Russell City Energy Center

Appendix 10-A
Civil Engineering Design Criteria

May 2001

Russell City Energy Center AFC

May 2001

APPENDIX 10A
CIVIL ENGINEERING DESIGN CRITERIA

10 A1 INTRODUCTION

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of civil engineering systems for the Russell City Energy Center (RCEC). Information that is more specific will be developed during execution of the project to support detailed design, engineering, material procurement specifications, and construction specifications as required by the California Energy Commission.

10 A2 CODES AND STANDARDS

The design of RCEC civil engineering systems will be in accordance with laws and regulations of the federal government, the State of California, the County of Alameda, the City of Hayward, and 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.

10 A2.1 Civil Engineering Codes and Standards

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

- American Association of State Highway and Transportation Officials (AASHTO) - Standards and Specifications
- American Concrete Institute (ACI) - Standards and Recommended Practices
- American Institute of Steel Construction (AISC) - Standards and Specifications
- American National Standards Institute (ANSI) - Standards
- American Society of Testing and Materials (ASTM) - Standards, Specifications and Recommended Practices
- American Water Works association (AWWA) - Standards and Specifications
- American Welding Society (AWS) - Codes and Standards
- Asphalt Institute (AI) - Asphalt Handbook
- California Energy Commission - Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California, 1989
- Concrete Reinforcing Steel Institute (CRSI) - Standards
- Factory Mutual (FM) - Standards
- National Fire Protection Association (NFPA) - Standards
- International Conference of Building Officials (ICBO) - Uniform Building Code (UBC), 1997
- Steel Structures Painting Council (SSPC) - Standards and Specifications

10 A2.2 Engineering Geology Codes, Standards and Certifications

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

10 A2.2.1 Federal

None are applicable.

10 A2.2.2 State

The Warren-Alquist Act, PRC, Section 25000 et seq. and the California Energy Commission (CEC) Code of Regulations (CCR), Siting Regulations, Title 20 CCR, Chapter 2, require that an Application for Certification (AFC) address geologic and seismic aspects.

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

10 A2.2.3 City

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

RCEC development activities will require certification by a Professional Geotechnical Engineer and a Professional Engineering Geologist during and following construction, in accordance with the Uniform Building Code UBC), Chapter 70. The Professional Geotechnical Engineer and the Professional Engineering Geologist will certify the placement of earthen fills and the adequacy of the site for structural improvements, as follows:

- Both the Professional Geotechnical Engineer and the Professional Engineer will address UBC Chapter 70, Sections 7006 (Grading Plans), 7009 (Cuts), 7012 (Terraces), 7013 (Erosion Control), and 7015 (Final Report).
- The Professional Geotechnical Engineer will also address UBC Chapter 70, Sections 7011 (Cuts) and 7012 (Terraces).

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

Russell City Energy Center

Appendix 10-B
Structural Engineering Design Criteria

May 2001

APPENDIX 10B
STRUCTURAL ENGINEERING DESIGN CRITERIA

10 B1.0 INTRODUCTION

The purpose of this appendix is to summarize the codes, standards, and practices, and the standard design criteria that will be used in the design and construction of the structural engineering portions of the Russell City Energy Center (RCEC). These criteria form the basis of the design for the structural components and systems of RCEC. More specific design information will be developed during detailed design to support equipment procurement and construction specifications. Section 10B2.0 summarizes the applicable codes and standards and Section 10B3.0 includes the general criteria for natural phenomena, design loads, architectural features, concrete, steel, and seismic design. Section 10B4.0 describes the structural design methodology for structures and equipment. Section 10B5.0 describes the hazard mitigation for RCEC.

10 B2.0 DESIGN CODES AND STANDARDS

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

- Specifications for materials will generally follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI).
- Field and laboratory testing procedures for materials will follow standard ASTM specifications.
- Design and placement of structural concrete will follow recommended practices and the latest version of the American Concrete Institute (ACI), the International Conference of Building Officials, Uniform Building Code, 1997 Edition (UBC 1997), and the Concrete Reinforcing Steel Institute (CRSI).
- Design, fabrication, and erection of structural steel will follow the recommended practices and the latest version of the American Institute of Steel Construction Code (AISC) and UBC 1997.
- Steel components for metal wall panels and roof decking will conform to the American Iron and Steel Institute (AISI) Specification for the Design of Light Gage Cold-Formed Structural Members.
- Welding procedures and qualifications for welders will follow recommended practices and codes of the American Welding Society (AWS).
- Preparation of metal surfaces for coating systems will follow the specifications and standard practices of the Steel Structures Painting Council (SSPC), National Association for Corrosion Engineers (NACE), and specific instructions of the coatings manufacturer.
- Fabrication and erection of grating will follow applicable standards of the National Association of Architectural Metals Manufacturers (NAAMM).
- Design and erection of masonry materials will follow recommended practices and codes of the latest revision of the ACI Concrete Masonry Structures Design and Construction Manual

and the International Conference of Building Officials, Uniform Building Code, 1997 Edition (UBC).

- Plumbing will conform to the Uniform Plumbing Code, 1994 Edition (UPC).
- Design will conform to requirements of the Federal and California Occupational Safety and Health Administration (OSHA and CALOSHA).
- Design of roof coverings will conform to requirements of the National Fire Protection Association (NFPA) and Factory Mutual (FM).

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

The following laws, ordinances, codes, and standards have been identified as applying to structural design and construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more conservative code will be met.

10 B2.1 Federal

- Title 29 Code of Federal Regulations, Part 1910, Occupational Safety and Health Standards.
- Walsh-Healy Public Contracts Act (P.L. 50-204.10).

