APPENDIX 10.2

Structural Engineering Design Criteria

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10.2.1 Introduction

This appendix summarizes codes, standards, criteria, and practices that will be generally used in the design and construction of structural engineering systems 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.

10.2.2 Codes and Standards

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

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

- American Institute of Steel Construction (AISC):
  - Manual of Steel Construction
  - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings—ASD
  - Specification for Structural Joints Using ASTM A325 or A490 Bolts
  - Code of Standard Practice for Steel Buildings and Bridges
- American Concrete Institute (ACI):
  - ACI 318, Building Code Requirements for Structural Concrete
  - ACI 301, Specifications for Structural Concrete for Buildings
  - ACI 543R, Design, Manufacture, and Installation of Concrete Piles
- American Society of Civil Engineers (ASCE):
  - ASCE 7, Minimum Design Loads for Buildings and Other Structures
- American Welding Society (AWS):
  - D1.1—Structural Welding Code—Steel
  - D1.3—Structural Welding Code—Sheet Steel
  - D1.4—Structural Welding Code – Reinforcing Steel

- California Code of Regulations - Title 24, California Building Code (CBC)
- California Energy Commission - Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California, 1989
- City of Chula Vista Laws, Ordinances, and Regulations
- Code of Federal Regulations, Title 29—Labor, Chapter XVII, Occupational Safety and Health Administration (OSHA).
  - Part 1910—Occupational Safety and Health Standards.
  - Part 1926—Construction Safety and Health Regulations
- Crane Manufacturers Association of America
  - Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes-No. 70
  - Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist-No. 74
- National Association of Architectural Metal Manufacturers (NAAMM)—Metal Bar Grating Manual.
- Hoist Manufacturers Institute (HMI), Standard Specifications for Electric Wire Rope Hoists (HMI 100).
- National Electric Safety Code (NESC),
- National Fire Protection Association (NFPA Standards).
  - NFPA 850 Fire Protection for Electric Generating Plants.
- OSHA Williams-Steiger Occupational Safety and Health Act of 1970.
- Steel Deck Institute (SDI)—Design Manual for Floor Decks and Roof Decks.
- Steel Joist Institute (SJI)—Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders

10.2.2.1 CBC Special Requirements

Prior to beginning any increment of construction, a description of the proposed lateral-force resisting systems for project structures and the applicable designs, plans and drawings will be submitted for approval.

Proposed lateral-force resisting systems, designs, plans, and drawings shall be those for:

- Major project structures
- Major foundations, equipment supports, and anchorage
- Large, field-fabricated tanks
- Turbine/generator pedestal

10.2.3 Structural Design Criteria

10.2.3.1 Datum

Site topographic elevations will be based on an elevation survey conducted using known established and generally recognized elevation benchmarks.

10.2.3.2 Frost Penetration

The site is located in an area free of frost penetration. The bottom elevation of all foundations for structures and equipment, however, will be maintained at a minimum of 12 inches below finished grade.

10.2.3.3 Temperatures

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

Maximum	105 degrees Fahrenheit (°F)
Minimum	25°F

10.2.3.4 Design Loads

10.2.3.4.1 General

Design loads for structures and foundations will be in accordance with applicable building code requirements.

10.2.3.4.2 Dead Loads

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

10.2.3.4.3 Live Loads

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

Lateral earth pressures, hydrostatic pressures, and wheel loads from trucks are considered as live loads and will be considered in design as prescribed by the applicable code(s).

Uniform live loads will be in accordance with ASCE Standard 7, but in no case will be less than the following:

- Roofs — 20 pounds per square foot (psf)
- Floors and Platforms (steel grating and checkered plates) — 75 psf

In addition, a uniform load of 50 psf will be used to account for piping and cable trays supported on or suspended from floor or platform framing, except that where piping and cable loads exceed 50 psf, the actual loads will be used.

Furthermore, a "roving" concentrated load of 5 kips will be applied concurrently with the uniform load to each supporting beam and girder of floors to maximize stresses in the individual members, but the reactions from these "roving" concentrated loads will not be carried to the columns.

- Floors (elevated concrete floors) — 100 psf

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

- Control Room Floor — 150 psf
- Stairs, Landings, and Walkways — 100 psf

In addition, a "roving" concentrated load of 2 kips will be applied concurrently to the uniform load to each supporting beam for walkways to maximize the stresses in the individual members, but the reactions from these concentrated loads will not be carried to the columns.

- Pipe Racks (each support level) — 100 psf

Where piping and cable tray loads exceed this design uniform load, the actual loads will be used. In addition, a "roving" concentrated load of 15 kips will be applied concurrently to each supporting beam for the pipe rack to maximize the stresses in the individual members, but the reactions from these "roving" concentrated loads will not be carried to the columns.

