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Document Title:	Morton Bay Geothermal Project AFC Volume 2 Appendix 2 Project Description
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Submitter Role:	Applicant Consultant
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Appendix 2A
Applicant's Incorporation Documentation and Legal Description

State of Delaware
Secretary of State
Division of Corporations
Delivered 09:47 AM 11/28/2022
FILED 09:47 AM 11/28/2022
SR 20224105350 - File Number 7155137

STATE OF DELAWARE
CERTIFICATE OF FORMATION
OF LIMITED LIABILITY COMPANY

The undersigned authorized person, desiring to form a limited liability company pursuant to the Limited Liability Company Act of the State of Delaware, hereby certifies as follows:

1. The name of the limited liability company is Morton Bay Geothermal LLC.

2. The Registered Office of the limited liability company in the State of Delaware is located at 1209 Orange Street, Corporation Trust Center (street), in the City of Wilimngton, Zip Code 19801. The name of the Registered Agent at such address upon whom process against this limited liability company may be served is The Corporation Trust Company.

By: [signature]
Authorized Person

Name: Rob Berntsen
Print or Type

LEGAL DESCRIPTION

The land referred to herein is situated in the State of California, County of Imperial, City of Calipatria and described as follows:

The Northeast quarter of Section 23, Township 11 South, Range 13 East, San Bernardino Base and Meridian, according to the Official Plat thereof.

Excepting.therefrom the minerals in, on and under the above described property heretofore conveyed by Mineral Deed recorded July 29, 1976 in Book 1390 page 336 of Official Records of Imperial County Records.

Also Excepting therefrom a perpetual production royalty equal to two-thirds of one percent (0.667%) of the steam, superheated brines and other superheated fluids (Geothermal Resources) and a perpetual production royalty equal to two- tenths of one percent (0.2%) of the metals, minerals and other materials (Extractable Byproducts) reserved by Grant Deed recorded March 20, 1989 in Book 1621 page 878, March 20, 1989 in Book 1621 page 891 and re-recorded July 14, 1989 in Book 1628 page 526, March 20, 1989 in Book 1621 page 900, July 25, 1989 in Book 1628 page 1661, all of Official Records of Imperial County Records.

Also Excepting therefrom a perpetual production royalty equal to one percent of the steam, superheated brines and other superheated fluids (Geothermal Resources) and a perpetual production royalty equal to three-tenths of one percent (0.3%) of the metals, minerals and other materials (Extractable Byproducts) reserved by Grant Deed recorded March 20, 1989 in Book 1621 page 913, March 20, 1989 in Book 1621 page 922, March 20, 1989 in Book 1621 page 931, March 20, 1989 in Book 1621 page 940, March 20, 1989 in Book 1621 page 949, March 20, 1989 in Book 1621 page 959, March 20, 1989 in Book 1621 page 968, March 20, 1989 in Book 1621 page 977, July 25, 1989 in Book 1628 page 1652, all of Official Records of Imperial County Records.

APN: 020-100-007

(End of Legal Description)

MAP

THE MAP CONNECTED HEREWITH IS BEING PROVIDED AS A COURTESY AND FOR INFORMATIONAL PURPOSES ONLY; THIS MAP SHOULD NOT BE RELIED UPON. FURTHERMORE, THE PARCELS SET OUT ON THIS MAP MAY NOT COMPLY WITH LOCAL SUBDIVISION OR BUILDING ORDINANCES. STEWART ASSUMES NO LIABILITY, RESPONSIBILITY OR INDEMNIFICATION RELATED TO THE MAPS NOR ANY MATTERS CONCERNING THE CONTENTS OF OR ACCURACY OF THE MAP.

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B1. Foundations and Civil Engineering Design Criteria

1.1 Introduction

The design, engineering, procurement, and construction activities on the project will be in accordance with various predetermined standards and project-specific practices. This appendix summarizes the civil engineering codes and standards, design criteria, and practices that will be used during design and construction. These criteria form the basis of the design for the foundations and civil systems of the project. More specific design information will be developed during the detailed design phase 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 summarizes the applicable codes and standards, and Section 3 includes the general criteria for foundations, design loads, and site work.

1.2 Design Codes and Standards

1.2.1 General Requirements

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 the applicable local codes and ordinances. Except where noted otherwise, the latest issue of all codes and standards, including addenda, in effect at the start of the project will be used, or as otherwise specified by governing agencies. The codes and standards, including all addenda, in effect at the time of purchase will be utilized for material and equipment procurement.

A summary of the codes and the standards to be used in the design and construction follows:

- Seismic standards and design criteria will follow the California Building Code (CBC).
- Specifications for materials will follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI), unless noted otherwise.
- Field and laboratory testing procedures for materials will follow ASTM standards.
- Design and placement of structural concrete and reinforcing steel will be in accordance with the codes, guides, and standards of the American Concrete Institute (ACI) and the Concrete Reinforcing Steel Institute (CRSI).
- Specifications for materials for roads will follow the State of California Department of Transportation Standard Specifications.
- Design and construction of roads will follow the American Association of State Highway and Transportation Officials (AASHTO), the State of California Department of Transportation standards, and California Fire Code (CFC).
- Design and construction of the sanitary sewer system will conform to the California Plumbing Code (CPC).
- Design and construction will conform to the federal and California Occupational Safety and Health Administration (OSHA and CAL-OSHA) requirements.

Other recognized standards will be used where required to serve as guidelines for the design fabrication, and construction.

1.2.2 Government Rules and Regulations

The following laws, ordinances, codes, and standards are applicable to the civil engineering design and construction. In cases where conflicts between cited codes (or standards) exist the requirements of the more stringent code will govern.

1.2.2.1 Federal

- Title 29, Code of Federal Regulations (CFR). Part 1910. Occupational Safety and Health Standards
- Title 29, CFR. Part 1926. National Safety and Health regulations for construction
- Walsh-Healy Public Contracts Act (Public Law [PL] 50-204.10)
- National Pollutant Discharge Elimination System (NPDES) (U.S. Environmental Protection Agency [EPA])

1.2.2.2 State

Business and Professions Code Section 6704, et seq.; Sections 6730 and 6736. Requires state registration to practice as a Civil Engineer or Structural Engineer in California.

- Labor Code Section 6500, et seq. requires a permit for construction of trenches or excavations 5 feet or deeper into which personnel must descend. This also applies to construction or demolition of any building, structure, false work, or scaffolding that is more than three stories high or equivalent.
- Title 24, California Code of Regulations (CCR) Section 2-111, et seq.; Section 3-100, et seq.; Section 4-106, et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6- T8-3233, et seq.; Section 6-T8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6-T8- 5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq. Adopts current edition of CBC as minimum legal building standards.
- State of California Department of Transportation, Standard Specifications
- Title 8, CCR Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq. Describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.
- Regulations of the following state agencies as applicable:
  - Department of Labor and Industry Regulations
  - Bureau of Fire Protection
  - Department of Public Health
  - Water and Power Resources
- Vehicle Code, Section 35780 et seq. requires a permit from Caltrans to transport heavy loads on state roads.
- CPC California Plumbing Code 2022
- Other recognized standards will be used where required to serve as guidelines for design, fabrication, and construction. When no other code or standard governs, the California Building Code (CBC), 2022 Edition will govern.

1.2.2.3 Local

County of Imperial, CA – Planning & Building Department

1.2.3 Industry Codes and Standards

1.2.3.1 American Association of State Highway and Transportation Officials (AASHTO)

A Policy on Geometric Design of Highways and Streets

1.2.3.2 American Concrete Institute (ACI)

ACI 117	Standard Specification for Tolerances for Concrete Construction and Materials
ACI 211.1	Standard Practice for Selecting Proportions of Normal, Heavyweight and Mass Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 302.1R	Guide for Concrete Floor and Slab Construction
ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308	Standard Practice for Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 318.1	Building Code Requirements for Structural Plain Concrete
ACI 347R	Guide to Formwork for Concrete

1.2.3.3 American Society for Testing and Materials (ASTM)

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A116	Standard Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A121	Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens)
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C443	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D3034	Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D3740	Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2.3.4 Concrete Reinforcing Steel Institute (CRSI)

Manual of Standard Practice

1.3 Civil Design Criteria

1.3.1 Foundations

1.3.1.1 General

Geotechnical exploration, testing, and analysis determine the most suitable bearing methods for foundations. Criteria will be established to permit design of the most economical foundation that is compatible with the life expectancy and service of the structure. The results of the subsurface investigation, laboratory testing program, and geotechnical assessment will be performed and will define the design standards.

1.3.1.2 Foundation Design Criteria

Foundations for all critical structures and equipment will be supported on reinforced concrete foundations. The design of reinforced concrete foundations will satisfy the requirements of ACI 318.

Detailed foundation design criteria, including allowable bearing pressures, will be developed based on the results of subsurface investigations.

1.3.1.3 Equipment Foundations

Each piece of equipment will be supplied with a reinforced concrete foundation suitable to its operation. Where the equipment could induce excessive vibration, the foundation will be provided with adequate mass to dampen vibratory motions. Special consideration will be given to vibration and stiffness criteria where specified by an equipment manufacturer. Equipment located within an enclosed building with a grade slab will generally be placed on a concrete pad that is raised above the grade slab to keep the equipment off the floor surface.

Minimum temperature and shrinkage reinforcing steel will be provided for equipment foundations unless additional reinforcement is required by design. Anchor bolts designed to develop their yield strength will be provided for critical equipment. For noncritical or lightly loaded equipment, concrete expansion anchors may be utilized to secure equipment to foundations.

1.3.1.4 Rotating Equipment Foundations

Dynamic behavior will be considered in the design of foundations subjected to significant rotating equipment loads such as foundations for the steam turbine and the brine injection pumps. A dynamic analysis will be performed to determine the natural frequencies and dynamic responses of the foundation. To account for soil and structure interaction, geotechnical data will be used to determine the soil stiffnesses and damping coefficients used in the dynamic analysis.

1.3.2 Design Loads

1.3.2.1 General

Design loads for pavements and buried items will be determined according to the criteria described below unless the applicable building code or local condition require more severe design conditions.

