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Appendix 2A
Engineering Design Criteria

APPENDIX 2A

Design Criteria

Civil Engineering Design Criteria

Introduction

This appendix summarizes the codes, standards, design criteria, and practices that will be generally used in the design and construction of civil engineering systems for the Stanton Energy Reliability Center (SERC). More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specifications, and construction specifications.

Codes and Standards

The design of civil engineering systems for the project will be in accordance with the laws, ordinances, and regulations of the federal government, State of California, Orange County, and City of Stanton, as well as applicable industry standards. The current issue or edition of the documents at the time of filing this Application for Certification (AFC) will apply unless otherwise noted. In cases where conflicts between the cited documents exist, requirements of the more conservative document will be used.

Civil Engineering Codes and Standards

The following codes and standards have been identified as applicable, in whole or in part, to civil engineering design and construction of power plants:

- American Association of State Highway and Transportation Officials (AASHTO) – Standards and Specifications
- American Concrete Institute (ACI) – Standards and Recommended Practices
- American Institute of Steel Construction (AISC) – Standards and Specifications
- American National Standards Institute (ANSI) – Standards
- American Society of Testing and Materials (ASTM) – Standards, Specifications, and Recommended Practices
- American Water Works Association (AWWA) – Standards and Specifications
- Asphalt Institute (AI) – Asphalt Handbook
- State of California Department of Transportation (Caltrans) Standard Specification
- California Energy Commission (CEC) – Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California, 1989
- Concrete Reinforcing Steel Institute (CRSI) – Standards
- California Building Code (CBC), 2016 (Note: new 2016 code to be issued January 1, 2017)
- Precast Prestressed Concrete Institute (PCI)

Engineering Geology Codes, Standards, and Certifications

Engineering geology activities will conform to the applicable federal, state, and local laws, regulations, ordinances, and industry codes and standards.

Federal

None are applicable.

State

The Warren-Alquist Act, Public Resources Code (PRC), Sections 25000 et seq. and the CEC Code of Regulations, Siting Regulations, Title 20 of the California Code of Regulations (CCR) Chapter 2, require that an AFC address the geologic and seismic aspects of the site.

The California Environmental Quality Act (CEQA), PRC 21000 et seq., and the CEQA Guidelines require that potential significant effects, including geologic hazards, be identified and that a determination be made as to whether they can be substantially reduced.

Local

California State Planning Law, Government Code Section 65302, requires each city and county to adopt a general plan consisting of nine mandatory elements to guide its physical development. Section 65302(g) requires that a seismic safety element be included in the general plan.

The site development activities will require certification by a California Professional Geotechnical Engineer (GE) and a Certified Engineering Geologist (CEG) during and following construction, in accordance with the CBC, Chapter 70. The Professional GE and the CEG will certify the placement of earthen fills and the adequacy of the site for structural improvements, as follows:

- Both the Professional GE and the CEG will address CBC Chapter 70, Sections 7006 (Grading Plans), 7011 (Cuts), 7012 (Terraces), 7013 (Erosion Control), and 7015 (Final Report).
- The Professional GE will also address CBC Chapter 70, Sections 7011 (Cuts) and 7012 (Terraces).

Additionally, the CEG will present findings and conclusions pursuant to PRC, Section 25523 (a) and (c); and 20 CCR, Section 1752 (b) and (c).

Structural Engineering Design Criteria

Introduction

This appendix summarizes the codes, standards, design criteria, and practices that will be generally used in the design and construction of structural engineering systems for the SERC. More specific project information will be developed during execution of the project to support detail design, engineering, material procurement specification, and construction specifications.

Codes and Standards

The design of structural engineering systems for the project will be in accordance with the laws, ordinances, and regulations of the federal government, State of California, County of Orange, City of Stanton, and applicable industry standards. The current issue or edition of the documents at the time of filing of this AFC will apply unless otherwise noted. In cases where conflicts between the cited documents exist, requirements of the more conservative document will be used.

The following codes and standards have been identified as applicable, in whole or in part, to structural engineering design and construction of power plants:

- California Building Code, 2016 Edition
- American Institute of Steel Construction (AISC):
  - Manual of Steel Construction—14th Edition
  - Specification for Structural Steel Buildings, June 22, 2010
  - Specification for Structural Joints Using High-Strength Bolts, December 31, 2009
  - Code of Standard Practice for Steel Buildings and Bridges, August 25, 2010
- American Concrete Institute (ACI):
  - ACI 318-11, Building Code Requirements for Structural Concrete
  - ACI 301-10, Specifications for Structural Concrete for Buildings
- American Society of Civil Engineers (ASCE):
  - ASCE 7-10, Minimum Design Loads for Buildings and Other Structures
- American Society of Mechanical Engineers (ASME)
  - STS-1-2011, Steel Stacks
- American Welding Society (AWS):
  - D1.1-10—Structural Welding Code—Steel
  - D1.3-08—Structural Welding Code—Sheet Steel
  - D1.4-11—Structural Welding Code—Reinforcing Steel
- Code of Federal Regulations, Title 29—Labor, Chapter XVII, Occupational Safety and Health Administration (OSHA):
  - Part 1910—Occupational Safety and Health Standards
  - Part 1926—Construction Safety and Health Regulations
- National Association of Architectural Metal Manufacturers (NAAMM)—Metal Bar Grating Manual
- Hoist Manufacturers Institute (HMI), Standard Specifications for Electric Wire Rope Hoists (HMI 100)
- Institute of Electrical and Electronics Engineers (IEEE) 980 – Guide for Containment and Control of Oil Spills in Substations
- National Electric Safety Code (NESC), C2-2012
- National Fire Protection Association (NFPA Standards)
  - Applicable mandatory provisions of NFPA 850 Fire Protection for Electric Generating Plants
- OSHA Williams-Steiger Occupational Safety and Health Act of 1970
- Steel Deck Institute (SDI)—Design Manual for Floor Decks and Roof Decks
- American Association of State Highway and Transportation Officials (AASHTO):
  - AASHTO LRFD Design Bridge Design Specifications, 4th Edition, 2007, with interim revisions
- Precast Prestressed Concrete Institute (PCI) PCI 120-10, PCI Design Handbook, 7th Edition

CEC Special Requirements

Prior to the start of any increment of construction, the proposed seismic-force procedures for project structures and the applicable designs, plans, and drawings for project structures will be submitted for approval.

Proposed seismic-force procedures, designs, plans, and drawings shall be those for the following:

- Major project structures
- Major foundations, equipment supports, and anchorage
- Large, field-fabricated tanks
- Switchyard structures, including pipe racks
- Bridges (vehicular and pedestrian)

Structural Design Criteria

Datum

Site topographic elevations will be based on an elevation survey conducted using known elevation benchmarks.

Frost Penetration

The site is located in an area considered free of frost penetration. Bottom elevation of all foundations for structures and equipment will be maintained at a minimum of 12 inches below the finished grade per CBC Section 1809.5.

Temperatures

The design basis temperatures for civil and structural engineering systems will be as follows:

- Maximum 112 degrees Fahrenheit (°F)
- Minimum 16°F

Design Loads General

Design loads for structures and foundations will comply with all applicable building code requirements.

Dead Loads

Dead loads will consist of the weights of structures and all equipment of a permanent or semi-permanent nature including tanks, bins, wall panels, partitions, roofing, drains, piping, cable trays, bus ducts, and the contents of tanks and bins measured at full operating capacity. The contents of the tanks and bins will not be considered as effective in resisting structure uplift due to wind forces, but will be considered as effective for seismic forces.

Live Loads

Live load will consist of uniform floor live loads and equipment live loads. Uniform live loads are assumed equivalent unit loads that are considered sufficient to provide for movable and transitory loads such as the weights of people, portable equipment and tools, small equipment or parts that may be moved over or placed on the floors during maintenance operations, and planking. The uniform live loads will not be applied to floor areas that will be permanently occupied by equipment.

Lateral earth pressures, hydrostatic pressures, and wheel loads from trucks will be considered as live loads.

Uniform live loads will be in accordance with ASCE Standard 7, but will not be less than the following:

- Roof—20 pounds per square foot (psf)
- Floors and Platforms (steel grating and checkered plates)—100 psf

In addition, a uniform load of 50 psf will be used to account for piping and cable trays, except that where the piping and cable loads exceed 50 psf, the actual loads will be used.

Furthermore, a concentrated load of 5 kilopounds (kip, or 1,000 pounds-force) will be applied concurrently to the supporting beams of the floors to maximize stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

- Floors (elevated concrete floors)—100 psf

In addition, elevated concrete slabs will be designed to support an alternate concentrated load of 2 kips in lieu of the uniform loads, whichever governs. The concentrated load will be treated as a uniform distributed load acting over an area of 2.5 square feet, and will be located in a manner to produce the maximum stress conditions in the slabs.

- Control or Electrical Enclosure or Module Floor—150 psf
- Stairs, Landings, and Walkways—100 psf

In addition, a concentrated load of 2 kips will be applied concurrently to the supporting beams for the walkways to maximize the stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

- Pipe Racks—50 psf

Where the piping and cable tray loads exceed the design uniform load, the actual loads will be used. In addition, a concentrated load of 8 kips will be applied concurrently to the supporting beams for the walkways to maximize the stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

- Hand Railings—Hand railings will be designed for a 200-pound concentrated load applied at any point and in any direction.
- Slabs on Grade—250 psf
- Truck Loading Surcharge Adjacent to Structures—250 psf
- Truck Support Structures—AASHTO-HS-20-44
- Special Loading Conditions—Actual loadings

Laydown loads from equipment components during maintenance and floor areas where trucks, forklifts, or other transports have access will be considered in the design of live loads.