10 B2.2 State

- Business and Professions Code Section 6704, et seq.; Section 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 where personnel have to descend. This also applies to construction or demolition of any building, structure, false work, or scaffolding which is more than three stories high or equivalent.
- Title 24 California Code of Regulations (CCR). Adopts current edition of UBC as minimum legal building standards.
- State of California Department of Transportation, Standard Specifications.
- Title 8 CCR Sections 1500, et seq.; Sections 2300, et seq.; and Sections 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
- Title 8 CCR Section 450, et seq. and Section 750, et seq. adopts American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASMEB and PVC) and other requirements for unfired and fired boilers.

10 B2.3 Industry Codes and Standards

- California Energy Commission, "Recommended Seismic Design Criteria for Non-Nuclear Power Generating Facilities in California," June 1989.

- International Conference of Building Officials, "Uniform Building Code" (UBC), 1997 Edition.
- Structural Engineers Association of California, "Recommended Lateral Force Requirements and Tentative Commentary," 1988 Recommendation and Commentary.
- Applied Technology Council, "Tentative Provision for the Development of Seismic Regulations for Buildings," (ATC-3-06), Amended December 1982.
- American Institute of Steel Construction (AISC).
  - Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design, June 1, 1989.
  - "Code of Standard Practice for Steel Buildings and Bridges."
  - "Allowable Stress Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
  - Manual of Steel Construction Allowable Stress Design, ninth Edition.
- American Iron and Steel Institute (AISI) "Specification for the Design of Cold-Formed Steel Structural Members," August 19, 1986, Edition Cold-Formed Steel Design Manual Parts I-VII."
- American Welding Society (AWS) "Structural Welding Code-Steel Twelfth Edition" (AWS D1.1-92).
- American Concrete Institute (ACI).
  - "Building Code Requirements for Reinforced Concrete" (ACI 318/318R-99).
  - "Building Code Requirement for Structural Plain Concrete" (ACI 318.1/318.1R-99).
  - "Code Requirements for Nuclear Safety Related Structures," Appendix B (Steel Embedments only) (ACI 349-90), except that anchor bolts will be embedded to develop their yield strength.
  - ACI 530-92 "Building Code Requirements for Concrete Masonry Structures".
  - ACI 212.3R-91--Chemical Admixtures for Concrete.
  - ACI 302.IR-89--Guide for Concrete Floor and Slab Construction.
  - ACI 350R-89--Environmental Engineering Concrete Structures
- Structural and Miscellaneous Steel.
  - ASTM A569/A569M-91a Specifications for Steel Carbon (0.15 maximum percent) Hot-Rolled Sheet and Strip, Commercial Quality.
  - ASME/ANSI STS-1-1986--Steel stacks, except for circumferential stiffening which shall be in accordance with British Standard 4076--1978 and except that seismic design shall be in accordance with UBC 1997.
- American Society for Testing and Materials (ASTM). The following codes and standards shall be included as a minimum.
  - ASTM A36/A36M-96--Standard Specification for Carbon Structural Steel.
  - ASTM A53-96--Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - ASTM A276 96--Specification for Stainless Steel Bars and Shapes.
  - ASTM A500-93--Specification for Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

- ASTM B695-91--Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- ASTM A307-94--Specification for Carbon Steel Bolts and Studs.
- ASTM A123 - 89a—Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- ASTM A153-95--Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- ASTM A82-A-95--Specification for Steel Wire, Plain, for Concrete Reinforcement.
- ASTM A185-94--Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- ASTM A 615/A615 M-96-Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

- Masonry Institute of America, "Reinforced Masonry Engineering Handbook."
- American Water Works Association (AWWA).
  - "Standards for Welding Steel Tanks," (AWWA D100-84).
  - "Standards for Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids" (AWWA C301-84).
  - "Standards for Reinforced Concrete Water Pipe—Noncylinder Type, Not Prestressed"(AWWA C302-87).
- American Association of State Highway and Transportation Officials—(GDHS-2), "A Policy on Geometric Design of Highways and Streets."
- Heating, Ventilating, and Air Conditioning Guide by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
- Uniform Plumbing Code (UPC), 1994 Edition.
- International Association of Plumbing and Mechanical Officials.
- National Fire Protection Association Standards (NFPA).
- Steel Structures Painting Council Standards (SSPC).
- American Society of Nondestructive Testing (SNT-TC-1A).
- International Standard Organization (ISO) 3945-85 "Mechanical Vibration of Large Rotating Machines with Speed Range from 10 to 200 revs/sec—Measurement and Evaluation of Vibration Severity In Situ."

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. Where no other standard or code governs, the UBC will be used.

10 B3 STRUCTURAL DESIGN CRITERIA

10 B3.1 Natural Phenomena

10 B3.1.1 Datum

Site topographic elevations will be based on the elevation survey conducted using the National Geodetic Vertical Datum (NGVD) of 1929 elevation benchmarks. The finished grade of the facility will be approximately 10.0 feet.

10 B3.1.2 Wind Speed

Design wind speed will be 70 miles per hour based on UBC 1997 edition for a 50-year recurrence interval. This design wind speed will be used to determine wind loads for all structures as discussed in Subsection B3.2.3 Wind Loads.

10 B3.1.3 Temperature

Design basis temperatures for civil and structural systems will be as follows:

Maximum	94 Degrees, F
Minimum	34 Degrees, F

10 B3.1.4 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" below the finished grade.

10 B3.1.5 Seismicity

The plant site is located in Seismic Zone 4, as determined from Figure No.16-2, "Seismic Zone Map of the United States," UBC 1997.

10 B3.1.6 Snow

The plant site is located in a zero ground snow load area, as determined from Figure No. A-16-1 of UBC 1997.

10 B3.2 Design Loads

Design loads for all structures will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

10 B3.2.1 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, piping, drains, electrical trays, bus ducts, and the contents of tanks and bins measured at full operating capacity. The contents of tanks and bins shall not be considered as effective in resisting column uplift due to wind forces but shall be considered effective for seismic forces.

10 B3.2.2 Live Loads

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

Equipment live loads are calculated loads based upon the actual weight and size of the equipment and parts to be placed on floors during dismantling and maintenance or to be temporarily placed on or moved over floors during installation.