1.3.2.2 Wheel Loads

Loads excited on roadway pavements, buried piping, electrical duct banks, and culverts will be reviewed and selected prior to design of the underlying items. As a minimum, these items will be designed for HL-93 loadings in accordance with AASHTO Standard Specifications. Loadings exceeding the HL-93 loadings will be considered where found applicable during the detailed design phase.

1.3.3 Site

1.3.3.1 Site Arrangement

The site arrangement will conform to all applicable laws, regulations, and environmental standards. The principal elements to be considered in selection of the site arrangement are the physical space requirements and relationships dictated by each of the major plant systems, and the constraints imposed by the physical size and existing topography of the site. Distances from the main plant to various systems will be minimized for economy. However, adequate clearance between various plant systems will be provided as needed for construction, operations, maintenance, and fire protection. The plant will be configured to minimize construction costs and visual impacts while remaining operationally effective. Utility interconnections will be optimized.

1.3.3.2 Site Preparation

Site preparation will consist of clearing and grubbing, the excavation of soils to design grade, and the preparation of fill slopes and embankments designed in such a fashion as to be stable and capable of carrying anticipated loads from either equipment or structures.

Root mats or stumps, tiles if any, will be removed and holes will be refilled with material suitable for embankment and compacted.

1.3.3.3 Earthwork

Earthwork requirements are based on the results of the subsurface investigation . If additional geotechnical data is required for final design the EPC Contractor will be responsible to obtain.

Shallow foundations built on controlled compacted structural fill and natural dense granular soils are expected to provide adequate bearing pressures. Estimated total static settlements and estimated liquefaction induced settlements will be summarized in the Geotechnical Study.

Excavation. Excavation work will consist of the removal, storage, and/or disposal of earth, sand, gravel, vegetation, organic matter, loose rock, boulders, and debris to the lines and grades necessary for construction.

Confined temporary excavations will be sloped or braced to prevent cave-ins during construction. All excavation and trenching operations will comply with local, state, and federal OSHA regulations.

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

Final earth grade adjacent to buildings will be sloped away from the building to maintain proper drainage.

Cut and fill slopes for permanent embankments will be designed to withstand horizontal ground accelerations for seismic design criteria as defined by site specific Geotechnical investigation, this will likely result in flat slopes. Geogrid reinforcement for fill slopes and soil nailing for cut slopes may be used for steep slopes requiring soil reinforcement to resist seismic loading. Slopes for embankments will be no steeper than 2:1 (horizontal: vertical). The grading plan may require the use of retaining walls. These will also be designed for seismic design criteria as defined by site specific geotechnical investigation.

Backfilling and Compaction. 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 in accordance with the Geotechnical Investigation and recommendations.

Structural fill supporting foundations, roads, parking areas, etc., will be compacted as determined by ASTM D698. Embankments, dikes, bedding for buried piping, and backfill surrounding structures will be compacted in accordance with the Geotechnical Investigation and recommendations.

The subgrade (original ground), subbases, and base courses of roads will be prepared and compacted in accordance with California Department of Transportation (Caltrans) requirements or as specified by geotechnical investigation. Testing will be in accordance with ASTM and Caltrans standards.

1.3.3.4 Berm Construction

The existing berm surrounding the site must be raised to an elevation of at least 3.5 feet above the 100-year flood elevation based on new 100-year flood mapping study to protect the site from flooding. This must be accomplished by not infringing on surrounding properties. To accomplish this, it is anticipated that the roads surrounding the property will shift inward toward the site and all slopes will also shift inward toward the site. All imported soil to raise the berms should be a mixture of available soil mixed with Portland cement to provide suitable material that is structurally sound and that will provide the necessary flood protection.

1.3.3.5 Site Drainage

The site drainage system will be designed to comply with all applicable federal, state, and local regulations. Onsite drainage will be accomplished by gravity flow, whenever possible. The surface drainage system will consist of mild slopes and open channels with road culvert crossings. The ground floor elevations and top of foundation of buildings and structures will be maintained at a minimum of 12 inches above the hydraulic grade line of the internal storm drainage network for a 100-year rainfall event. The graded areas away from structures will be at a minimum slope of 1 percent.

Design of the site drainage facilities will be performed in accordance with state and local governmental requirements. Drainage facilities will be designed for the flow resulting from a 50-year 24-hour rainfall. They will also be designed to prevent flooding of permanent plant facilities and overflow of plant roads during a 50-year, 24-hour storm. The flow of storm water within the site will be designed to generally follow the existing flow.

Erosion and Sedimentation Control. The proposed site development will alter the land areas of the site. Existing vegetation will be removed during site preparation operations. This will be followed by the earthwork activities required for construction of specific facilities. Final finish grading will begin when all other earthwork operations are complete.

Erosion and sedimentation control will be provided to retain sediment on site and prevent violations of water quality standards.

1.3.3.6 Roads

Access to the plant site will be from existing public roadways. Access within the plant site will be provided by the asphalt paved loop road that encircles the power block and major equipment in the resource production facility.

Unless otherwise required by Governing agencies, all other plant roads will generally be a minimum of 20 feet in width with an asphaltic cement paved surface.

1.3.3.7 Fencing and Security

Chain-link security fencing will be provided around the facility site, substation, and other areas requiring controlled access. Fencing heights will be in accordance with applicable codes and regulatory requirements. Controlled access gates will be located at the entrances to secured areas.

1.3.3.8 Sanitary Waste System

The sanitary waste system design will conform to the Imperial County regulations and California Plumbing Code.

1.3.3.9 Spill Protection

Spill containment measures will be provided for chemical storage tanks and chemical additive/lube oil skid areas. All other chemical storage tanks will be provided with a containment structure with a volume equal to at least 100 percent of the largest tank capacity plus inches of freeboard. In addition, all outdoor containment structures will have a volume equal to at least the capacity of the tank plus the volume of rainfall from a 100 year, 24 hour storm additional volume from deluge systems or other fire protection measures shall also be considered. Concrete curbs will be provided for chemical additive/lube oil skid areas. Where required for protection of the containment structure, appropriate surface coatings will be provided.

Appendix B2
Structural and Seismic Engineering Design Criteria

B2. Structural and Seismic Engineering Design Criteria

2.1 Introduction

The project design, engineering, procurement, and construction activities will be in accordance with various predetermined standards and project-specific practices. This appendix summarizes the structural and seismic engineering codes and standards, design criteria, and practices that will be used during design and construction. These criteria form the basis for the project structural design work. More specific design information will be developed during 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 summarizes the applicable codes and standards, and Section 3 includes the general criteria for natural phenomena, design loads, materials, seismic design, and architecture. Section 4 describes the structural design methodology for structures and equipment. Section 5 addresses project hazard mitigation.

2.2 Design Codes and Standards

2.2.1 General Requirements

Work will be designed and specified in accordance with applicable laws and regulations of the federal government and the State of California and applicable local codes and ordinances. Except where noted otherwise, the latest issue of codes and standards, including addenda, in effect at the start of the project will be used. The codes and standards, including addenda, in effect at the time of purchase will be used for material and equipment procurement.

A summary of the codes and the standards to be used in design and construction follows:

- Seismic standards and criteria will follow the California Building Code (CBC).
- Specifications for materials will follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI), unless noted otherwise.
- Field and laboratory testing procedures for materials will follow ASTM standards.
- Structural concrete and reinforcing steel will be designed and placed in accordance with the codes, guides, and standards of the American Concrete Institute (ACI) and the Concrete Reinforcing Steel Institute (CRSI).
- Structural steel will be designed, fabricated, and erected in accordance with the American Institute of Steel Construction (AISC)
- Steel components for metal wall panels and roof decking will conform to the American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members.
- Welding procedures and qualifications for welders will follow the recommended practices and codes of the American Welding Society (AWS).
- Metal surfaces for coating systems will be prepared following the specifications and standard practices of the Steel Structures Painting Council (SSPC) and the specific instructions of the coatings manufacturer.

- Masonry materials will be designed and erected in accordance with the ACI Building Code Requirements for Masonry Structures.
- Roof covering design will comply with the requirements of the National Fire Protection Association (NFPA).
- Design and construction will conform to federal and California Occupational Safety and Health Administration (OSHA and CAL-OSHA) requirements.

Other recognized standards will be used where required to serve as guidelines for design, fabrication, and construction. When no other code or standard governs, the California Building Code (CBC), 2022 Edition will govern.

2.2.2 Government Rules and Regulations

The following laws, ordinances, codes, and standards are applicable to structural design and. construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more stringent code will govern. The sections in the California Building Code (CBC) have been quoted throughout this document as reference. These sections are based on the 2022 editions of CBC. However, the latest edition of CBC at the start of the project will apply to the engineering design.

2.2.2.1 Federal

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.
- Title 29, CFR, Part 1926, National Safety and Health regulations for construction.
- Walsh-Healy Public Contracts Act (Public Law [PL] 50-204.10).