Live loads may be reduced in accordance with the provisions of CBC Section 1607.

Posting of the floor load capacity signs for all roofs, elevated floors, platforms, and walkways will be in compliance with the OSHA Occupational Safety and Health Standard, Walking and Working Surfaces, Subpart D. Floor load capacity for slabs on grade will not be posted.

Earth Pressures

Earth pressures will be in accordance with the recommendations contained in the project-specific geotechnical report.

Groundwater Pressures

Hydrostatic pressures attributable to groundwater or temporary water loads will be considered.

Wind Loads

The wind forces will be calculated in accordance with CBC 2016 with an ultimate design wind speed of 115 miles per hour and an exposure category of "C." The project's structures are considered risk category III structure based on CBC 2013 Table 1604.5.

Seismic Loads

Structures will be designed and constructed to resist the effects of earthquake loads as determined in CBC 2013, Section 1613. In the absence of geotechnical data and where soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used. The occupancy category of the structure is III (per CBC Table 1604.5), and the corresponding importance factor (I) is 1.25. Other seismic parameters will be obtained from the geotechnical report.

Snow Loads

Snow loads will not be considered.

Turbine-Generator Loads

The combustion turbine generator loads for foundation design will be furnished by the equipment manufacturers, and will be applied in accordance with the equipment manufacturers' specifications, criteria, and recommendations.

Special Considerations for Steel Stacks

Steel stacks will be designed to withstand the normal and abnormal operating conditions in combination with design wind loads and seismic loads, and will include the along-wind and across-wind effects on the stacks. The design will meet the requirements of ASME/ANSI STS-1-2000, "Steel Stacks," using allowable stress design method, except that increased allowable stress for wind loads as permitted by AISC will not be used.

Special Considerations for Structures and Loads during Construction

For temporary structures, or permanent structures left temporarily incomplete to facilitate equipment installations, or temporary loads imposed on permanent structures during construction, the allowable stresses may be increased by 33 percent.

Structural backfill may be placed against walls, retaining walls, and similar structures when the concrete strength attains 80 percent of the design compressive strength (f'_c), as determined by sample cylinder tests. Restrictions on structural backfill, if any, will be shown on the engineering design drawings.

Design restrictions imposed on construction shoring removal that are different from normal practices recommended by the ACI Codes will be shown on engineering design drawings.

Metal decking used as forms for elevated concrete slabs will be evaluated to adequately support the weight of concrete plus a uniform construction load of 50 psf, without increase in allowable stresses.

Design Bases

General

Reinforced concrete structures will be designed by the strength design method, in accordance with the CBC and the ACI 318, "Building Code Requirements for Structural Concrete."

Steel structures will be designed by either using strength design (Load & Resistance Factor Design) or allowable strength design methods, in accordance with the CBC and the AISC Specification for Structural Steel Buildings.

Allowable soil bearing pressures for foundation design will be in accordance with the "Final Subsurface Investigation and Foundation Report" for the facility.

Factors of Safety

The factor of safety for all structures, tanks, and equipment supports will be as follows:

- **Against overturning:** 1.50
- **Against sliding:** 1.50 for wind loads, 1.10 for seismic loads
- **Against uplift due to wind:** 1.50
- **Against buoyancy:** 1.25

Allowable Stresses

Calculated stresses from the governing loading combinations for structures and equipment supports will not exceed the allowable limits permitted by the applicable codes, standards, and specifications.

Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the strength design equations will be determined based on CBC 2016, Sections 1605.2, 1605.3, and ACI-318-11 Section 9.2. The Allowable Stress Design load combinations of CBC 2016 Section 1605.3 will be used to assess soil bearing pressure and stability of structures per CBC 2016 Section 1605.3.

Steel-framed structures will be designed in accordance with CBC 2016, Chapter 22 and the ANSI/AISC 360-10 Specification for Structural Steel Buildings, June 22, 2010. Connections will conform to Research Council on Structural Connections of the Engineering Foundation Specification for Structural Joints.

Construction Materials

Concrete and Grout

The design compressive strength (f'_c) of concrete and grout, as measured at 28 days, will be as follows:

- **Underground electrical duct bank encasement:** 2,000 psi and lean concrete backfill (Class D)
- **Structural concrete:** 4,000 psi
- **Structural grout:** 5,000 psi

The classes of concrete and grout to be used will be shown on engineering design drawings or indicated in design specifications.