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

a. Roofs 20 psf

All roof areas will be designed for wind loads as indicated in Subsection B3.2.3, Wind Loads. Ponding loading effect due to roof deck and framing deflections will be investigated in accordance with AISC Specification Article K2. All roof areas will be designed for a minimum of 20 psf live load in addition to calculated dead loads.

b. Floors and Platforms (Steel Grating and Checkered Plate) 100 psf

In addition, a uniform load of 50 psf will be used to account for piping and cable tray, except where the piping and cable tray loads exceed 50 psf, in which case the actual loads will be used. Pipe hanger loads for the major piping systems will be specifically determined and located. Piping expansion and dynamic loads will be considered on an individual basis for their effect on the structural systems. Loads imposed on perimeter beams around pipe chase areas will also be considered on an individual basis.

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. The 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 slab.

d. Control Room Floor 150 psf

e. Stairs, Landings and Walkways 100 psf

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

f. Pipe Racks 100 psf

Where the piping and cable tray loads exceed the design uniform load, the actual loads will be used. In addition, a concentrated load of 15 kips will be applied concurrently to the supporting beams for the walkways to maximize the stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

g. Hand Railings

Hand railings will be designed for either a uniform horizontal force of 50 plf applied simultaneously with a uniform vertical live load of 100 plf, or a 200 pound concentrated load applied at any point and in any direction, whichever governs.

h. Slabs on Grade 250 psf

Consideration will be given to designing appropriate areas of the ground floor for support of heavy equipment such as construction and maintenance cranes.

i. Truck Loading Surcharge Adjacent to Structures 250 psf

j. 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 load.

Live loads may be reduced in accordance with the provisions of UBC Section 1606.

Posted 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.

10 B3.2.3 Wind Loads

Wind loads for all structures will be based on UBC 1997. Basic wind speed shall be 70 miles per hour and wind stagnation pressure (qs) 12.6 psf. A step function of pressure with height under Exposure C conditions will be used. The Importance Factor shall equal 1.0. Height brackets and velocity pressures will be as follows.

Height Aboveground Feet	**Velocity Pressure** Pounds-force per square foot
Grade to 20	13.9
20 to 40	15.4
40 to 60	17.3
60 to 100	19.13
100 to 160	21.44
160 to 200	23.05

The above velocity pressures are average values for the indicated height brackets. Design wind pressures will be determined by multiplying the velocity pressures by the appropriate pressure coefficients given in UBC Table No. 16-H using Method 1.

If wind design governs, the detailing requirements and limitations in the UBC 1997 seismic provisions will also be followed.

10 B3.2.4 Steel Stack

The steel stack and supports shall be capable of enduring specified normal and abnormal design operating conditions in combination with high wind or seismic event for the design life of the facility. Effects of wind will include along-wind and across-wind response. The RCEC will address the design considerations, meet the requirements, and utilize the design methods of Steel Stacks, ASME/ANSI STS-1-1986, and AISC Manual of Steel Construction Allowable Stress Design, Ninth Edition, except that increased allowable stresses for wind will not be used. Design values for yield strength and modulus of elasticity of the stack material will depend on the composition of the material and the maximum temperature of the metal at design operating conditions, and will be as prescribed by the ASME Pressure Vessel Code, Section VIII, Division 2, Part AM. Seismic loads shall be in accordance with UBC 1997.

10 B3.2.5 Seismic Loads

Seismic loads will be determined in accordance with the requirements specified in Section 10B3.6 - Seismic Design Criteria.

10 B3.2.6 Construction Loads

Structural integrity will be maintained without use of temporary framing struts or ties and cable bracing insofar as possible. However, construction or crane access considerations may dictate the use of temporary structural systems.

10 B3.2.7 Earth Pressures

Earth pressures will be in accordance with the recommendations contained in the project-specific "Final Subsurface Investigations and Foundation Report."

10 B3.2.8 Groundwater Pressures

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

10 B3.2.9 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.

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 an increase in allowable stresses.

10 B3.2.10 Load Combinations

At a minimum, the following load combinations will be considered. Applicable code-prescribed load combinations will also be considered.

- Dead load
- Dead load plus live load plus all loads associated with normal operation of the equipment, e.g., temperature and pressure loads, piping loads, normal torque loads, impact loads, etc.
- Dead load plus live load plus all loads associated with normal operation plus wind load
- Dead load plus live load plus all loads associated with normal operation plus seismic load
- Dead load plus construction loads
- Dead load plus live load plus emergency loads
- Dead load plus wind load
- Dead load plus seismic load

Every building component shall be provided with the strength adequate to resist the most critical effect resulting from the following combination of loads.

- Dead plus floor live plus roof live
- Dead plus floor live plus wind
- Dead plus floor live plus seismic

- Dead plus floor live plus wind plus roof live/2
- Dead plus floor live plus roof live plus wind/2
- Dead plus floor live plus roof live plus seismic

Note: Use live load only where required by UBC 1997 in combination with seismic.

10 B3.2.11 Allowable Stresses

Each load combination shall not exceed the allowable stress permitted by the appropriate code for that combination.

The 1997 UBC/1998 CBC allows a 33% stress increase for seismic and wind design in Section 1612.3.2l, which specifies loading combinations to be used for design of structures and portions thereof when using the allowable stress design method. These combinations are permitted a one-third increase in allowable stresses for all combinations including wind or seismic. Steel structural design will utilize these combinations along with the special seismic load combinations specified in Section 1612.4. Section 1612.3.1, which does not allow a 33% stress increase for seismic and wind design of structures, and specifies loading combinations to be used for the design of structures and portions thereof, will not be used. Therefore, the load combinations of section B3.2.11.2 (steel design) will comply with the UBC/CBC design requirements. Additionally, welded, bolted, or other intermittent connections such as inserts for anchorage of nonstructural components will not use the 1/3 increase in allowable stress when considering wind and seismic forces.