2.2.2.2 State

- Business and Professions Code Section 6704, et seq.; Sections 6730 and 6736. Requires state registration to practice as a Civil Engineer or Structural Engineer in California.
- Labor Code Section 6500, et seq. Requires a permit for construction of trenches or excavations 5 feet or deeper into which personnel descend. This also applies to construction or demolition of any building, structure, false work, or scaffolding that is more than three stories high or equivalent.
- Title 24, California Code of Regulations (CCR) Section 2-111, et seq.; Section 3-100, et seq.; Section 4-106, et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6-18-3233, et seq.; Section 6-T8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6-T8- 5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq. Adopts current edition of CBC as minimum legal building standards.
- Title 8, CCR Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq. Describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.
- Regulations of the following state agencies as applicable:
  - Department of Labor and Industry Regulations
  - Bureau of Fire Protection
  - Department of Public Health
  - Water and Power Resources

2.2.2.3 Local

County of Imperial – Planning and Building Department

2.2.3 Industry Codes and Standards

2.2.3.1 American Concrete Institute (ACI)

ACI 117	Standard Specification for Tolerances for Concrete Construction and Materials
ACI 211.1	Standard Practice for Selecting Proportions of Normal, Heavyweight, and Mass Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 302.18	Guide for Concrete Floor and Slab Construction
ACI 304R	Guide for Measuring. Mixing, Transporting. and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308	Standard Practice for Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 318.1	Building Code Requirements for Structural Plain Concrete
ACI 347R	Guide to Formwork for Concrete
ACI 530	Building Code Requirements for Masonry Structures
AC1 530.1	Specifications for Masonry Structures

2.2.3.2 American Institute of Steel Construction (AISC)

Code of Standard Practice for Steel Buildings and Bridges

Manual of Steel Construction

Specification for Structural Steel Buildings

Design Specification for Structural Joints Using ASTM A325 or A490 Bolts

2.2.3.3 American Iron and Steel Institute (AISI)

Specification for the Design of Cold-Formed Steel Structural Members

2.2.3.4 American Society for Testing and Materials (ASTM)

ASTM A36	Standard Specification for Structural Steel
ASTM A53	Standard Specification for Pipe. Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A82	Stranded Specification for Steel Wire, Plain, For Concrete Reinforcement
ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A108	Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel hardware
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A240	Standard Specification for Heat-resisting Chromium and Chromium-Nickel Stainless Steel plate, Sheet and Strip for Pressure Vessels
ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A446	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM B695	Standard Specification for Coatings of Zinc mechanically Deposited on Iron and Steel
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C90	Standard Specification for Load-Bearing Concrete Masonry Units
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C109	Standard Test method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
ASTM C129	Standard Specification for Non-Load Bearing Concrete Masonry Units
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete

ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcinated natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
ASTM C1064	Standard Test method for Temperature of Freshly Mixed Portland Cement Concrete
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
ASTM D1752	Standard Specification for Performed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

2.2.3.5 American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 2 - Alternative Rules

ASME/STS-1, Steel Stacks

2.2.3.6 American Society of Civil Engineers (ASCE)

ASCE 7-16	Minimum Design Loads for Buildings and Other Structures

2.2.3.7 American Water Works Association (AWWA)

AWWA D100	Welded Steel Tanks for Water Storage

2.2.3.8 American Welding Society (AWS)

AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code - Reinforcing Steel
AWS D1.6	Structural Welding Code – Stainless Steel

2.2.3.9 California Energy Commission

Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California

2.2.3.10 Concrete Reinforcing Steel Institute (CRSI)

Manual of Standard Practice

2.2.3.11 California Building Code

CBC California Building Code 2022

2.2.3.12 Metal Building Manufacturers Association (MBMA)

Low Rise Building Systems Manual

2.2.3.13 National Fire Protection Association (NFPA)

NFPA 22	Standard for Water Tanks for Private Fire Protection
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 80	Standard for Fire Doors and Fire Windows
NFPA 850	Recommended Practice for Fire Protection for Electric Generating Plants

2.2.3.14 Steel Structures Painting Council (SSPC)

Steel Structures Painting Manual, Volume 2, Systems and Specifications

2.3 Structural Design Criteria

2.3.1 Natural Phenomena

The design criteria based on natural phenomena are discussed in this section. The climatological data listed were retrieved from isopluvials for 100 year, 24 hour precipitation for southern half of California, prepared by U.S. Department of Commerce. National Oceanic & Atmospheric Administration, National Weather Service Office of Hydrology. The detail design will be based on the latest available data at the start of the project.

2.3.1.1 Seismicity

The site soils have been classified as Site Class E per the preliminary geotechnical investigation. The mapped MCE_R, 5% damped, spectral response acceleration parameter at a period of 1 second, S_1, equals 0.6. The mapped MCE_R, 5% damped, spectral response acceleration parameter at short periods, S_s, equals 1.5. Per ASCE 7-10, Supplement 3, Section 11.4.8, a ground motion hazard analysis shall be performed for structures on Site Class E sites with S_s greater than or equal to 1.0 or S_1 greater than or equal to 0.2. A ground motion hazard analysis has yet to be performed at this time.

2.3.1.2 Snow

The plant site is located in a zero ground snow load area.

2.3.2 Design Loads

2.3.2.1 Dead Loads

Dead loads include the weight of all components forming the permanent parts of structures and all permanent equipment. The dead load of permanent plant equipment will be based on actual equipment weights. For major equipment, structural members and foundations will be specifically located and designed to carry the equipment load into the structural system. For equipment weighing less than the uniform live load, the structural system will be designed for the uniform live load.

The contents of tanks and bins at full operating capacity will be considered as dead loads. The contents of tanks and bins will not be considered effective in resisting uplift due to wind forces but will be considered effective for seismic forces.

2.3.2.2 Live Loads

Live loads are the loads superimposed by the use and occupancy of the building or structure. They do not include wind loads, snow loads, or seismic loads.

Uniformly distributed live loads are specified to provide for movable and transitory loads, such as the weight of people, office furniture and partitions, portable equipment and tools, and other nonpermanent materials. These uniform live loads will not be applied to floor areas permanently occupied by equipment, with no access beneath. Uniform live loads for equipment lay-down areas will be based on the actual weight and size of the equipment and parts that may be temporarily placed on floors during dismantling, maintenance, installation, or removal.

The design live loads will be as follows:

- Ground Floor (Grade Slab) - A uniform load of 250 psf, nonpermanent equipment weights, storage weights, or lay-down weights, whichever is greater, will be used.
- Grating Floors, Platforms, Walkways, and Stairs - A uniform live load of 100 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 load will not be carried to columns. Maximum deflection of the grating will be limited to 1/4 inch.
- Elevated Concrete Slabs - A uniform load of 100 psf, nonpermanent equipment weights, storage weights, or lay-down weights, whichever is greater, will be used.
- Elevated concrete slabs will be designed to support either the prescribed live load or a single concentrated load of 2 kips, whichever produces the greater stresses. The concentrated load will be treated as uniformly distributed load acting over an area of 2.5 square feet and will be located to produce the maximum stress conditions in the metal decking for concrete slabs will be designed for a load during construction equal to the weight of concrete plus 50 psf (no increase in allowable stress).
- Roof - Roof areas will be designed for a minimum live load of 20 psf. Ponding loading effect due to roof deck and framing deflections will be investigated in accordance with Section K2 of the AISC Specification for Structural Steel Buildings.
- Piperacks - A minimum uniform load of 100 psf will be used for each level of the piperacks, except that where 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.

- Truck Loads - A surcharge load of 250 psf will be applied to plant structures accessible to truck traffic. Road pavements, underground piping, conduits, sumps, and foundations subject to truck traffic will be designed for wheel loadings in accordance with Appendix C.1, Section 3.2.2.
- Thermal Forces - Thermal forces caused by thermal expansion of equipment and piping under all operating conditions will be considered.
- Dynamic Loads - Dynamic loads will be considered and applied in accordance with the manufacturer's criteria/recommendations and industry standards.

2.3.2.3 Wind Loads

Wind loads for structures and their components will be determined in accordance with ASCE 7-16, using a basic wind speed of 104 mph at 33 feet above grade. Risk Category III will be used. Exposure category D should be used.

2.3.2.4 Seismic Loads

Seismic loads will be determined in accordance with the requirements specified in Section 3.4.

2.3.2.5 Other Loads

Other expected loads required to predict the structural response of structures will be considered where appropriate (i.e., water hammer, test loads, etc.).

2.3.2.6 Load Combinations

Applicable code prescribed load combinations will be considered in the design of structures. As a minimum, the following load combinations will be considered, where allowable stress design is used:

- Dead load
- Dead load + live load + operating loads
- Dead load + live load + operating loads + 1.3 wind load
- Dead load + live load + operating loads + seismic /1.4
- Dead load + construction loads
- Dead load + live load + emergency loads
- 2/3 Dead load + wind load
- 0.9 Dead load + seismic/1.4 load

Operating loads include all loads associated with normal operation of the equipment (e.g., temperature and pressure loads, piping loads, normal torque loads, impact loads, etc.).

2.3.2.7 Strength Requirements

Each load combination will not exceed the stress or strength levels permitted by the appropriate code for that combination.

Concrete Structures

The required strength (U) of concrete structures will be at least equal to the following, or as required by 2022 CBC Section 1605.2:

- U 1.4 Dead
- U 1.2 Dead + 1.6 (Live + Earth) + 0.5 Roof Live

- U 1.2 Dead + 1.6 Roof Live + (0.5 Live or 0.8 Wind)
- U 1.2 Dead + 1.6 Wind + 0.5 Live + 0.5 Roof Live
- U 1.2 Dead + 1.0 Seismic + 0.5 Live
- U 0.9 Dead + 1.6 Wind + 1.6 Earth Pressure
- U 0.9 Dead + 1.0 Seismic + 1.6 Earth Pressure

Steel Structures.

The required strength (S) based on elastic design methods and allowable stresses (without 1/3 increase allowed for wind or seismic loading) defined in the AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, will be at least equal to the following:

- S = Dead
- S = Dead + Live
- S = 0.75 (2/3 Dead + Wind)
- S = 0.75 (0.9 Dead + Seismic/1.4)
- S = 0.75 (Dead + Live + 1.3 Wind)
- S = 0.75 (Dead + Live + Seismic/1.4)

For load combinations including seismic loading, frame members and connections will conform to the additional requirements of Sections 1633A and 2213A of the CBC.

2.3.2.8 Factors of Safety

Minimum factors of safety for structures, tanks, and equipment supports will be as follows:

- Overturning - 1.50
- Sliding - 1.50
- Buoyancy - 1.20
- Uplift due to wind - 1.50

2.3.3 Materials

2.3.3.1 Structural Steel

General

Structural steel will conform to ASTM A572, GR 50 or other materials as required and accepted for use by the AISC Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design.

High-strength bolts for connections will conform to ASTM A325. Bolts other than high- strength bolts will conform to ASTM A307, Grade A. Non-headed anchor bolts will conform to ASTM A36, unless higher strength bolting materials are required by design. Drilled-in expansion bolts for concrete will be Hilti-Kwik Bolt TZ2, designed in accordance with ICC ESR-4266.