Reinforcing Steel

Reinforcing steel bars for concrete will be deformed bars of billet steel, conforming to ASTM A615, Grade 60 or A706, Grade 60.

Welded wire fabric for concrete will conform to ASTM A185.

Structural and Miscellaneous Steel

Structural and miscellaneous steel will generally conform to ASTM A36, ASTM A572, or ASTM A992 except in special situations where higher strength steel is required.

High-strength structural bolts, including nuts and washers, will conform to ASTM A325 or ASTM A490.

Bolts other than high-strength structural bolts will conform to ASTM A307, Grade A.

Concrete Masonry

Concrete masonry units will be hollow, normal weight, non-load-bearing Type I, conforming to ASTM C90, lightweight.

Mortar will conform to ASTM C270, Type S. Grout will conform to ASTM C476.

Other Materials

Other materials for construction (such as anchor bolts, shear connectors, concrete expansion anchors, and embedded metal) will conform to industry standards and will be identified on engineering design drawings or specifications.

Mechanical Engineering Design Criteria

Introduction

This section summarizes the codes, standards, design criteria, and practices that will be generally used in the design and construction of mechanical engineering systems for SERC. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification, and construction specifications.

Codes and Standards

The design of the mechanical systems and components will be in accordance with the laws, ordinances, and regulations of the federal government, State of California, Orange County, City of Stanton, and applicable industry standards. The current issue or revision of the documents at the time of the filing of this AFC will apply unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirements shall apply.

The following codes and standards are applicable to the mechanical aspects of the power facility:

- California Building Standards Code, 2016
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- American Society of Mechanical Engineers (ASME) Pressure Vessel Code
- ASME/ANSI B31.1 Power Piping Code
- ASME Performance Test Codes
- American National Standards Institute (ANSI)
- American Gear Manufacturers Association (AGMA)
- Air Moving and Conditioning Association (AMCA)

- American Petroleum Institute (API)
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- American Welding Society (AWS)
- Heat Exchange Institute (HEI)
- Manufacturing Standardization Society (MSS) of the Valve and Fitting Industry
- National Fire Protection Association (NFPA)
- Hydraulic Institute Standards (HIS)
- Tubular Exchanger Manufacturer's Association (TEMA)

Mechanical Engineering General Design Criteria

General

The systems, equipment, materials, and their installation will be designed in accordance with the applicable codes; industry standards; and local, state, and federal regulations, as well as the design criteria; manufacturing processes and procedures; and material selection, testing, welding, and finishing procedures specified in this section.

Detailed equipment design will be performed by the equipment vendors in accordance with the performance and general design requirements to be specified later by the owner's engineer. Equipment vendors will be responsible for using construction materials suited for the intended use.

Materials—General

Asbestos will not be used in the materials and equipment supplied. Where feasible, materials will be selected to withstand the design operating conditions, including expected ambient conditions, for the design life of the plant. It is anticipated that some materials will require replacement during the life of the plant due to corrosion, erosion, and so on.

Pumps

Pumps will be sized in accordance with industry standards. Where feasible, pumps will be selected for maximum efficiency at the normal operating point. Pumps will be designed to be free from excessive vibration throughout the operating range.

Tanks

Large outdoor storage tanks will not be insulated except where required to maintain appropriate process temperatures or for personnel protection.

Overflow connections and lines will be provided. Maintenance drain connections will be provided for complete tank drainage.

Manholes, where provided, will be at least 24 inches in diameter and hinged to facilitate tank maintenance and inspection. Storage tanks will have ladders and cleanout doors as required to facilitate access/maintenance. Provisions will be included for proper tank ventilation during internal maintenance.

Heat Exchangers

The heat exchangers will be provided as components of mechanical equipment packages and may be air-cooled, or water-cooled shell-and-tube or plate type. Shell and tube-type heat exchangers will be designed in accordance with TEMA or manufacturer's standards. Fouling factors will be specified in accordance with TEMA standards.

Pressure Vessels

Pressure vessels will include the following features/appurtenances:

- Designed to ASME Boiler and Pressure Vessel Code Section VIII
- Process, vent, and drain connections for startup, operation, and maintenance
- Materials compatible with the fluid being handled
- A minimum of one manhole and one air ventilation opening (e.g., hand hole) where required for maintenance or cleaning access
- For vessels requiring insulation, shop-installed insulation clips spaced not greater than 18 inches on center
- Relief valves in accordance with the ASME Code

Piping and Piping Supports

Stainless steel pipe may be Schedule 10S where design pressure permits. Underground water piping may be high-density polyethylene or polyvinyl chloride where permitted by code, operating conditions, and fluid properties. In general, water system piping will be high-density polyethylene or polyvinyl chloride where embedded or used underground. Aboveground piping materials will be selected based on fluid compatibility as well as design pressure and temperature.