10 B3.2.11.1 Concrete Structures

For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with UBC Section 1909.

The required strength (U) shall be at least equal to the following.

- U = 1.4 Dead + 1.7 Live
- U = 0.75 (1.4 Dead + 1.7 Live + 1.7 Wind)
- U = 0.9 Dead + 1.3 Wind
- U = 1.4 (Dead + Live + Seismic)
- U = 0.9 Dead + 1.43 Seismic
- U = 1.4 Dead + 1.7 Live + 1.7 Earth Pressure
- U = 0.9 Dead + 1.7 Earth Pressure

10 B3.2.11.2 Steel Structures

The required strength (S) based on the elastic design methods and the allowable stresses (Fs) defined in Part 1 of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings is as follows.

- S = Dead + Live + (Roof Live Load) = 1.0 Fs.
- S = Dead + Live + (Wind or Earthquake) = 1.4
- S = Dead + Live + Wind = 2
- S = Dead + Live + Wind = 2
- S = Dead + Live + Earthquake = 1.4

- S = 0.9 Dead + Earthquake = 1.4

Frame members and connections will conform to the additional requirements of UBC Sections 1633 and 2213.

10 B3.3 Architecture

General design criteria for the architectural systems are as follows.

10 B3.3.1 Architecture—Engineered Buildings

General design criteria for materials and installation of architectural systems or components will be as follows.

Interior Walls. Where durability is required, interior walls may be constructed of concrete block masonry, structurally designed and reinforced as required. In offices, shops, etc., metal studs with gypsum board will usually be used to form interior partitions. Insulation for sound control will be used where required by design.

Fire Exits. Fire exits will be provided at outside walls as required by code. Exit signs will be provided. Fire doors will bear an Underwriters' Laboratories certification level for class of opening and rating for door, frame, and hardware. Doors will conform to wood or hollow metal door requirements and have fillers adequate to meet the fire rating.

Large Access Exterior Doors. Large access exterior doors will be rolling steel type with weather seals and windlocks. Components will be formed from galvanized steel, factory primed, and field painted. Doors will be motor-operated with override manual operation.

Painting. Exterior steel material that is not galvanized or factory finished will be painted. Painted color will match or harmonize with the color of the exterior face of the wall panels.

Color Schemes. Color schemes will be selected for overall compatibility.

10 B3.3.2 Architecture—Prefabricated Metal Buildings

Prefabricated metal buildings (packaged to include exterior doors, wall louvers, windows, and related enclosure components) will be furnished as follows.

Building Enclosure. Building enclosures will be of manufacturer's standard modular rigid frame construction with tapered or uniform depth rafters rigidly connected at ends to pinned-base tapered or uniform depth columns. Purlins and girts will be cold-formed "C" or "Z" sections conforming to "Specifications for Design of Cold-Formed Steel Structural Members" of American Iron and Steel Institute. All other members will be of ASTM A36 hot rolled shapes conforming to "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of American Institute of Steel Construction. Roof slopes will be approximately 1-inch rise per 12 inches of run. Metal roof coverings will be of prefinished standing seam panels of 24-gauge minimum.

Steel. Cold-formed components will conform to ASTMA570, Grade E, 42,000 psi minimum yield for material thicknesses equal to or less than 0.23 inch, or to ASTMA375, 50,000 pounds per square inch (psi) minimum yield for high tensile strength purlin or girt sections with material thicknesses equal to or less than 0.23 inch. Roof covering and wallcovering will conform to ASTM A446, Grade A, galvanized 33,000 psi minimum yield. All cold-formed components will be manufactured by precision roll or break forming.

10 B3.4 Concrete

Reinforced concrete structures will be designed in accordance with UBC 1997 and ACI 318-99, Building Code Requirements for Reinforced Concrete.

10 B3.4.1 Materials

The materials described below will be specified and used as a basis for design.

Reinforcing Steel. Reinforcing steel shall meet the requirements of ASTM A615 Grade-60. Welded wire fabric for concrete will conform to ASTM A 185.

Cement. Cement used in all concrete mixes will be Portland cement meeting the requirements of ASTMC150.

Aggregates. Fine aggregates will be clean natural sand. Coarse aggregates will be crushed gravel or stone. All aggregates shall meet the requirements of ASTM C33.

Admixtures. Plasticizers and retarders will be used to control setting time and to obtain optimum workability. Air entrainment of 4 to 6 percent by volume will be used in all concrete mixes. Calcium chloride will not be permitted. Interior slabs to be trowel finished may use less air entrainment.

Water. Clean water of potable quality shall be used in all concrete.

10 B3.4.2 Design

The system of concrete and steel reinforcing strength combinations will be used as follows.

- Concrete strength—psi (at 28days)--See table in Subsection 10B3.4.3
- Reinforcing strength—60,000 psi, Grade 60

10B3.4.3 Mixes

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

Material	Compressive Strength
Electrical ductbank encasement and lean concrete backfill (Class L-1)	2000 psi
Structural concrete (Class S-1)	3000 psi
Structural concrete (Class S-2)	4000 psi
Grout (Class G-1)	5000 psi

10B3.4.4 Concrete Tests

Quality control testing of concrete will be performed by an independent laboratory and will consist of the following.

Preliminary Review. Before concrete mixes are designed, the source and quality of materials will be determined and the following reports will be submitted.

- The type, brand, manufacturer, composition, and method of handling (sack or bulk) of cement.
- The type, source, and composition of fly ash.

- The classification, brand, manufacturer, and active chemical ingredients of all admixtures.
- The source of coarse aggregates and test reports to verify compliance with ASTMC33.
- The source of fine aggregates and test reports to verify compliance with ASTMC33.
- The results of tests to determine compliance of admixtures with appropriate ASTM requirements.