Structural steel will be detailed and fabricated in accordance with the AISC Code of Standard Practice and the AISC Specification for Structural Steel Buildings. Structural material will be fabricated and assembled in the shop to the greatest extent possible. Structural members will be welded in accordance with AWS D1.1. Columns will be milled to bear on the baseplate or cap plate. Connections will have a minimum of two bolts.

Exterior structural steel will be either hot-dip galvanized or shop-primed and finish painted after installation. Interior structural steel will be shop primed after fabrication. Surface preparation and painting will be in accordance with Steel Structures Painting Council standards. Galvanizing will be in accordance with the requirements of ASTM standards.

2.3.3.2 Design

Reinforced concrete structures will be designed by the Ultimate Strength Method in accordance with the CBC and ACI 318, Building Code Requirements for Reinforced Concrete.

2.3.4 Seismic Design Criteria

This section provides the general criteria and procedures to be used for the seismic design of buildings, structures, and structural components.

2.3.4.1 Seismic Performance Objectives

The seismic performance objectives for this facility are:

- Resist minor levels of earthquake ground motion without damage.
- Resist moderate levels of earthquake ground motion without structural damage, but with some nonstructural damage.
- Resist major levels of earthquake ground motion without collapse, but with some structural as well as nonstructural damage.

To achieve these objectives and to meet the requirements of the California Energy Commission (CEC) and local codes, the facility will be designed in accordance with the CBC.

2.3.4.2 General Criteria

The plant site is located in Seismic Category D according to CBC Chapter 16. For seismic load calculations, the Importance Factor for Risk Category III structures (power plants) is 1.25 based on ASCE 7-16 Table 11.5-1. Accordingly, an Importance Factor of 1.25 will be used for all plant buildings, structures, and structural components except special use structures requiring higher Importance Factors as noted in Table 2-1.

Buildings and structures will be designed in accordance with ASCE 7-16 Chapter 12. Nonbuilding structures will be designed in accordance with ASCE 7-16 Chapter 15, and nonstructural components will be designed in accordance with ASCE 7-16 Chapter 13.

In addition to 2022 CBC requirements, water storage tanks will meet the seismic design requirements of AWWA D100, Appendix C.1.

2.3.4.3 Critical Structures

Critical structures are those structural components that are necessary for power production and are costly to repair or replace or that require a long lead time to repair or replace; or are used for the storage, containment, or handling of hazardous or toxic materials.

Seismic loads for critical structures will be determined by the equivalent lateral force procedure of ASCE 7-16. Table 2-1 identifies the critical structures and the associated seismic load coefficients that will be used in their design.

2.4 Structural Design Methodology

This section describes the structural aspects of the design of the proposed facility. Each major structural component of the plant is addressed by defining the design criteria and analytical techniques that will be employed.

2.4.1 Structures

2.4.1.1 Steam Turbine Foundation

The steam turbine foundation will be designed to support the turbine and generator components.

The foundation will be designed to resist the loadings furnished by the manufacturer plus loadings from natural phenomena and structural framing, if applicable, and will be constructed of reinforced concrete.

Foundation Loads

Equipment foundation loads will be furnished by the turbine manufacturer and will be combined with the other loads imposed on the foundation. Typical loading data supplied by the manufacturer includes the following. The steam turbine foundations will be designed for these loads:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Normal torque loads
- Normal machine unbalance loads
- Emergency loads, such as turbine accident or generator short-circuit
- Thermal loads due to thermal expansion or contraction of the machines, connected piping, and turbine pedestal components
- Shrinkage and creep loads
- Condenser vacuum load (steam turbine only)

Induced Forces

The steam turbines and associated equipment will be securely anchored to their foundations using cast-in-place steel anchor bolts designed to resist the equipment forces and seismic or wind loads.

Structural System

The turbine foundation system will consist of a reinforced concrete mat. The steam turbine generator will be provided with a reinforced concrete rigid frame pedestal and a reinforced concrete mat.

Structural Criteria

The foundation design will address the following considerations:

- Allowable settlements

- Equipment, structure, and environmental loads
- Factors of safety against overturning and sliding
- Equipment performance criteria
- Natural frequencies and dynamic effects of rotating equipment
- Access and maintenance

Soil pressures will satisfy the allowable bearing pressure criteria that will be developed during project detailed design to provide a safety factor against hearing failure.

2.4.1.2 Analytical Techniques

Steam Turbine Pedestal and Foundation. Computer analyses will be used for both static and dynamic loads on the steam turbine pedestal and foundation. The pedestal deck and columns will be modeled as a 3-dimensional (3-D) space frame structure using 3-D beam elements. The foundation mat will be modeled using 3-D plate bending elements.

The interaction between the mat soil will be modeled using a system of vertical and horizontal springs attached to a fixed boundary.

Static analyses will be performed to obtain structure displacements and internal forces and moments produced by the static portion of the load combinations, including seismic loads. Dynamic analyses will be performed to confirm the adequacy of the pedestal and foundation to support the operating machinery and sustain the dynamic loads associated with machinery operation within specified displacement and stress limits. Dynamic analyses may not be required where the effects of a particular dynamic loads are specified by the manufacturer in terms of equivalent static loads.

2.4.1.3 Buildings and Enclosures

The various plant buildings and enclosures will provide support, protection, and access to the systems contained within their boundaries. Generally, each building and enclosure will be one story and pre-engineered.

Foundation Loads

Foundation loads will be determined from the analysis and design of the superstructure and from the support of the equipment contained within the structure. The following loads will be considered:

- Dead loads
- Live loads
- Equipment and piping loads
- Wind loads
- Seismic loads

Induced Forces

Each building and enclosure will be securely anchored to its foundation using cast-in-place steel anchor bolts designed to resist any induced forces.

Structural System

Buildings and enclosures will be designed as AISC Type 1 rigid frames or as Type 2 simple braced frames. For resisting seismic lateral loads, the structures will be classified as ordinary structures with a concentric braced frame, an ordinary moment-resisting frame, or a special moment-resisting frame, in accordance with the definitions of ASCE 7-16.

The foundation systems for buildings and enclosures will typically consist of individual spread footings to resist the column loads, and an isolated slab-on-grade floor system.

Structural Criteria

Building and enclosure steel frames will be designed and constructed using the materials and criteria set forth in Section 3.

Analytical Techniques

Building and enclosure foundations will be designed as simple spread footings or mat foundations, using static analysis techniques. The foundations will be analyzed assuming a linear soil pressure distribution.

2.4.2 Tanks

2.4.2.1 Field-Erected Storage Tanks

Field-erected storage tanks will typically be vertical, cylindrical shells consisting of stainless steel or carbon steel construction with a protective interior coating. Tank roofs will be either self-supported domes or cones. Tank bottoms will be ground-supported, flat-bottomed, with a slope of 1 percent. Tanks will have ladders, landing platforms, and handrails to provide access to working areas. Vents, manholes, overflow piping, and grounding lugs will be provided as necessary.

Foundation Loads

Foundation loads will be determined using project-specific design criteria. Tank and foundation design will include the following loads:

- Dead loads (including contained fluid load)
- Live loads
- Wind loads
- Seismic loads (including hydrodynamic loads)

Induced Forces

Storage tanks will be securely anchored to their foundations using cast-in-place steel anchor bolts designed to resist tank-induced forces.

Structural System

Each tank will be a cylindrical steel shell that resists lateral loading through shear in the tank wall. Overturning will be resisted by anchor bolts connecting the tank wall to the foundation.

Structural Criteria

Tank structures will be designed and constructed using the criteria established in API 650 or NFPA 22, as applicable.

Foundations will be designed and constructed as reinforced concrete structures using the criteria from Section 3.

Analytical Techniques

Tank foundations will typically be designed as circular ringwalls using static analysis techniques. Each ringwall will be proportioned to resist the design load of the tank and the maximum overturning moment due to wind or seismic loading. The ringwall will also be proportioned to resist maximum anchor bolt uplift force. Circumferential reinforcing steel will be provided in the ringwall to develop the hoop stress produced by the lateral soil pressure within the ringwall.

2.4.2.2 Shop-Fabricated Storage Tanks

Shop-fabricated storage tanks will be either vertical or horizontal, cylindrical, carbon steel shells. The tanks will have ladders, landing platforms, and handrails, to provide access to working areas. Each tank will have nozzles for fill connection, fill drain, overflow, vent connections, manholes, and grounding lugs as necessary.

Foundation Loads

Foundation loads will be furnished by the tank manufacturer and will be superimposed with loads for the foundation itself.

Typical loadings supplied by the manufacturer include:

- Dead loads
- Live loads
- Wind loads
- Seismic loads (including hydrodynamic loads)
- Temperature and pressure loads

Induced Forces

Each tank will be securely anchored to its foundation using cast-in-place steel anchor bolts or concrete expansion anchors designed to resist tank-induced forces.

Structural System

Each tank will consist of a cylindrical steel shell, either supported by integral legs or saddle supports, or with a flat bottom hearing directly on the foundation.

Structural Criteria

Tanks will be designed by a tank manufacturer in accordance with the relevant ASME code, ANSI code, and ASTM standards.

Analytical Techniques

The tank foundations will typically be designed using static analysis techniques assuming a rigid mat. The foundations will be analyzed assuming a linear soil pressure distribution. The mats will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading.

The tanks will be designed and analyzed by a tank manufacturer to satisfy the requirements of the relevant ASME code, ANSI code, and ASTM standards.

2.4.3 Equipment and Equipment Foundations

Plant equipment will be designed in accordance with manufacturers' standards and applicable codes and industry standards. Equipment will be designed to resist project-specific environmental loadings, as applicable.

Foundations will be designed to resist the loadings furnished by the manufacturers and will be constructed of reinforced concrete.

2.4.3.1 Equipment/Foundation Loads

Equipment and foundation loads will be determined by the manufacturers using project- specific design criteria. Typical loadings used for design will include:

- Dead loads
- Live loads
- Operating loads
- Wind loads
- Seismic loads
- Emergency loads

Foundation loads furnished by the equipment manufacturers will be superimposed with loads for the foundation itself.

2.4.3.2 Induced Forces

The equipment will use steel anchor bolts, concrete expansion anchors, welds, and other equipment anchorage devices to resist equipment-induced forces.