Threaded piping joints will not normally be used in piping used for lubricating oil and natural gas services. Victaulic type mechanical couplings may be used for low energy aboveground piping, where feasible.

Piping systems will have high point vents and low point drains.

Hose and process tubing connections to portable components and systems will be compatible with the respective equipment suppliers' standard connections for each service.

Stainless steel piping will be used for portions of lubricating oil system and fuel gas system downstream of the final filters. Carbon steel piping may be used elsewhere.

Valves

General Requirements. Valves will be arranged for convenient operation from ground or platform level where possible and, if required, will have extension spindles, chain operators, or gearing. Hand-actuated valves will be designed to be operable by one person. Gear operators will be provided on manual valves 8 inches or larger as a general rule.

Valves will be arranged to close when the hand wheel is rotated in a clockwise direction when looking at the hand wheel from the operating position. The direction of rotation to close the valve will be clearly marked on the face of each hand wheel.

The stops that limit the travel of each valve in the open or closed position will be arranged on the exterior of the valve body. Valves will be fitted with an indicator to show whether they are open or closed. Only critical valves will be remotely monitored for position.

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 be of cast or forged steel material. 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 operating at less than atmospheric pressure will include means to prevent air in-leakage.
No provision will be made to repack valve glands under pressure.

Drain and Vent Valves. Drains and vents in 600-pound class or higher piping and 900F or higher service will be double-valved.

Low Pressure Water Valves. Low pressure water valves will generally be of the butterfly type and of cast or ductile iron construction. Ductile iron valves will have ductile iron bodies, covers, gates (discs), and bridges; the spindles, seats, and faces will be bronze. Fire protection valves will be Underwriters Laboratories-approved butterfly valves meeting NFPA requirements.

Instrument Air Valves. Instrument air valves will use the ball type of bronze or stainless steel construction, with valve face and seat made of approved wear-resistant alloy.

Motor Actuated Valves. Electric motor actuators will be designed specifically for the operating speeds, differential and static pressures, process line flowrates, operating environment, and frequency of operations for the application. Electric actuators will have self-locking features. A hand wheel and declutching mechanism will be provided to allow hand wheel engagement at any time except when the motor is energized. Actuators will automatically revert back to motor operation, disengaging the hand wheel, upon energizing the motor. The motor actuator will be placed in a position relative to the valve that prevents leakage of liquid, steam, or corrosive gas from valve joints onto the motor or control equipment.

Safety and Relief Valves. Safety valves and/or relief valves will be provided as required by applicable code for pressure vessels, heaters, and boilers. Safety and relief valves will be installed vertically. Piping systems that can be over-pressurized by a higher-pressure source will also be protected by pressure-relief valves. Equipment or parts of equipment that can be over-pressurized by thermal expansion of the contained liquid will have thermal relief valves.

Instrument Root Valves. Instrument root valves will be specified for operation at the working pressure and temperature of the piping to which they are connected. Test points and sample lines in systems that are 600-pound class or higher service will be double-valved.

Heating, Ventilating, and Air Conditioning

Heating, ventilating, and air conditioning (HVAC) system design will be based on site ambient conditions specified in AFC Section 2, Project Description.

HVAC systems are only provided for equipment rooms where needed such as electric equipment / motor control center rooms. These rooms are not designed for human comfort, but rather for the temperature / humidity needs of the equipment. HVAC equipment will typically include wall-mounted-type air conditioning units.

Thermal Insulation and Cladding

Parts of the facility requiring insulation to reduce heat loss or afford personnel safety will be thermally insulated. Minimum insulation thickness for hot surfaces near personnel will be designed to limit the outside lagging surface temperature to a maximum of 140°F.

The thermal insulation will have as its main constituent calcium silicate, foam glass, fiber glass, or mineral wool, and will consist of preformed slabs or blankets, where feasible.

Asbestos-containing materials will not be used. An aluminum jacket or suitable coating will be provided on the outside surface of the insulation. Insulation system materials, including jacketing, will have a flame spread rating of 25 or less when tested in accordance with ASTM E 84.

Insulation at valves, pipe joints, or other points to which access may be required for maintenance will be specified to be removable with a minimum of disturbance to the pipe insulation. At each flanged joint, the molded material will terminate on the pipe at a distance from the flange equal to the overall length of the flange bolts to permit their removal without damaging the molded insulation. Outdoor aboveground insulated piping will be clad with textured aluminum of not less than 30 mil thickness and will be frame reinforced. At the joints, the sheets will be sufficiently overlapped and caulked to prevent moisture from penetrating the insulation.

Design temperature limits for thermal insulation will be based on system operating temperature during normal operation.

Outdoor and underground insulation will be moisture resistant.

