interconnection Study Process Agreement (Agreement)** for the San Diego Community Power Project 2 (SCPP) between ENPEX Corporation and the California Independent System Operator Corporation (CAISO).

Please note that the executed copy being returned with this letter was marked by the ISO with both Full Capacity and Energy Only selected on Appendix A. We have selected Full Capacity on Appendix A as evidenced by my initials and a circle around Full Capacity.

Thank you for your assistance with this matter.

Sincerely,

Richard H Hertzberg
President

ENCLOSURE Executed original Agreement

Copy: Ms Linda Wright, ISO
Mr. Bill Felts, Cogentrix Energy, Inc.

ENPEX Corporation, 1329 Stratford Court, Del Mar, CA 92014 Tel 858.792.5505 Fax 858.792.7456