2.4.3.3 Structural System

Foundations will typically consist of individual pads bearing directly on a ground improvement system or compacted fill. For equipment located in buildings, the pads may be constructed integrally with the grade slab

2.4.3.4 Structural Criteria

Plant equipment will be designed to resist project-specific criteria in accordance with the manufacturers' standards and applicable codes and industry standards.

2.4.3.5 Analytical Techniques

Equipment foundations will typically be designed using static analysis techniques assuming a rigid mat. Foundations will be analyzed assuming a linear soil pressure distribution. Mats will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading.

Equipment will be designed and analyzed by the manufacturer to satisfy the requirements of the relevant codes and industry standards.

2.5 Hazard Mitigation

The project will be designed to mitigate natural and environmental hazards caused by seismic and meteorological events. This section addresses the structural design criteria used to mitigate such hazards.

2.5.1 Seismic Hazard Mitigation Criteria

This appendix describes the civil and structural design criteria that will be applied to the project.

Project seismic design criteria were selected based on the following considerations:

- Compliance with applicable laws, ordinances, regulations, codes, and standards
- Life safety
- Structural behavior and performance
- Reliability of the plant
- Financial impacts from seismically induced outages
- Seismic probability and magnitude

The project seismic design criteria were developed to incorporate these considerations using a systematic approach to correlate performance criteria with assumed risk level. The following procedure was used to establish the design criteria:

- The seismic hazards were assessed by studying the geologic features of the surrounding area. Major faults were identified, and information was collected regarding each fault's proximity, capability, recurrence, and magnitude.
- The seismic risk associated with each source was assessed considering historical magnitudes.
- Appropriate design criteria and analysis methods consistent with the seismic performance criteria were established for each major plant structure, equipment, and component.

Specific design features that will be incorporated into the plant to mitigate the identified. Seismic hazards include:

- Appropriate analysis techniques will be employed to calculate structure-specific seismic loads.
- Plant structures, equipment, piping, and other components will be designed to resist the project-specific seismic loads.
- Critical equipment will be positively anchored to its supporting structure.
- Anchorages will be designed to resist project-specific seismic loadings.
- Adequate factors of safety against overturning and sliding due to seismic loads will be provided.
- The design of piping connections to structures, tanks, and equipment will consider differential seismic displacements between components.
- Adjacent structures will be seismically isolated from one another.
- Structural elements will be designed to comply with special detailing requirements intended to provide ductility.
- Connections for steel structures will have a minimum load carrying capability without regard to the calculated load.
- Lateral and vertical displacements of structures and elements of structures will be limited to specified values.

- Appropriate measures will be taken for soil liquefaction to limit damage.

The foregoing design features are intended to provide the degrees of safety for structures and equipment as follows:

- Resist minor earthquakes without damage. Plant remains operational.
- Resist moderate earthquakes without structural damage but with some nonstructural damage. Plant remains operational or is returned to service following visual inspection and/or minor repairs.
- Resist major earthquakes without collapse but with some structural and nonstructural damage. Plant is returned to service following visual inspection and/or moderate repairs.

2.5.2 Meteorological and Climatic Hazard Mitigation

Meteorological and climatic data were used to establish the project design basis. Portions of the data and the design basis that pertain to structural engineering are provided in this appendix.

Specific design features that will be incorporated into the plant to mitigate meteorological and climatic hazards include:

- Structures and cladding will be designed to resist the wind forces.
- Sensitive structures will be designed for wind-induced vibrational excitation.
- Roofs will be sloped and equipped with drains to prevent accumulation of rainfall.
- Site drainage systems will be designed to convey the runoff from a 24 hour rainfall event with a 10 year recurrence interval.
- Ground floor levels of structures will be placed minimum 6 inches above finished grade.
- A variable height dike will surround the project site completely.
- Building drain lines will be installed with backflow prevention devices.
- The bases of plant equipment will be placed minimum 6 inches above finished grade.
- The plant site will be graded to convey runoff away from structures and equipment.

The foregoing design features will be incorporated in accordance with the applicable codes and standards identified in this appendix.

The degree of safety offered by these features is consistent with the requirements of the applicable codes and standards and the economic benefits these features provide.

Table 2-1. Seismic Load Coefficients of Critical Structures

Critical Structure	Importance Factor (I)
Fire Pump Building	1.5
Other Buildings	1.25
Fire Water tank	1.5
Flat Bottom Tanks and Their Foundations and Anchorage	1.25
Other Tanks and their Foundations and Anchorage	1.25
Foundations for Steam Turbine/Generator	1.25

Appendix B3
Architectural Design Criteria

B3. Architectural Design Criteria

3.1 Introduction

The design, engineering, procurement, and construction activities on the project will be in accordance with various predetermined standards and project-specific practices. This appendix summarizes the architectural design and engineering codes and standards, design criteria, and practices that will be used during design and construction. These criteria form the basis that govern the architectural design of plant facilities. More specific design information will be developed during the detailed design phase 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 summarizes the basic criteria, Section 3 identifies applicable codes and standards, and Section 4 includes the general performance requirements for building components.

3.2 Criteria

Plant buildings typically will be designed as single-story pre-engineered metal buildings (PEMB), with insulated metal wall and roof panels, and will be in compliance with the California Building Code and other applicable local, state and federal codes, standards and regulations, as well as site environmental conditions.

The buildings will be laid out to accommodate the spaces required for plant equipment and operations. Aisles and clearances will provide access for operation, maintenance, equipment removal and egress. Personnel walkways to equipment (for routine maintenance), doors, stairs, and other access points will be provided. Plant security, fire protection and fire rated separations, and life safety features will also be considered in the building layout.

Pre-Engineered Metal Building System shall be designed, engineered, and supplied by the vendor and shipped to the site as components to be erected in the field. Components include, but are not limited to the following:

1. Structural steel framing.
2. Metal roof panels.
3. Insulated and non-insulated metal wall panels.
4. Mineral wool core fire rated metal wall panels.
5. Translucent panels, where shown.
6. Thermal insulation and vapor barrier.
7. Metal liner panels.
8. Personnel and equipment doors, frames and door hardware.
9. Overhead coiling door.
10. Crane/Monorail beams and supports, where shown.
11. Trim, flashing, closures and sealants.
12. Accessories, including gutters, downspouts and splash blocks.
13. Other appurtenances as required for a complete installation.

Buildings shall include equipment and systems to be fully functional for their intended use including, but not limited to the following: Electrical, HVAC, fire protection, plumbing, lighting, telecommunication, security, furnishings, fixtures, and accessories. Steel backing and support shall be provided for all wall mounted equipment as required.

PEMBs designed for similar facilities typically are Type II-B non-combustible construction. The construction type and occupancies will be evaluated during detail design. Wood framing material that supports combustion and materials containing asbestos shall not be used. Wood or other materials that support combustion shall not be used for interior finish materials or trim, except as included during detail design.

Highly polished, slippery materials shall not be used for finish floor surfaces.

Control Rooms are critical facilities that shall be designed in accordance with proper human factors considerations. Furnishings shall be of high quality and conform to industry standard ergonomic design standards. The Central Control Room will be designed to comply with the Americans with Disabilities Act (ADA) and Accessibility Guidelines for Buildings and Facilities (ADAAG).

3.3 Codes and Standards

Meet or exceed the requirements set forth in the latest adopted editions and published addenda of the following publications in effect on the date of contract award are a part of this Section. Where conflicting codes, regulations or specifications occur, the more stringent supersedes.

3.3.1 Building Codes

- California Building Code (Title 24, Part 2)
- California Electrical Code (Title 24, Part 3)
- California Mechanical Code (Title 24, Part 4)
- California Plumbing Code (Title 24, Part 5)
- California Energy Code (Title 24, Part 6)
- California Fire Code (Title 24, Part 9)
- California Green Building Standards Code (Title 24, Part 11)
- California Reference Standard Code (Title 24, Part 12)
- Standard for the Installation of Sprinkler Systems of California
- Americans with Disabilities Act (ADA Standards)

3.3.2 Standards

AAMA – American Architectural Manufacturers Association

AAMA 501.1	Standard Test Method for Water Penetration of Windows, Curtain Walls, and Doors Using Dynamic Pressure
AAMA 501.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 621	Voluntary Specifications For High Performance Organic Coatings On Coil Coated Architectural Hot Dipped Galvanized (HDG) And Zinc-aluminum Coated Steel Substrates
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

AAMA 2603	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)

AISC – American Institute of Steel Construction

ANSI/AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 325	Steel Construction Manual (15th Edition)
AISC	Detailing for Steel Construction (3rd Edition)
ANSI/AISC 341	Seismic Provisions for Structural Steel Buildings
ANSI/AISC 360	Specification for Structural Steel Buildings
Design Guide 3	Serviceability Design Considerations for Steel Buildings
Design Guide 5	Design of Low- and Medium-Rise Steel Buildings
Design Guide 7	Industrial Building Design

AISI – American Iron and Steel Institute

S100	North American Specification for the Design of Cold-Formed Steel Structural Members

ASCE/SEI – American Society of Civil Engineers/Structural Engineering Institute

ASCE/SEI 7-22	Minimum Design Loads for Buildings and Other Structures
ASCE/SEI 7-22	Minimum Design Loads and Associated Criteria for Buildings and Other Structures

ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers

90.1	Energy Standard for Buildings except Low-Rise Residential Buildings

ASME – American Society of Mechanical Engineers

B30.17	Cranes and Monorails (With Underhung Trolley or Bridge)

ASTM – American Society for Testing and Materials

A36/A36M	Standard Specification for Carbon Structural Steel
A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A307	Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000 PSI Tensile Strength
A529/A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