Testing

Hydrostatic testing, including pressure testing at 1.5 times the design pressure or as required by the applicable code, will be specified and performed for pressure boundary components where an in-service test is not feasible or permitted by code.

Welding

Welders and welding procedures will be certified in accordance with the requirements of the applicable codes and standards before performing any welding. Records of welder qualifications and weld procedures will be maintained.

Painting

Except as otherwise specified, equipment will receive the respective manufacturer’s standard shop finish. Finish colors will be selected from among the paint manufacturer’s standard colors.

Finish painting of uninsulated piping will be limited to that required by OSHA for safety or for protection from the elements.

Piping to be insulated will not be finish painted.

Lubrication

The types of lubrication specified for facility equipment will be suited to the operating conditions and will comply with the recommendations of the equipment manufacturers.

The initial startup charge of flushing oil will be the equipment manufacturer’s standard lubricant for the intended service. Subsequently, such flushing oil will be sampled and analyzed to determine whether it can also be used for normal operation or must be replaced in accordance with the equipment supplier’s recommendations.

Rotating equipment will be lubricated as designed by the individual equipment manufacturers. Where automatic lubricators are fitted to equipment, provision for emergency hand lubrication will also be specified. Where applicable, equipment will be designed to be manually lubricated while in operation without the removal of protective guards. Lubrication filling and drain points will be readily accessible.

Electrical Engineering Design Criteria

Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of electrical engineering systems for SERC. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement, and construction specifications as required by CEC.

Codes and Standards

The design of the electrical systems and components will be in accordance with the laws, ordinances, and regulations of the federal government, State of California, Orange County, City of Stanton, and applicable industry standards. The current issue or revision of the documents at the time of the filing of this AFC will apply unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement shall apply.

The following codes and standards are applicable to the electrical aspects of the power facility:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- California Electrical Code
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

Switchyard and Transformers

Switchyard

The switchyard will be located on the western end of Parcel 1 of the site and will interconnect via a 0.25-mile-long tie-line to the Southern California Edison (SCE) Barre Substation. The switchyard will be of the aerial conductor cable type and will consist of high-voltage SF_6-insulated dead-tank circuit breakers. Connections to the aerial conductor cable will be provided from a three-winding transformer for the inter-tie to the utility grid via underground conductor cable. The high-voltage circuit breaker will be equipped with a no load break, air-insulated, disconnect switch on each side. An isolating disconnect switch will also be installed in each generator transformer connection to allow generator/transformer isolation when the corresponding generator/transformer is out of service. Aerial conductor cable will be used as the primary interconnection material within the switchyard. The conductors will be attached to post-insulator columns on structural steel supports.

Current and voltage transformers will be located at points within the switchyard to provide for metering and relaying.

Control, protection, and monitoring for the switchyard will be located in the switchyard control enclosure. Monitoring and alarms will be available to the supervisory control system operator workstations in the control module. All protection and circuit breaker control will be powered from the station battery-backed 125-Vdc system.

The switchyard design will meet the requirements of the National Electrical Safety Code—ANSI C2.

A grounding grid will be provided to control step and touch potentials in accordance with IEEE Standard 80, Safety in Substation Grounding. All equipment, structures, and fencing will be connected to the grounding grid of buried copper conductors and ground rods, as required. The substation ground grid will be tied to the plant ground grid.

Lightning protection will be provided by shield wires and/or lightning masts for any overhead lines. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults will be detected, isolated, and cleared in a safe and coordinated manner as soon as practicable for the safety of equipment, personnel, and the public. Protective relaying will meet IEEE requirements and will be coordinated with SCE's requirements.

There will be a 0.25-mile-long generator tie-line to the utility substation 66-kilovolt (kV) bus. The high-voltage circuit breaker will be provided with a breaker failure relay protection scheme. Breaker failure protection will be accomplished by protective and timing relays. The high-voltage breaker will have two redundant trip coils.

Interface with SCE's supervisory control and data acquisition system will be provided. Interface will be at the interface terminal box and remote terminal unit. Communication between the facility switchyard and the control building to which it is connected will be included.

Revenue metering will be provided on the 66-kV outgoing lines recording net power to or from the SCE switchyard (bi-directional). The revenue meters and a metering panel will be located in the switchyard relay room.

Transformers

Both generators will be connected to the 66-kV switchyard through a common 13.8- to 66-kV step-up transformer, each with a generator 15-kV metal-clad vacuum circuit breaker. The step-up transformer will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116. The transformer will be three-winding, delta-wye, ONAN/ONAF/ ONAF, 65°C rise. The neutral point of the HV winding wye-connected winding will be solidly grounded. The main step-up transformer will have metal oxide surge arrestors adjacent to the HV terminals and will have manual de-energized ("no-load") tap changers located in the HV windings.