Design Mix Tests. Concrete will be proportioned to provide an average compressive strength as prescribed in UBC 1997 Section 1905.3. Documentation that proposed concrete proportions will produce an average compressive strength equal to or greater than required average compressive strength will be established based on trial mixtures in accordance with UBC Section 1905.3.3

Field Control Tests. Field control tests will include the following.

- Aggregate gradation. Each 500 tons of fine aggregate and each 1,000 tons of coarse aggregate will be sampled and tested in accordance with ASTM D75 and C136.
- Slump. A slump test will be made from each of the first three batches mixed each day. An additional test will be made for each 50 cubic yards placed in any one-day.
- Air content. An air content test will be made from one of the first three batches mixed each day and from each batch of concrete from which compression test cylinders are made. Air content tests will be in accordance with ASTMC231.
- Compression tests. One set of four concrete test cylinders will be made each day from each class of concrete being placed. Additional sets will be made depending on the amount of concrete placed each day. For each additional 100 cubic yards of each class, or major fraction thereof, placed in any one day, four additional sets of cylinders will be made. One cylinder of each set will be tested at an age of seven days, two cylinders of each set will be tested at 28 days, and one cylinder shall be stored until otherwise directed. Compression tests will be in accordance with ASTMC39.

10 B3.4.5 Reinforcing Steel Test

Mill test reports certifying that reinforcing steel is in accordance with ASTM and project specifications will be required.

10 B3.5 Steel and Other Metals

10 B3.5.1 Structural Steel

Steel framed structures will be designed in accordance with the UBC 1997 and the AISC Specification for the Structural Steel Building, Allowable Stress Design and Plastic Design, June 1, 1989. In addition, steel-framed structures will be designed in accordance with the criteria discussed in the following subsections.

10 B3.5.1.1 Materials

Structural steel shapes, plates, and appurtenances for general use will conform to ASTM A36 or A 572. Structural steel required for heavy framing members might consider the use of ASTM A441. Structural steel required for tubes will conform to ASTM A500, Grade B. Connection bolts will conform to ASTM A325. Connections will conform to AISC Specification for Structural Joints, November 13, 1985 edition. Welding electrodes will be as specified by the AWS. All structural steel will be shop primed after fabrication. Exterior structural steel may be hot dipped galvanized in lieu of prime painted.

10 B3.5.1.2 Tests

Mill test reports or reports of tests made by the fabricator will be required certifying that all material is in conformance with the applicable ASTM specification. In addition, the fabricator will provide an affidavit stating that all steel specified has been provided at yield stresses in accordance with the drawings and the specification.

10 B3.5.1.3 Design

All steel framed structures will be designed as "rigid frame" (AISC Specification Type 1) or "simple" space frames (AISC Specification Type 2), utilizing single span beam systems, vertical diagonal bracing at main column lines, and horizontal bracing at the roof and major floor levels. The use of Type 1 rigid frames will generally be limited to one-story, open garage, warehouse or shed-type structures, or to prefabricated metal buildings.

Suspended concrete slabs will be considered as providing horizontal stability by diaphragm action after setup and curing. Deflections of the support steel will be controlled to prohibit "ponding" of the fresh concrete as it is placed. Metal roof decks attached with welding washers or fasteners may be considered to provide a structure with lateral force diaphragm action. Grating floors will not be considered as providing horizontal rigidity.

Connections will be in accordance with AISC standard connection design for field bolted connections. Connections will be designed with bolts for bearing type joints with threads in shear plane except where connections are required to be slip-critical. Larger diameter bolts may be used to develop larger capacity connections or elsewhere as determined by the engineer.

10 B3.6 Seismic Design Criteria

This section provides the general criteria and procedures that will be used for seismic design of structures, equipment, and components.

RCEC is located in Seismic Zone 4 according to the Uniform Building Code, 1997 edition. The seismic performance objectives for this facility are as follows.

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

To achieve these objectives and to meet the requirements of the CEC and local codes, the facility will be designed in accordance with the 1997 edition of the Uniform Building Code. All structures, equipment internals, and components will be separated from adjoining structures.

10 B.3.6.1 Buildings and Structures

The seismic zone used for this site will be Zone 4 as determined from UBC 1997 Figure No. 16-2 titled "Seismic Zone Map of the United States," using an Importance Factor of 1.00. Seismic loading will be used in the design of structures only when it is greater than the computed wind loads.

Non-building structures are to be designed in accordance with UBC 1997 Section 1634. These are typically regular structures as defined in the UBC, so the static lateral force procedure will be applicable. In the event that dynamic analysis will be required based on discussions with the CBO, the affected structures will be evaluated in accordance with the requirements of the UBC.

Buildings and structures defined by UBC 1997 Section 1629.8.3 will be designed using the static lateral force procedure of Section 1630.

Buildings and structures defined by UBC 1997 Section 1629.8.4 will be designed using the dynamic lateral force procedure of Section 1631. The ground motion representation will use the response spectrum indicated in UBC Figure 16-3.

Lateral forces on elements of structures and nonstructural components will be determined from the greater of UBC 1632.2 requirements, or UBC 1634.5 requirement for equipment supported laterally at or below grade.

Steel-framed structures will comply with the requirements of UBC Chapter 22, Section 2213 including the requirements of Section 2213.5.1

Water storage tanks will meet the seismic design requirements of AWWA D100, Section 13, and UBC 1634.

10 B4 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.

10 B4.1 Structures

10 B4.1.1 Combustion and Steam Turbine Foundations

Combustion and steam turbine foundations will be designed to support the turbine and generator components.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10 B4.1.1.1 Foundation Loads

Foundation loads will be furnished by the combustion turbine manufacturer and will be superimposed with loads for the foundation itself. Typical loading data supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads from project specific criteria
- Seismic loads from project specific criteria
- Hydrostatic loads
- Temperature and pressure loads
- Emergency loads such as turbine accident loads

A typical combustion turbine foundation is indicated on Figure 10B4.1-1 and 10B4.1-2. A typical steam turbine foundation is indicated on Figure 10B4.1-3.