A563/A563M	Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
A572/A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A755/A755M	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products
A759	Standard Specification for Carbon Steel Crane Rails
A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
A792/A792M	Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A992/A992M	Standard Specification for Structural Steel Shapes
A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable
A1011/A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
C665	Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
C754	Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
C920	Standard Specification for Elastomeric Joint Sealants
C991	Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings
C1047	Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
C1325	Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units
C1363	Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
D1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D3841	Standard Specification for Glass-Fiber-Reinforced Polyester Plastic Panels
D4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
D6226	Standard Test Method for Open Cell Content of Rigid Cellular Plastics
E72	Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
E84	Standard Test Method for Surface Burning Characteristics of Building Materials
E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E119	Standard Test Methods for Fire Tests of Building Construction and Materials
E283	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
E330	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
E331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
E1592	Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
E1646	Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
E1680	Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems
E1980	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
E2190	Standard Specification for Insulating Glass Unit Performance and Evaluation
F436/F436M	Standard Specification for Hardened Steel Washers Inch and Metric Dimensions

F1136/F1136M	Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
F2329/F2329M	Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
F3125/F3125M	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

AWS – American Welding Society

AWS A2.4	Standard Symbols for Welding, Brazing, and Non-destructive Examination
AWS D1.1	Structural Welding Code - Steel
AWS D1.3	Structural Welding Code - Sheet Steel
AWS QC1	Standard for AWS certification of Welding Inspectors

CMAA – Crane Manufacturers Association of America

DASMA – Door and Access Systems Manufacturers Association

FM Global – FM Approvals

GA – Gypsum Association

IAS – International Accreditation Service

AC472	Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems

MBMA – Metal Building Manufacturers Association

MBMA	Energy Design Guide for Metal Building Systems, Second Edition
MBMA	Metal Building Systems Manual
MBMA	Metal Roofing Systems Design Manual
MBMA	Seismic Design Guide for Metal Building Systems

NAIMA – North American Insulation Manufacturers Association

NEMA – National Electrical Manufacturers Association

NFPA – National Fire Protection Association

NFPA 10	Portable Fire Extinguishers
NFPA 72	National Fire Alarm and Signaling Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives

NFPA 252	Standard Method for Fire Tests of Door Assemblies

OSHA – Occupational Safety and Health Administration

PIP – Process Industry Practices

ARS08111	Standard Steel Doors and Frames Supplier Specification
ARS08112	Standard Steel Doors, Frames and Related Hardware Installation Specification
ARS08710	Standard Steel Door Hardware Supplier Specification
ARS13120	Pre-Engineered Metal Buildings
CVC01017	Plant Site Data Sheet
CVC01018	Project Data Sheet
STC01015	Structural Design Criteria

RCSC – Research Council on Structural Connections

RCSC	Specification for Structural Joints Using High-Strength Bolts

SDI – Steel Door Institute

SMACNA – Sheet Metal and Air Conditioning Contractors' National Association

SMACNA	Architectural Sheet Metal Standards
SMACNA	HVAC Duct Construction Standards
SMACNA	Industrial Duct Construction Standards
SMACNA	Seismic Hazard Standards

SSPC – Society for Protective Coatings

SP-1	Solvent Cleaning
SP-2	Hand Tool Cleaning
SP-6	Commercial Blast Cleaning
SP-15	Commercial Grade Power Tool Cleaning
Paint 15	Steel Joist Shop Primer/Metal Building Primer
Paint 20	Zinc-Rich Coating (Type I – Inorganic, and Type II – Organic)

SJI – Steel Joist Institute

SJI	Standard Specifications and Load and Weight Tables for Open Web Steel Joists and for Joist Girders

UL – Underwriters Laboratories

UL 10B	Standard for Safety Fire Tests of Door Assemblies

UL 10C	Standard for Safety Positive Pressure Fire Tests of Door Assemblies
UL 580	Standard for Tests for Uplift Resistance of Roof Assemblies
UL 723	Standard for Test for Surface Burning Characteristics of Building Materials
UL 790	Standard for Standard Test Methods for Fire Tests of Roof Coverings
UL 1040	Standard for Fire Test of Insulated Wall Construction
UL 2218	Standard for Impact Resistance of Prepared Roof Covering Materials

3.4 Building Components

3.4.1 Performance Requirements

3.4.1.1 Structural Performance

Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual." The design of structures and their members, components, and covering will be per governing codes and references, except where the minimums are exceeded by other provisions of this document.

Design members to withstand all dead loads, live loads, snow loads, collateral loads from lighting, cable trays, piping, HVAC, fire suppression/detection, utility supports, overhead door loads, crane/monorail loads, seismic loads, and design loads due to pressure and suction of wind calculated in accordance with the applicable code.

3.4.1.2 Thermal Movements

Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

3.4.1.3 Metal Roof Panels

Structural Standing Seam Metal Roof Panels: Formed with 24 gauge face sheet, 3 inch high vertical ribs at panel edges and evenly spaced raised longitudinal planks, manufactured for sequential installation by attaching panels to supports using concealed clips and engaging edges of adjacent panels and mechanically seaming panel ribs together, sealed with factory applied sealant. Provide a factory coil coated finish with a Fluoropolymer two-coat system.

3.4.1.4 Insulated Metal Wall Panels

Factory-foamed vertical wall panel system consisting of a 24 gauge exterior metal face sheet with a 26 gauge interior metal face sheet, bonded to factory foamed-in-place core in thermally-separated profile, with no glues or adhesives, and with factory sealed double tongue-and-groove joint, attached to supports using concealed fasteners. Provide a factory coil coated finish with a Fluoropolymer two-coat system.

3.4.1.5 Mineral Wool Core Metal Wall Panels

If required, a fire-resistant vertical wall panel system consisting of a 24 gauge exterior metal face sheet with a 26 gauge interior metal face sheet laminated to a structural mineral wool core. Minimum 6 inch panel thickness to comply with 1-hour and 2-hour fire rating. Provide a factory coil coated finish with a Fluoropolymer two-coat system.

3.4.1.6 Metal Liner Panels

Factory formed, 26 gauge, concealed fastener panels with interconnecting side joints, fastened to supports with concealed fasteners, with factory applied sealant inside laps when added moisture resistance is required. Provide a factory coil coated finish with a Fluoropolymer two-coat system.

3.4.1.7 Thermal Insulation

Unfaced Metal Building Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; continuous, vapor-tight edge tabs, in thickness required to achieve minimum required thermal values.

3.4.1.8 Exterior Hollow Metal Doors and Frames

Exterior steel doors shall be maximum duty, 14 gauge steel faced, full flush, factory assembled units conforming to requirements of ANSI/SDI A250.8. Fire rated doors shall comply with the requirements of NFPA 252, UL 10B and UL 10C. Select doors will have cardkey secured access which will be defined in detail design.

3.4.1.9 Interior Hollow Metal Doors and Frames

Interior steel doors shall be extra heavy duty, 16 gauge steel faced, full flush, factory assembled units conforming to requirements of ANSI/SDI A250.8. Fire rated doors shall comply with the requirements of NFPA 252, UL 10B and UL 10C. Select doors will have cardkey secured access which will be defined in detail design.

3.4.1.10 Overhead Roll Up Doors

Electric operated overhead coiling doors rated for high-cycle use (minimum 100,000 operational, service free cycles), steel faced, insulated and factory assembled to the fullest extent possible. Electric motor operator and controls shall be suitable for operation in hazardous classified areas, Class 1, Div. 2, where indicated.

3.4.1.11 Accessories

Provide components required for a complete metal roof panel assembly including copings, fascia, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items.

3.4.1.12 Windows

Insulating glazing shall be designed and sealed to prevent accumulation of moisture in the glazing unit. In accordance with CBC and NFPA 101, windows located in fire barriers shall be provided with fire rated glazing, fire shutter or automatic water curtain system to achieve the required fire rating as approved by the authority having jurisdiction.

3.4.1.13 Interior Walls

Interior walls shall be constructed with steel studs and gypsum board. For fire-resistance rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119.

Appendix B4
Mechanical Engineering Design Criteria

B4. Mechanical Engineering Design Criteria

4.1 Introduction

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

4.2 Codes and Standards

The design of the mechanical systems and components will be in accordance with the laws and regulations of the federal government, state of California, County of Imperial, California Codified Ordinances, and industry standards. The current issue or revision of the documents at the time of the filing of this Application for Certification (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, 2022
- American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code
- ASME B31.1 Power Piping Code
- ASME Performance Test Codes
- ASME Standard TDP-1
- ASMEB16.5, and B16.34
- American Boiler Manufacturers Association (ABMA)
- American Gear Manufacturers Association (AGMA)
- Air Moving and Conditioning Association (AMCA)
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- American Welding Society (AWS)
- Cooling Tower Institute (CTI)
- Heat Exchange Institute (HEI)
- Manufacturing Standardization Society (MSS) of the Valve and Fitting Industry
- National Fire Protection Association (NFPA)
- Hydraulic Institute (HI) Standards
- Tubular Exchanger Manufacturer’s Association (TEMA)

4.3 Mechanical Engineering General Design Criteria

4.3.1 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 project A/E firm. Equipment vendors will be responsible for using construction materials suited for the intended use.

4.3.2 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, etc.

4.3.2.1 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.

4.3.2.2 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 removal. 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.

4.3.2.3 Heat Exchangers

The surface condenser will be designed in accordance with Heat Exchange Institute (HEI) standards. Other heat exchangers will be provided as components of mechanical equipment packages and may be shell-and-tube. Heat exchangers will be designed in accordance with TEMA or manufacturer's standards. Fouling factors will be specified in accordance with TEMA.

4.3.2.4 Pressure Vessels

Pressure vessels will include the following features/appurtenances:

- 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., handhole) 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 applicable codes

4.3.2.5 Piping and Piping Supports

All piping shall be designed, fabricated installed, and tested in accordance with ASME B31.1 Power piping.

4.3.2.6 Valves

General Requirements

Valves will be arranged for convenient operation from floor level where possible and, if required, will have extension spindles, chain operators, or gearing. Hand-actuated valves will be operable by one person. Gear operators will be provided on manual valves 8 inches or larger.

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

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; however, 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 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 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.

4.3.2.7 Heating, Ventilating, and Air Conditioning (HVAC)

HVAC system design will be based on site ambient conditions specified in 2021 ASHRAE Handbook – Fundamentals, WMO 747185 “Imperial County AP, CA”.

Except for the HVAC systems serving the control room, maintenance shop, lab areas, and administration areas, the systems will not be designed to provide comfort levels for extended human occupancy.