Facility power will be supplied through unit auxiliary transformers, each connected to the 13.8-kV generator output busses. Two two-winding, delta-wye 13.8- to 4.16-kV transformers with low-impedance grounding resistors will be provided.

Control Engineering Design Criteria

Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and installation of instrumentation and controls for SERC. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specifications, and construction specifications.

Codes and Standards

The design specification of all work will be in accordance with the laws and regulations of the federal government, the State of California, Orange County, and City of Stanton, as well as applicable industry standards. A summary of general codes and industry standards applicable to design and control aspects of the power facility follows:

- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- The Institute of Electrical and Electronics Engineers (IEEE)
- International Society of Automation (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- American Society for Testing and Materials (ASTM)

Control Systems Design Criteria

General Requirements

Electronic signal levels, where used, will be 4 to 20 milliamps for analog transmitter outputs, controller outputs, electric-to-pneumatic converter inputs, and valve positioner inputs.

The switched sensor full-scale signal level will be between 0 and 125 volts.

Pressure Instruments

In general, pressure instruments will have linear scales with units of measurement in pounds per square inch, gauge.

Pressure gauges will have either a blowout disk or a blowout back and an acrylic or shatterproof glass face.

Pressure gauges on process piping will be resistant to plant atmospheres.

Pressure test points will have isolation valves and caps or plugs. Pressure devices on pulsating services will have pulsation dampers.

Temperature Instruments

In general, temperature instruments will have scales with temperature units in degrees Fahrenheit. Exceptions to this are electrical machinery resistance temperature detectors and transformer winding temperatures, which are in degrees Celsius.

Bimetal-actuated dial thermometers will have 4.5- or 5-inch-diameter (minimum) dials and white faces with black scale markings, and will consist of every angle-type. Dial thermometers will be resistant to plant atmospheres.

Temperature elements and dial thermometers will be protected by thermowells except when measuring gas or air temperatures at atmospheric pressure. Temperature test points will have thermowells and caps or plugs.

Resistance temperature detectors will be 100-ohm platinum, three-wire type. The element will be spring-loaded, mounted in a thermowell, and connected to a cast iron head assembly.

Thermocouples will be Type J or K dual-element, grounded, spring-loaded, for general service. Materials of construction will be dictated by service temperatures. Thermocouple heads will be the cast type with an internal grounding screw.

Level Instruments

Reflex-glass or magnetic level gauges will be used. Level gauges for high-pressure service will have suitable personnel protection.

Gauge glasses used in conjunction with level instruments will cover a range that includes the highest and lowest trip/alarm set points.

Flow Instruments

Flow transmitters will typically be of the differential pressure-type. Alternate type flow transmitters may be used where required to ensure high accuracy measurements. In general, linear scales will be used for flow indication and recording.

Magnetic type flow transmitters may be used for liquid flow measurement below 200°F.

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 when suitable for the intended service.

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.

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 in valves of sizes larger than 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 pounds per square inch (psi).

In general, control valves will be specified for a noise level no greater than 85 decibels, A-rated (dBA) when measured 3 feet downstream and 3 feet away from the pipe surface.

Valve actuators will use positioners and the highest pressure, smallest size actuator, and will be the pneumatic-spring diaphragm or piston type. Actuators will be sized to shut off against at least 110 percent of the maximum shutoff pressure and designed to function with instrument air pressure ranging from 80 to 125 pounds per square inch gauge.

Hand wheels will be furnished only on those valves that can be manually set and controlled during system operation (to maintain plant 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. The coil enclosure will normally be a minimum of NEMA 4 but will be suitable for the area of installation.

Valve position feedback (with input to the supervisory control system for display) will be provided for all control valves.

Instrument Tubing and Installation

Tubing used to connect instruments to the process line will be seamless stainless steel for primary instruments and sampling systems.

Instrument tubing fittings will be the compression type.

Differential pressure (flow) instruments will be fitted with three-valve manifolds; two-valve manifolds will be specified for other instruments as appropriate.

Instrument installation will be designed to correctly sense the process variable. Taps on process lines will be located so 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 valves.

Instrument tubing 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.

Pressure and Temperature Switches

Field-mounted pressure and temperature switches will have 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.

Field-Mounted Instruments

Field-mounted instruments will be of a design suitable for the area in which they are located. 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 grouped on racks. Supports for individual instruments will be prefabricated, off-the-shelf, 2-inch pipe stand type. Instrument racks and individual supports will be mounted to concrete floors, to platforms, or on support steel in locations not subject to excessive vibration.

Individual field instrument sensing lines will be sloped or pitched in such a manner and be of such length, routing, and configuration that signal response is not adversely affected.