10 B4.1.1.2 Induced Forces

The combustion turbine and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts or sleeved through-bolts designed to resist the equipment forces.

10 B4.1.1.3 Structural System

Refer to Figure 10B4.1-1, 10B4.1-2 and 10B4.1-3 for information regarding the specific structural system.

10 B4.1.1.4 Structural Criteria

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section 10B3.4 Concrete. The foundation system will likely be a pile or soil supported rigid mat.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Allowable settlements
- Equipment, structure, and environmental loads
- Natural frequencies of rotating equipment
- Access and maintenance
- Equipment performance criteria
- Dynamic effects of the rotating machinery

Environmental loading will be determined in accordance with, Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads.

Seismic loading to the foundation from the combustion turbine will be calculated using equivalent lateral forces applied at the center-of-gravity of the equipment in accordance with the criteria specified in Section 10B3.6 Seismic Design Criteria for rigid equipment.

Load combinations and their respective strength factors for the foundation design will be as indicated in Subsection 10B3.2.10 Load Combinations and Subsection 10B3.2.11 Allowable Stresses.

10 B4.1.1.5 Analytical Techniques

The combustion turbine foundation will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed as a combined footing assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The factors of safety against overturning and sliding will be 1.5 and 1.1, respectively.

The combustion turbine foundation will be checked for dynamic response of the operating combustion turbine. Manual calculations and simple computer models based on the fundamental principles of dynamic behavior of structures will be used to determine the natural frequencies of the support system. Where soil-structure interaction effects are important, low strain soil properties will be used to calculate soil springs using the procedures from Vibrations of Soils and Foundation by Richard, Hall, and Woods or a similar procedure. The concrete foundation will be analyzed as a rigid body on soil springs with the equipment modeled as a rigid mass located at its center of gravity and rigidly attached to the foundation. The foundation will be proportioned such that the principal natural frequencies will be at least 10 percent removed from the equipment operating speed.

Should the resulting foundation design prove to be uneconomical, the dynamic behavior of the foundation will be evaluated and compared to ISO 3945 Criteria for Vibration Severity. The resultant vibration level will be within the "Good" range of this standard.

A procedure for the dynamic analysis of large fan foundations supported by soil or piers may be used to evaluate the dynamic behavior of the turbine foundations.

10 B4.1.2 Heat Recovery Steam Generator (HRSG) Foundation

The HRSG foundation will be designed to support the HRSG and associated equipment.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10 B4.1.2.1 Foundation Loads

Foundation loads will be furnished by the HRSG manufacturer and will be superimposed with loads for the foundation itself. Typical loading data supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Hydrostatic loads
- Temperature and pressure loads

The HRSG foundation will be designed to resist a superimposed uniform live load of 250 psf over the area not otherwise occupied by equipment.

A typical HRSG foundation is indicated on Figures 10B4.1-4 and 10B4.1-5.

10 B4.1.2.2 Induced Forces

The HRSG and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist the equipment forces.

10 B4.1.2.3 Structural System

Refer to Figures 10B4.1-4 and 10B4.1-5 for information regarding the specific structural system.

10 B4.1.2.4 Structural Criteria

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section B3.4 Concrete. The foundation system will be a reinforced concrete rigid mat.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Allowable settlements
- Equipment, structure, and environmental loads
- Access and maintenance
- Equipment performance criteria

Environmental loading will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads.

Seismic loading to the foundation will be supplied by the HRSG manufacturer and will reflect the structural system used by the HRSG to resist lateral loading.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10 Load Combinations and Subsection 10B3.2.11 Allowable Stresses.

10 B4.1.2.5 Analytical Techniques

The HRSG foundation will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The factors of safety against overturning and sliding will be 1.5 and 1.5, respectively.

10 B4.1.3 Stack and Foundation

The two stacks will be carbon steel stacks supported on a reinforced concrete mat foundation. The height of the stacks will be approximately 145 feet and each will be 18 feet in diameter. Final stack height will be determined based upon the results of air modeling.

10 B4.1.3.1 Foundation Loads

Foundation loads will be determined using project specific design criteria.

The design of the stack and foundation will include the following loads:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads

A typical steel stack foundation is indicated on Figure 10B4.1-6. Foundation loading magnitudes cannot be determined until specific stack design is completed.

10 B4.1.3.2 Induced Forces

The stack will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist the foundation and stack induced forces.

10 B4.1.3.3 Structural System

The steel stack will resist lateral loading as a fixed base cantilevered structure.

10 B4.1.3.4 Structural Criteria

The predominate forces acting on the stack will result from wind or seismic loading. The stack will be designed as indicated in Appendix B, Subsection 10B3.2.4 Steel Stacks.

Seismic loads will be determined in accordance with UBC Section 1634 Nonbuilding Structures. The fundamental period will be determined using UBC equations and will be calculated by both considering and ignoring the structural contribution of any lining material. The lower period will be used in the development of the seismic forces.

The allowable longitudinal stress, F, for the design of the stack shell will be determined from the following equations from ASME/ANSI STS-1-1986.

F = 1/8 Et/r/FS for t/r < 8Fp/E

F = [Fy - Ks (Fy - Fp)] / FS for t/r > 8Fp/E

< 20Fy/E

F = Fy/FS for t/r > 20Fy/E

where

E	=	Steel modulus of elasticity,
t	=	Shell plate thickness with corrosion allowance,
r	=	Shell radius,
FS	=	Factor of safety equal to 1.5,
Fy	=	Steel yield stress, and
Fp	=	Steel proportional limit equal to 0.70 Fy.

$$Ks = \left[\frac{\frac{20Fy}{E} - \frac{t}{r}}{\frac{20Fy}{E} - \frac{8Fp}{E}} \right]^2$$

The minimum shell thickness will be 1/4-inch plus 1/16-inch corrosion allowance. The corrosion allowance will be considered in the generation of seismic loads but not in the resistance to seismic or wind loads. Allowable stresses for stiffeners, platform members, and other details will be in accordance with the American Institute of Steel Construction Allowable Stress Design, Ninth Edition. Allowable stresses for the shell will not be increased for wind or seismic loadings.