4.3.2.8 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 pre-formed slabs or blankets, where feasible. Asbestos-containing materials are prohibited. 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 E84.

Insulation at valves, pipe joints, steam traps, 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 frame-reinforced. At the joints, the sheets will be sufficiently overlapped and caulked to prevent moisture from penetrating the insulation. Steam trap stations will be "boxed" for ease of trap maintenance.

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

Outdoor and underground insulation will be moisture-resistant.

4.3.2.9 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.

4.3.2.10 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.

4.3.2.11 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.

4.3.2.12 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. Oil cups will be specified. 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.

Appendix B5
Instrumentation and Control Design Criteria

B5. Instrumentation and Control Design Criteria

5.1 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 the Project. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification and construction specifications.

5.2 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, and local codes and ordinances. 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)
- Institute of Electrical and Electronics Engineers (IEEE)
- California Independent System Operator (CAISO)
- International Society of Automation (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- North American Electric Reliability Council (NERC)
- American Society for Testing and Materials (ASTM)

5.3 Control Systems Design Criteria

5.3.1 Distributed Control System

The distributed control system (DCS) consists of several automation systems that will monitor, control, and manage various aspects of plant operations. The facility will have its own control room equipped with operator consoles.

The integrated Operator consoles formed with several ancillary workstations will provide primary operator interface for both monitoring and control functions for the plant. Several graphics will be developed for the DCS and third-party interfaces. All Operator workstations or HMI will be able to monitor and interface with package supplied control systems.

The measurement and control devices are installed at the process equipment inside the environmentally controlled Satellite control room or PDC buildings. DCS I/O modules, controllers and communication devices are installed in cabinets and located in PDC via and interfaced with field instruments and MCC.

Each of packaged equipment control systems shall be physically independent and dedicated to their function. Each system shall have separate dedicated cabling, field instruments and hardware and shall be based on programmable electronic monitoring/control systems.

The DCS controls the process between its safe operating parameters, provides all essential data to the plant operator, displays alarms for out-of-range parameters, and alerts the operator of equipment malfunctions. A comprehensive graphical display is available to the operator to monitor any part of the process in the required detail, through its human machine interface (HMI). As well, the DCS receives data from various packaged equipment PLC-based control systems via an Ethernet. The DCS collects and archives data to be used by various business management systems. The DCS is designed with sufficient redundancy, so that no single core component failure can cause loss of monitoring and control over any process unit.

5.4 Instruments Design Criteria

5.4.1 General

In general, instrumentation design and selection will be based on the applicable process industry practices (PIPs) and API RP 551.

All instrumentation shall be fitted with a permanent label made of stainless steel. The label shall show, as a minimum, the instrument tag number and service description. American Customary Units (ACUs) shall be used for all process measurements, plot plans and dimensional layouts, instrumentation drawings and human machine interfaces. The design of the packaged units will be consistent with the balance of the plant as practically possible. The shutdown and safety protection of the package, if required, shall be implemented in the Plant Safety Instrumented System (SIS).

5.4.2 Pressure Instruments

In general, pressure instruments will have linear scales with units of measurement in pounds per square inch, gauge (psig). Pressure gauges will have either a blowout disk or a blowout back and an acrylic or shatterproof glass face. Pressure gauges on process ping will be resistant to plant atmosphere. Siphons will be installed on pressure gauges in steam service as required by the system designs. Steam pressure-sensing transmitters or gauges mounted above the steam line will be protected by a loop seal.

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

5.4.3 Temperature Instruments

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.

Temperature elements 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.

5.4.4 Level Instruments

Reflex-glass or magnetic level gauges will be use 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.

5.4.5 Flow Instruments

Flow transmitters for general use will be the differential pressure-type with the range similar to the primary element. In general, linear scales will be used for flow indication and recording. In addition, as appropriate for service, the use of magnetic, Coriolis or Pitot tubes such as Annubar will be used.

5.4.6 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 involve other style valve bodies (e.g., butterfly, eccentric disk) will be specified as appropriate for the intended service.

Valves will be designed to fail in a safe position.

5.4.7 Instrument Tubing and Installation

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

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use and will be standardized as much as practical throughout the plant. Differential pressure (flow) instruments will be fitted with five-valve manifolds; two-valve manifolds will be specified for other instruments as appropriate.

1.1.1. Pressure and Temperature Switches

Field-mounted pressure and temperature switches will have either NEMA Type 4X housings or housings suitable for the environment.

In general, switches will be applied such that the actuation point is within the center ⅓ of the instrument range.

5.4.8 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 pipestand. 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.

5.4.9 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 ⅜ inch. Each instrument air user will have a shutoff valve, filter, outlet gauge, and regulator at the instrument.

Appendix B6
Electrical Engineering Design Criteria

B6. Electrical Engineering Design Criteria

6.1 Introduction

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

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Checkout, testing, and startup
- Project completion

This appendix summarizes the codes and standards, standard design criteria, and industrial good practices that will be used during the project. The general electrical design criteria defined herein form the basis of the design for project electrical components and systems. 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 summarizes the applicable codes and standards, and Section 3 includes the general design criteria for motors, power and control wiring, protective relaying, classification of hazardous areas, grounding, lighting, heat tracing, lightning protection, raceway and conduit, and cathodic protection.

6.2 Design Codes and Standards

Work will be designed and specified in accordance with applicable laws and regulations of the Federal Government and the State of California and applicable local codes and ordinances.

The latest version of the following general codes and industry standards will be used in design and construction:

- Antifriction Bearing Manufacturers Association (AFBMA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- National Electrical Code (NEC) 2023
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC) 2023
- National Fire Protection Association (NEPA)
- Occupational Safety and Health Act (OSHA)
- Underwriters' Laboratories Inc. (UL)

In addition to these general codes and standards, the following specific standards will be used:

Batteries

IEEE 450	Recommended Practice for Maintenance, Testing and Replacement of Large lead Storage Batteries
IEEE 484	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations

Battery Chargers

NEMA AB-1	Molded Case Circuit Breakers
NEMA PE-5	Electric Utility Type Battery Chargers

Cable: Low Voltage Power, Control, and Instrument

ASTM B 3	Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard, or Soft
ASTM B 33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 496	Standard Specification for Compact Round Concentric–Lay Standard Copper Conductors
ICEA S-66-524	Cross-Linked-Thermosetting-Polyethylene-insulated Wire (NEMA WC 7) and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the (NEMA WC 8) transmission and Distribution of Electrical Energy
ICEA S-73-532	Standard for Control Cables (NEMA WC 57)
ICEA S-82-552	Instrumentation Cables and Thermocouple Wires (NEMA WC 55)
IEEE-1202	Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies
NEC	National Electrical Code, NFPA 70
NEMA WC 26	Wire and Cable Packaging

Cable Medium Voltage Power

ASTM B 3	Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B 496	Standard Specification for Compact Round Concentric-Lay Stranded Copper Conductors

ICEA S-66-524	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire
(NEMA WC 7)	and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-68-516	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the (NEMA WC 8) Transmission and Distribution of Electrical Energy
IEEE-1202	Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies
NEC	National Electrical Code, NFPA 70
NEMA WC 26	Wire and Cable Packaging
UL 1072	Standard for Medium-Voltage Power Cables

Cable Tray

NEMA VE-1	Cable Tray Systems

Cathodic Protection Equipment

ANSI B1.1	Unified Inch Screw Threads
ANSI B2.1	Pipe Threads
ASTM A 518	Corrosion-Resistant High Silicon Cast Iron
ASTM B 418	Cast and Wrought Galvanic Zinc Anodes for use in Saline Electrolytes

Circuit Breakers, High Voltage

ANSI/IEEE C37.04	Rating Structure for AC High Voltage Circuit Breakers rated on a Symmetrical Current Basis
ANSI C37.06	Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C37.09	C High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C37.010	Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.11	Requirements for Electrical Control for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis

Conduit

UL 6. ANSI C80.1	Rigid Steel Conduit
UL 797, ANSI C80.3	Electrical Metallic Tubing
UL 514, ANSI C80.4	All Fittings
UL 886	Hazardous Area Fittings
UL 360	Flexible Liquid-tight Conduit

NEMA TC6	PVC and ABS Plastic Utilities Duct and Underground Installation
NEMA TC9	Fittings for ABS and PVC Plastic Utilities for Duct for Underground Installation
UL 651	Electrical Rigid Nonmetallic Conduit
NEMA TC2, UL 514	Fittings for Electrical Rigid Nonmetallic Conduit

<u>Distribution Panels</u>

ANSI C97.1	Low Voltage Cartridge Fuses, 600 volts or less
NEMA AB-1	Molded Case Circuit Breakers
NEMA PB-1	Panelboards
UL 50	Electrical Cabinets and Boxes
UL 67	Panelboards
NEMA ICS	Industrial Controls and Systems
NEMA KSI	Enclosed Switches

<u>Grounding Cable</u>

ASTM B8	Specifications for Concentric-Lay Stranded Copper Conductors

<u>Grounding Connectors and Accessories</u>

NEMA CC-1	Electrical Power Connectors for Substations

<u>Lighting Fixtures</u>

NEMA FA-1	Outdoor Floodlighting Equipment
NEMA LE-1	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

<u>Lightning Arresters</u>

ANSI/IEEE C62.11	Standard for Metal-Oxide Surge Arresters for AC Power Circuits

<u>Secondary Unit Substations</u>

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
ANSI/IEEE C37.20.1	Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
ANSI/IEEE C37.20.2	Standard for Metal-Clad and Station -Type Cubicle Switchgear

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
ANSI C57.12.00	General Requirements for Distribution, Power and Regulation Transformers
ANSI/IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
ANSI/IEEE C57.12.90	Test Code for Liquid Immersed Distribution and Power, and regulating Transformers
ANSI/IEEE C57.12.91	Test Code for Dry-Type Distribution and Power Transformers

<u>Metal-Clad Switchgear and Nonsegregated Phase Bus</u>

ANSI A58.1	Minimum Design Load in Buildings and Other Structures
ANSI C37.04	Rating Structure for AC High-Voltage Circuit Breakers on a Symmetrical Current Basis
ANSI 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
ANSI C37.23	Guide for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus
ANSI C57.13	Requirements for Instrument Transformers