Liquid level controllers will generally be the nonindicating, displacement-type with external cages.

Instrument Air System

Branch headers will have a shutoff valve 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, filter, outlet gauge, and regulator at the instrument.

Chemical Engineering Design Criteria

Introduction

The purpose of this appendix is to summarize the general chemical engineering design criteria for SERC. These criteria form the basis of the design for the chemical components and systems of the project. More specific design information is developed during detailed design to support equipment and erection specifications. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement specifications, and construction specifications as required by CEC.

Design Codes and Standards

The design specification of all work will be in accordance with the laws and regulations of the federal government, State of California, Orange County, and City of Stanton, as well as applicable industry standards. A summary of general codes and industry standards applicable to chemical aspects of the power facility follows:

- ANSI—American National Standards Institute
- ANSI B31.1—Power Piping Code
- ASME—American Society of Mechanical Engineers
- ASME—Performance Test Code 31, Ion Exchange Equipment
- ASTM—American Society for Testing and Materials
  - ASTM D859-94—Referee Method B for Silica as SiO_2
  - ASTM D888-96—Referee Method A for Dissolved Oxygen
  - ASTM D513-96—Referee Method D for CO_2
- CBSC—California Building Standards Code
- California OSHA—Occupational Safety and Health Administration
- UL—Underwriters Laboratories

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.

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.

General Criteria

Design Water Quality Facility Raw Water Supply

Service water will be provided from a new connection to Golden State Water Company in Dale Avenue.

Potable Water System

Potable water will be provided to the site from a connection to Golden State Water Company in Dale Avenue.

Demineralized Water System

Demineralized water will be produced using a reverse osmosis process followed by ion exchange mixed bed demineralizers. The high-quality demineralized water will be used for the combustion turbine water injection for nitrogen oxides reduction, online water wash, and turbine power augmentation systems. The demineralized water will be stored in a 100,000-gallon demineralized water storage tank, sized for more than 8 hours of storage during peak demand.

The demineralized water will be the highest practical quality and will meet manufacturer's requirements. Minimum quality requirements will be as follows:

Table 2A-1. LM6000 Demineralized Water Purity Requirements

Parameter	Units	Value
Total Solids	ppm	5.0
Total Dissolved Solids	ppm of TDS	3.0
Silica	mg/L as SiO_2	0.1
Conductivity @ 25°C*	micromho/centimeter	0.1
pH*	std. unit	6.5 to 7.5
Chloride	mg/L as Cl-	0.5
Sulfate	mg/L as SO_4^{2-}	0.5

* Measured in the absence of carbon dioxide.

Notes:

°C = degree(s) Celsius
mg/L = milligram(s) per liter
micromho/centimeter = microsiemen(s)/cen
ppm = part(s) per million
SiO_2 = silicon dioxide
TDS = total dissolved solids

Construction Water

Water for use during construction will be supplied from a connection to the Golden State system.

Fire Protection Water

The source of water for plant fire protection needs will be supplied from the Golden State Water Company. Two connections to Golden Stare will be provided for fire water supply reliability: one on the eastern side of the site near Pacific Street and the second on the western side of the site near Dale Avenue. Each connection will be provided with a back flow preventer and detector check. The two connections will be headered together within the site and will be provided with branch isolation valves for overall fire water supply reliability.

Chemical Conditioning

Ion Exchange System Chemical Conditioning

There will be no chemical feed systems that will supply water conditioning chemicals to the ion exchange system. The ion exchange vessels will contain cation resins and anion resins. Regeneration of ion exchange resins will occur offsite at the water treatment vendor's location.

Chemical Storage Capacity

Chemical storage tanks will, in general, be sized to store a minimum of 1.5 times the normal bulk shipment. The minimum acceptable volume of the selective catalytic reduction aqueous ammonia storage tank will provide at least 7 days' storage.

Containment

Chemical storage tanks containing corrosive fluids will be surrounded by curbing. Curbing and drain piping design will allow a full tank capacity spill without overflowing the curbing. For multiple tanks located within the same curbed area, the largest single tank will be used to size the curbing and drain piping. For outdoor chemical containment areas, additional containment volume will be included for stormwater.

Coatings

Tanks, piping, and curbing for chemical storage applications will be provided with a protective coating system. The specific requirements for selection of an appropriate coating will be identified prior to equipment and construction contract procurements.

Wastewater Treatment

Wastewater will be primarily generated from the water treatment reverse osmosis process. The ion exchange demineralizers will not produce wastewater as resin regeneration will occur offsite via contracted vendor.

Wastewater from combustion turbine water washes will be collected in a water wash drains tank. The wastewater will be hauled offsite via contracted disposal vendor.

The plant design will not include a permanent sanitary waste system. Contracted portable toilet/restrooms may be rented as needed.