The stack will be supported using an octagonal or circular shaped reinforced mat footing. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix G and Appendix B, Section B3.4 Concrete. The foundation system will likely be a soil supported or pile supported rigid mat.

The foundation design will address the following considerations.

- Soil bearing capacities and earth pressures
- Allowable settlements

- Structure and environmental loads

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10 Load Combinations and Subsection 10B3.2.11 Allowable Stresses.

10 B4.1.3.5 Analytical Techniques

Moments, shears, and axial forces will be calculated using static analysis procedures on a cantilevered member. Longitudinal stresses resulting from axial loads and flexure will be combined and compared to a single allowable stress.

The stack foundation will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads while maintaining a minimum 1.5 factor of safety against overturning. The factor of safety against sliding will be a minimum of 1.5.

10 B4.1.4 Buildings

The various plant site buildings will provide support, enclosure, protection, and access to the systems contained within its boundaries.

10 B4.1.4.1 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

10 B4.1.4.2 Induced Forces

Each building and associated major equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist any induced forces.

10 B4.1.4.3 Structural System

The buildings will be designed as AISC Type 1 rigid frames or as Type 2 simple braced frame. For the purpose of resisting seismic lateral loads, the structure will be classified as a regular structure with a concentric braced frame, ordinary moment resisting frame, or special moment resisting frame in accordance with the definitions of Chapters 16 and 22 of the Uniform Building Code.

10 B4.1.4.4 Structural Criteria

The building steel frames will be designed and constructed using the materials and criteria set forth in Section 10B3.5 Steel and Other Metals.

Environmental loading will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads.

Seismic loading for the buildings will be calculated using equivalent lateral forces applied to the structure in accordance with the procedures of UBC Chapter 16.

Building foundations will be designed and constructed using reinforced concrete according to the criteria set forth in Section 10B3.4 Concrete. The foundation system will likely be comprised of shallow soil supported spread footings to resist the column loads and an isolated slab on grade floor system or mat foundation.

The foundation design will address the following considerations.

- Soil bearing capacities and earth pressures
- Allowable settlements
- Equipment, structure, and environmental loads
- Access and maintenance
- Equipment performance criteria

Load combinations and their respective allowable stresses will be as indicated in Subsection 10B3.2.10 Load Combinations and Subsection 10B3.2.11 Allowable Stresses.

10 B4.1.4.5 Analytical Techniques

The building foundations will be designed using static analysis techniques assuming rigid spread footings or rigid mat. Spread footings or the mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded assuming a linear soil pressure distribution. The footings will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The factors of safety against overturning and sliding will be 1.5 and 1.1, respectively.

10 B4.2 Tanks

10 B4.2.1 Vertical, Cylindrical Field Erected Water Storage Tanks

The vertical, cylindrical, field erected water storage tanks will generally be of carbon steel construction with a protective interior coating.

The tank roof will be of the self-supported dome or cone type. The tank bottom will be ground supported, flat bottomed, with a slope of 1 percent. The tank will be provided with ladders, landing platforms, and handrails as required providing access to all working areas. Vents, manholes, overflow piping, and grounding lugs will also be provided as necessary.

The typical foundation will consist of a circular ringwall. The interior of the ring will be comprised of compacted backfill with a layer of compacted sand to serve as a bearing surface for the tank bottom.

10 B4.2.1.1 Foundation Loads

Foundation loads will be determined using project specific design criteria.

The design of the tank and foundation will include the following loads.

- Dead loads
- Live loads

- Wind loads
- Seismic loads
- Hydrodynamic loads

A typical field erected tank foundation is presented on Figure 10B4.2-1. Foundation loading magnitudes from the tank will not exceed bearing allowables of the soil.

10 B4.2.1.2 Induced Forces

Storage tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces in accordance with AWWA D100-84.

10 B4.2.1.3 Structural System

Storage tanks will resist lateral loading through shear in the tank walls. Overturning will be resisted by anchor bolts connecting the tank wall to the foundation. Refer to Figure 10B4.2-1 for information regarding the specific structural system.

10 B4.2.1.4 Structural Criteria

The foundation will be designed and constructed as a reinforced concrete ringwall using the criteria from Section 10B3.4 Concrete. Tank structures will be designed and constructed using the criteria established in AWWA D100-84.

Environmental loadings will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads multiplied by the appropriate pressure coefficient from Table No. 16-H of UBC.

Seismic loads will be determined in accordance with Section 10B3.6 Seismic Design Criteria and AWWA D100-84, Section 13.

The seismic overturning moment will be determined from AWWA D100-84, Section 13.3.3.1 for a Seismic Zone 4. The structure coefficient will be determined from Table 16-P. The value of C1 will be determined from Section 13.3.3.1. The site amplification factor, S, will be determined from Table 17.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10 Load Combinations, Subsection 10B3.2.11 Allowable Stresses, and Section 3 of AWWA D100-84.

Design loads will be applied at the center of gravity of the tank. Tank foundation design will include the moment resulting from lateral displacement (hydrodynamics) of the tank contents in accordance with AWWA D100-84, Section 13.3.3.2.

Piping connections will be designed with a minimum 2 inches of flexibility in all directions as specified in AWWA D100-84, Section 13.5.

10 B4.2.1.5 Analytical Techniques

The tank foundation will be designed using static analysis techniques of a circular ringwall. The ringwall will be proportioned to resist the dead load of the tank and the overturning moment determined from AWWA D100-84. The ringwall will also be proportioned to resist maximum anchor bolt-uplift force. Circumferential reinforcing steel hoops will be provided in the ringwall to develop the hoop stress produced by lateral soil pressure within the ringwall. The ringwall will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads while maintaining a minimum 1.5 factor of safety against overturning. The factor of safety against sliding will be a minimum of 1.5.

