APPENDIX 2C

Structural Engineering Design Criteria

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2C1 Introduction

This appendix summarizes the codes, standards, criteria and practices that will be generally used in the design and construction of structural engineering systems for the Contra Costa Generating Station (CCGS). More specific project information will be developed during execution of the CCGS to support detailed design, engineering, material procurement specification and construction specifications.

2C2 Codes and Standards

The design of structural engineering systems for the CCGS will be in accordance with the laws and regulations of the federal government, the State of California and Contra Costa County ordinances, and the 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:

- California Building Code (CBC), 2007 Edition.
- American Institute of Steel Construction (AISC):
  - Manual of Steel Construction – 13th Edition
  - ANSI/AISC 360-05 Specification for Structural Steel Buildings, March 9, 2005
  - 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 – 05, Building Code Requirements for Structural Concrete
- ACI 301, Specifications for Structural Concrete for Buildings
- ACI 350R, Environmental Engineering Concrete Structures
  - ACI 543R, Design, Manufacture, and Installation of Concrete Piles
- American Society of Civil Engineers (ASCE):
  - ASCE 7-05 – 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

- Code of Federal Regulations, Title 29 – Labor, Chapter XVII, Occupational Safety and Health Administration (OSHA).
  - Part 1910 – Occupational Safety and Health Standards
  - Part 1926 – Construction Safety and Health Regulations
- National Association of Architectural Metal Manufacturer (NAAMM) – Metal Bar Grating Manual.
- Hoist Manufacturers Institute (HMI), Standard Specifications for Electric Wire Rope Hoists (HMI 100).
- Steel Deck Institute (SDI) – Design Manual for Floor Decks and Roof Decks.

2C3 CEC Special Requirements

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

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

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

2C4 Structural Design Criteria

2C4.1 Topographic Elevations

Site topographic elevations will be based on an elevation survey conducted using known elevation benchmarks tied to NGVD 29 Datum.

2C4.2 Frost Penetration

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

2C4.3 Temperatures

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

Maximum: 110° F
Minimum: 20° F

2C4.4 Design Loads

2C4.4.1 General

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

2C4.4.2 Dead Loads

Dead loads will 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 seismic forces.

2C4.4.3 Live Loads

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

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

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

a. Roofs: 20 psf
b. Steel grating and checkered plates: 100 psf

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

Furthermore, a concentrated load of 2 kips will be applied concurrently to the supporting beams of the floors to maximize stresses in the members, but the reactions from the concentrated loads will not be carried to subsequent supporting beams or columns.

c. 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.

d. Slabs on Grade: 250 psf
e. Truck Loading Surcharge Adjacent to Structures: 250 psf
f. Truck Support Structures: AASHTO-HS-20-44
k. Special Loading Conditions: Actual loadings

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

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

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

2C4.4.4 Earth Pressures

Earth pressures will be in accordance with the recommendations contained in the CCGS geotechnical report.

2C4.4.5 Groundwater Pressures

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

2C4.4.6 Wind Loads

The wind forces will be calculated in accordance with the CBC considering a basic wind speed (3 second gust) of 95 mph and a "C" exposure category. Occupancy category is III, and importance factor I=1.15. The project site location is considered within the Special Wind Region of the Coast or Delta Bay as stipulated by the Contra Costa County Building Department.

2C4.4.7 Seismic Loads

Structures will be designed and constructed to resist the effects of earthquake loads as determined in CBC 2007.

TABLE
2007 CBC Site Class and Site Seismic Coefficients[a]

	CDC Table/ Figure	Factor/ Coefficient	Value
Occupancy Category (power generation facility)			III
Soil Profile Type	Table 1613.5.2	Site Class	D
Mapped Spectral Response Acceleration for MCE at 0.2 second Period	Figure 1613.5(3)	SS	1.50g
Mapped Spectral Response Acceleration for MCE at 1.0 second Period	Figure 1613.5(4)	S1	0.50g
Site Coefficient	Table 1613.5.3(1)	Fa	1.0
Site Coefficient	Table 1613.5.3(2)	Fv	1.5
Adjusted MCE Spectral Response Parameter	Equation 16-37	SMS	1.50g
Adjusted MCE Spectral Response Parameter	Equation 16-38	SM1	0.75g
Design Spectral Acceleration Parameter	Equation 16-39	SDS	1.0g

TABLE
2007 CBC Site Class and Site Seismic Coefficients[a]

	CDC Table/ Figure	Factor/ Coefficient	Value
Design Spectral Acceleration Parameter	Equation 16-40	SD1	0.50g
Seismic Design Category	Table 1613.5.6(1) or 1613.5.6(2)		D
Importance Factor[b]	Table 11.5-1 (ASCE 7-05)	I	1.25

[a]Site specific soils related values will be confirmed with final Geotechnical Report.

[b]Importance Factor for structures associated with fire safety will be 1.5 (to be confirmed with Building Official).

2C4.4.8 Snow Loads

Snow loads will not be considered.

2C4.4.9 Turbine-Generator Loads

The combustion turbine-generators and the steam-turbine generators loads for pedestal and foundation design will be furnished by the equipment manufacturers, and will be applied in accordance with the equipment manufacturers' specifications, criteria and recommendations. Both static and dynamic loading will be considered.

2C4.4.10 Special Considerations for Steel Stacks

Steel stacks will be designed to withstand the normal and abnormal operating conditions in combination with wind loads and seismic loads, and will include the along-wind and across-wind effects on the stacks. The design will meet the requirements of ASME/ANSI STS-1-2006, "Steel Stacks," using allowable stress design method, except that increased allowable stress for wind loads, as permitted by AISC, will not be used.

2C4.4.11 Special Considerations for Structures and Loads During Construction

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

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

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

2C5 Design Bases

2C5.1 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 Allowable Stress Design (ASD) method or the Load and Resistance Factor Design (LRFD) method, in accordance with ANSI/AISC 360-05 Specification for Structural Steel Buildings.

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

Reinforced concrete for sumps, cooling tower basins, and other structures designed to contain water will meet the requirements of ACI 350.

2C5.2 Factors of Safety

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

Against Overturning: 1.50

Against Sliding: 1.50 for Wind Loads, 1.10 for Seismic Loads

Against Uplift Due to Wind: 1.50

Against Buoyancy: 1.25

2C5.3 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.

2C5.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the strength design equations will be determined based on CBC 2007, Sections 1605.2. The Allowable Stress Design load combinations of CBC 2007 section 1605.3 will be used to assess soil bearing pressure and stability of structures.

Steel framed structures will be designed in accordance with CBC 2007, Chapter 22

2C6 Construction Materials

2C6.1 Concrete and Grout

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

- Electrical duct bank encasement and lean concrete backfill (Mix Class A): 2000 psi

- General Structural concrete (Mix Class B): 4000 psi
- Concrete in contact with water or exposed to aggressive environment (Mix Class C): 5000 psi
- Grout : 5000 psi minimum

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

2C6.2 Reinforcing Steel

Reinforcing steel bars for concrete will be deformed bars of billet steel, conforming to ASTM A 615, Grade 60.

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

2C6.3 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 is required.

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

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

2C6.4 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 M.

Grout will conform to ASTM C 476.

2C6.5 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 specifications.