- Hand (Guard) Railings

Hand (guard) railings will be designed for either a uniform horizontal force of 50 pounds per linear foot (plf) applied simultaneously with a 100 plf uniform vertical live load, or a 200-pound concentrated load applied to the top rail at any point and in any direction, whichever governs.

- Slabs on Grade — 250 psf
- Truck Loading Surcharge Adjacent to Structures — 250 psf
- Truck Support Structures — AASHTO-HS-20-44
- Special Loading Conditions — Actual loadings

Laydown loads due to equipment components which may occur during maintenance and floor areas in locations where trucks, forklifts or other transports will have access will be considered in the design of live loads.

Live loads may be reduced in accordance with the provisions of the UBC.

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

10.2.3.4.4 Earth Pressures

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

10.2.3.4.5 Groundwater Pressures

Hydrostatic pressures due to groundwater or temporary water loads will be considered based on a seasonal maximum groundwater elevation.

10.2.3.4.6 Wind Loads

Wind forces will be calculated in accordance with ASCE 7-98 as permitted by the CBC using a basic wind speed (3-second gust of 90 miles per hour (mph) and exposure category "D" considering the site's proximity to the open waters of San Diego Bay.

10.2.3.4.7 Seismic Loads

Structures will be designed and constructed to resist the effects of earthquake loads as prescribed in the CBC based on a Zone 4 seismic hazard. Plant facilities will be considered as Occupancy Category 3 (Special Occupancy Structure) with a seismic importance factor (I) of 1.0. Other seismic parameters will be as set forth in the CBC based on site characteristics as described in the site geotechnical report and the framing characteristics of the structure being designed.

10.2.3.4.8 Snow Loads

Snow loads will not be considered.

10.2.3.4.9 Turbine-Generator Loads

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

10.2.3.4.10 Special Considerations for Steel Stacks

Steel stacks will be designed to withstand normal and abnormal operating conditions in combination with required wind and seismic loads. Design loads to be considered will include the "along-wind" and "across-wind" effects on the stacks. The design will meet the requirements of ASME/ANSI STS-1-1986, "Steel Stacks," using the allowable stress design method, except that increased allowable stress for wind loads, as permitted by AISC, will not be used.

10.2.3.4.11 Special Considerations for Structures and Loads During Construction

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

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

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

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

10.2.4 Design Bases

10.2.4.1 General

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

Steel structures will be designed by the working stress method, in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

Allowable soil bearing pressures for foundation design will be in accordance with the results of the final subsurface investigation and foundation report for the Facility.

10.2.4.2 Factors of Safety

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

Against Overturning	1.50
Against Sliding	1.50 for Wind Loads 1.10 for Seismic Loads
Against Uplift Due to Wind	1.50
Against Buoyancy	1.25

10.2.4.3 Allowable Stresses

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

10.2.4.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, strength design equations will be determined based on 2001 CBC, Sections 1612.2, 1612.4, 1909.2 and related equations of ACI-318. The Allowable Stress Design load combinations of 2001 CBC section 1612.3 will be used to assess soil bearing pressure and stability of structures according to 2001 CBC sections 1805 and 1629.1, respectively.

Steel-framed structures will be designed in accordance with 2001 CBC, Chapter 22, Divisions I, III and IV and the AISC Specification for the Structural Steel Buildings, Allowable Stress Design and Plastic Design. Connections will conform to recommendations of the Specification for Structural Joints Using ASTM A325 or A490 Bolts as approved by the Research Council on Structural Connections of the Engineering Foundation.

10.2.5 Construction Materials

10.2.5.1 Concrete and Grout

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

Electrical ductbank encasement and lean concrete backfill (Class L-1)	1,500 psi
Structural concrete (Class S-1)	3,000 psi
Structural concrete (Class S-2)	4,000 psi
Grout (Class G-1)	5,000 psi

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

10.2.5.2 Reinforcing Steel

Reinforcing steel bars for concrete will be deformed bars of billet steel, conforming to ASTM A 615, Grade 60 or Grade 40 when greater ductility is needed.

Welded wire fabric for concrete will conform to ASTM A 185.

10.2.5.3 Structural and Miscellaneous Steel

Structural and miscellaneous steel will generally conform to ASTM A 36, ASTM A 572, or ASTM A992 except in special situations where higher strength steel may be required.

High strength structural bolts, including nuts and washers, will conform to requirements set forth in ASTM A 325 or ASTM A 490.

Bolts other than high-strength structural bolts will conform to ASTM 307, Grade A.

10.2.5.4 Concrete Masonry

Concrete masonry units will be hollow, normal weight, non-load bearing Type I, conforming to ASTM C 129.

Mortar will conform to ASTM C 270, Type S.

Grout will conform to ASTM C 476.

10.2.5.5 Other Materials

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