<u>Motor Control Centers</u>

NEMA ST-20	Dry-Type Transformers for NEMA General purpose Applications
NEMA AB-1	Molded Case Circuit Breakers
NEMA ICS-1	General standards for Industrial Controls and Systems
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 508	Industrial Control Equipment
UL 845	Motor Control Centers

<u>Motors, Low Voltage</u>

NEMA MG-1	Motors and Generators
AFBMA 9/	Antifriction Bearing Manufactures Association
ANSI B3.15	
NEMA MG-2	Safety Standard for Construction and Guide for Selection,
APBMA 11/	Installation and Use of Electrical motors and Generators

ANSI B3.16

NEMA MG-13	Frame Assignment for Alternating Current Integral Horsepower Induction Motors

Motors, Medium Voltage

ANSI/IEEE C50.41	Polyphase Induction Motors for Electric Power Generating Stations
IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
NEMA MG-1	Motors and Generators
NEMA MG-2	Safety Standard for Construction and Guide for Selection, Installation, and Use of Electrical Motors and Generators

Neutral Grounding Resistors

ANSI C76.1	Requirements and Test Costs for Outdoor Apparatus Bushings
IEEE 32	Requirements, Terminology, and Test Procedures for Neutral Grounding Devices

Relay Panels

ANSI C37.20	Switchgear Assemblies Including Metal-Enclosed Bus
ANSI C37.90	Relays and Relay Systems Associated with Electric power Apparatus

Transformers, Dry-Type

ANSI U1	General Requirements for Dry-Type Distribution and Power Transformers
NEMA ST-20	Dry-Type transformers for General Application
UL 506	Standard for Safety, Specialty transformers
IEEE 693	Recommended Practice for Seismic Design of Substations
IEEE 62271-37-013	Alternating Current Generator Circuit Breakers
California	Rules for Overhead Line Construction

G.O. No.95

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.

6.3 Electrical Design Criteria

6.3.1 Electric Motors

6.3.1.1 General Motor Design Criteria

These paragraphs outline basic motor design guide parameters for selecting and purchasing electric motors. The following design parameters will be considered:

- Motor manufacturer
- Environment, including special enclosure requirements
- Voltage, frequency, and phases
- Running and starting requirements and limitations and duty cycle
- Motor type (synchronous, induction, DC, etc.) and construction
- Power factor
- Motor Efficiency
- Service factor
- Speed and direction of rotation
- Insulation
- Oil lubrication systems
- Bearing construction, rating life of rolling elements, and external lube oil system for sleeve or plate bearings
- Ambient noise level and noise level for motor and driven equipment
- Temperature detectors
- Termination provisions for power, grounding, and accessories
- Installation, testing, and maintenance requirements
- Special features (shaft grounding, temperature and vibration monitoring, surge protection, etc.)
- Motor space heater requirements

Safety Considerations for Motors

The Occupational Safety and Health Administration rules will be followed for personnel protection. Belt guards will be specified for personnel safety and, when required, to prevent foreign objects from contacting belt surfaces. Guard screens will be provided over motor enclosure openings to prevent direct access to rotating parts. Electrical motors will be adequately grounded.

Motors in hazardous areas will conform to applicable regulatory requirements and will be UL labeled. Motor electrical connections will be terminated within oversized conduit boxes mounted to the motor frame.

Codes and Standards

Motors will be designed, manufactured, and tested in accordance with the latest applicable standards, codes, and technical definitions of ANSI, IEEE, NEMA, and AFBMA, as supplemented by requirements of the specifications.

Testing Requirements

Each type of ac and dc machine will be tested in accordance with the manufacturer's routine tests at the factory to determine that it is free from electrical or mechanical defects and to provide assurance that it meets specified requirements.

Electrical Design Criteria

Special requirements for individual motors and specifications for special application motors will be included in individual specification technical sections. The motor nameplate horsepower multiplied by the motor nameplate service factor will be at least 15 percent greater than the driven equipment operating maximum brake horsepower. For motors with 1.15 service factor, the maximum load brake horsepower will not exceed the motor nameplate horsepower.

Windings and Insulation

Insulated windings will have Class F nonhygroscopic insulation systems with Class B temperature rise and ambient temperature in accordance with NEMA MG1 standards.

Insulated stator winding conductors and wound-rotor motor secondary windings will be copper. The insulation resistance corrected to 40° C will be not less than motor rated kV +1 megohms for all windings. Where required, the windings will be treated with a resilient, abrasion-resistant material.

Overspeeds

Squirrel-cage and wound-rotor induction motors, except crane motors, will be so constructed that in an emergency of short duration they will withstand, without mechanical injury, overspeeds above synchronous speed in accordance with the table in NEMA MG1- 12.48, Overspeeds for Motors.

Space Heaters

Space heaters will be sized as required to maintain the motor internal temperature above the dew point when the motor is not running. Motor space heaters will not cause winding temperatures to exceed rated limiting values or cause thermal protective device over-temperature indication when the motor is not energized.

In general, motors 1,000 hp or larger will have 240 V, single-phase, 60 Hz rated space heaters and will be energized by a 120 V, single-phase 60 Hz system. All 4,000 V motors will have space heaters. Heaters will be located and insulated so that they do not damage motor components or finish. Space heater leads will be stranded copper cable with 600 V insulation and will include terminal connectors.

Nameplates

Motor nameplate data will conform to NEMA MG1-20.60 requirements.

Environment

Location of individual motors within the plant will determine ambient temperature, corrosive environment, hazardous environment, and humidity to be experienced by the motors. These conditions will be considered in the purchase specification.

6.3.2 Power and Control Wiring

6.3.2.1 Design Conditions

In general, all cables shall be UL listed. In areas with higher ambient temperatures, larger conductors will be used, or higher temperature rated insulation will be selected. Conductor size and ampacity will be coordinated with circuit protective devices. Cable feeders from 4.16 kV switchgear to power equipment will be sized so that a short-circuit fault at the terminals of the load will not result in damage to the cable before normal operation of fault interrupting device (breaker is tripped or fuse is melted).

Instrument cable will be shielded and twisted to minimize electrical noise interference as follows:

- Aluminum-polyester tape with 100 percent coverage and copper drain wire will be used for shielding.
- Low-level analog signal cables will be made up of twisted and shielded pairs.
- Except where specific reasons dictate otherwise, cable shields will be electrically continuous. When two lengths of shielded cable are connected at a terminal block, a point on the terminal block will be used for connecting the shields.
- For multi-pair cables using individual pair shields, the shields will be isolated from each other. To be effective, instrument cable shields will be grounded on one end.
- Multi-pair cables used with thermocouples will have individually isolated shields so that each shield will be maintained at the particular couple ground potential.
- Each resistance temperature detector (RTD) system will be a three-wire system consisting of one power supply and one or more RTDs and will be grounded at only one point.
- RTDs embedded in windings of transformers and rotating machines will be grounded at the frame of the respective equipment.

6.3.2.2 Conductors

Design Basis

Electrical conductors will be selected with an insulation level applicable to the system voltage for which they are used and ampacities suitable for the load being served. The type of cable used will be determined by individual circuit requirements and individual equipment manufacturer's recommendations.

Cable Ampacities

The maximum ampacities for any cable will be in accordance with the NEC. In addition to ampacity, special requirements such as voltage drop, fault current availability, temperature derated ampacity and environment will be taken into consideration when sizing cable.

Insulation

Cable insulation and construction will be as follows.

Flame Retardance

To minimize the damage that can be caused by a cable fire, cables will have insulations and jackets with non-propagating and self-extinguishing characteristics. As a minimum, these cables will meet the flame test requirements of IEEE 383, using a gas-burner flame source. These characteristics are essential for cables installed in electrical cable tray in the plant.

Medium Voltage Power Cable

Power cable with minimum 5 kV class and 133 percent insulation level will supply all 4.16 kV service and will be routed in trays, channel, conduits, or underground duct banks.

Low Voltage Power Cable, 600 Volts

Power cable with 600V class insulation will supply power to loads at voltage levels of 480 VAC and below and 125 VAC and below. Cables will be routed in trays, channel, conduits, or ducts. All cables shall meet or exceed flame test requirements of IEEE 1202

Control Cable, 600 Volts

Non-shielded control cable with 600V class insulation will be used for control, metering, and relaying. Cables will be routed in trays, channel, conduits, or ducts.

Instrument Cable, 300 or 600 Volts

Instrument cable will be used for control and instrument circuits that require shielding to avoid induced currents and voltages.

Thermocouple Extension Cable

Thermocouple extension cable will be used for extension leads from thermocouples to junction boxes and to instruments for temperature measurements. Cables will be routed in trays or conduits. The cable jacket shall be UL listed type PLTC in accordance with NEC.

High Temperature Cable

High temperature cable will be used for wiring to devices located in areas with ambient temperatures normally above 75°C. Cables will be routed in conduit. Cable lengths will be minimized by terminating the cable at terminal boxes or conduit outlet fittings located outside the high temperature area and continuing the circuit with control or thermocouple extension cable.

Lighting and Fixture Cable

Lighting and fixture cable designations and conductor sizes will be identified on the drawings. The wire used for interior lighting and receptacles will be copper 600V, 75-degree type THWN insulation or equal.

Grounding Cable

Grounding cable will be insulated, or un-insulated bare copper conductor sized as required.

Switchboard and Panel Cable

Switchboard and panel cable will be insulated to 600V. Cable will be NEC Type SIS or XHHW-2, meeting the LTL VW-1 flame test.

Special Cable

Special cable will include cable supplied with equipment, prefabricated cable, coaxial cable, communication cable, etc. This cable will normally be supplied by a particular manufacturer. Special cable will be routed in accordance with the manufacturer's recommendations.

Miscellaneous Cable

If other types and constructions of cable are required as design and construction of the unit progress, they will be designated and routed as required.

Appendix 2C
Heat and Mass Balance Diagram

This Appendix is filed under a request for confidential designation

Appendix 2C, Heat and Mass Balance Diagram have been provided under a request for confidentiality.