The tank structure will be designed and proportioned such that during the application of any load, or combination of loads, the maximum stresses as stipulated in AWWA D100-84 will not be exceeded.

10 B4.2.2 Horizontal, Cylindrical, Shop Fabricated Storage Tanks

The horizontal, cylindrical, shop fabricated tanks will be of carbon steel construction.

Tanks will be provided with ladders, landing platforms, and handrails as required providing access to all working areas. Each tank will be provided with a fill connection, fill drain, overflow, vent connections, manholes, and grounding lugs as necessary.

Foundations will be designed to resist the loadings imposed by the tanks and will be constructed of reinforced concrete.

10 B4.2.2.1 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 the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Hydrodynamic loads

10 B4.2.2.2 Induced Forces

Tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces.

10 B4.2.2.3 Structural System

Tanks will be supported by integral legs or saddle supports designed to resist gravity and environmental loadings.

10 B4.2.2.4 Structural Criteria

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section 10B3.4 Concrete. The foundation will likely be a soil supported rigid mat.

Environmental loadings will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads multiplied by the appropriate pressure coefficient from Table No. 16-H of UBC.

Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the tank or tank component in accordance with the criteria specified in Section 10B3.6 Seismic Design Criteria.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10 Load Combinations and Subsection 10B3.2.11 Allowable Stresses.

10 B4.2.2.5 Analytical Techniques

Tank foundations will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The factors of safety against overturning and sliding will be 1.5 and 1.5, respectively.

The tanks will be designed by a tank manufacturer in accordance with the ASME code, ANSI code, and the ASTM standards. Gravity and lateral loadings will be transferred to the foundation by integral legs or a saddle support system.

10 B4.3 Equipment

10 B4.3.1 Combustion and Steam Turbines

Combustion and steam turbines and accessories will be designed to resist all design loads. The combustion and steam turbines will be constructed of carbon and alloy steels as required by the manufacturer's standards and shall meet all applicable codes and standards.

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

10 B4.3.1.1 Equipment Loads

Equipment loads will be determined by the manufacturer based on project performance criteria. Typical loadings used for design include the following.

- Dead loads
- Live loads
- Operating loads
- Construction loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Emergency loads such as turbine accident loads

10 B4.3.1.2 Induced Forces

The combustion turbine and associated equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10 B4.3.1.3 Structural Criteria

The combustion turbine, generator, and accessories will be designed to resist project specific design loads and UBC specified loads.

Environmental loading will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads multiplied by the appropriate pressure coefficient from Table No. 16-H of UBC.

Seismic loading and design of the combustion turbine and accessories will be in accordance with project specific criteria and UBC. Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the equipment or component in accordance with the criteria specified in Section 10B3.6 Seismic Design Criteria.

Inlet air filtration equipment and inlet air duct support structures shall be designed to resist the loading specified in UBC Chapter 16. For the purposes of resisting seismic lateral loads, the inlet air duct support structure will be classified as regular or irregular in accordance with the criteria established in UBC Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in UBC Chapter 16 and Subsection 10B3.6.1 Buildings and Structures.

Lateral forces on elements of structural and nonstructural components will be determined in accordance with UBC Section 1632, with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with UBC Table 16-O. These seismic forces will be combined with forces due to normal operating loads.

Lateral forces on equipment will be determined in accordance with UBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with UBC Table 16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10 Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections will remain in the elastic range.

10 B4.3.1.4 Analytical Techniques

The combustion turbine and auxiliary equipment will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix 10. Stamps will be affixed to denote conformance to the appropriate codes.

10 B4.3.2 Heat Recovery Steam Generator (HRSG)

The HRSG and accessories will be provided with platforms, stairways, and handrails as required to provide access for operations and maintenance.

The HRSG and components will be designed to resist all design loads. The HRSG and components will be constructed of carbon and alloy steels as required by the manufacturer's standards and shall meet all applicable codes and standards.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10 B4.3.2.1 Equipment Loads

Equipment loads will be determined by the manufacturer and will be based on project performance criteria and applicable codes and standards. Typical loading used for design includes the following.

- Dead loads
- Live loads
- Operating loads
- Construction loads
- Wind loads
- Seismic loads
- Hydrostatic loads
- Temperature and pressure loads

10 B4.3.2.2 Induced Forces

The HRSG and associated equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10 B4.3.2.3 Structural Criteria

The HRSG and associated equipment will be designed to resist project specific design loads and UBC specified loads.

Environmental loading will be determined in accordance with Appendix 10B, Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads multiplied by the pressure coefficients from Table No. 16-H of UBC.

Seismic loading and design of the HRSG and associated equipment will be in accordance with project specific criteria and the UBC. Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the equipment or component in accordance with the criteria specified in Section 10B3.6 Seismic Design Criteria. The HRSG support structure will be designed to resist, at a minimum, the lateral forces specified in UBC Section 1634, Non-building structures and the applicable criteria of Section 10B3.6 Seismic Design Criteria.

For the purpose of resisting lateral seismic forces, the HRSG support structure will be classified as regular or irregular in accordance with the criteria established in UBC Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in UBC Chapter 16 and, Subsection 10B3.6.1 Buildings and Structures.

Lateral forces on elements of structural and nonstructural components will be determined in accordance with UBC Section 1632 with Z equal to 0.4, I equal to 1.0 and ap and Rp in accordance with UBC Table 16-O.

Lateral forces on equipment will be determined in accordance with UBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with UBC Table16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10 Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, stresses in the structural supporting members and connections shall remain in the elastic range.

10 B4.3.2.4 Analytical Techniques

The HRSG and associated equipment will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix 10B and Appendix 10C. Stamps will be affixed to denote conformance to the appropriate codes.

10 B4.3.3 Power Transformers

Power transformers, transformer equipment, material, and accessories will conform to the applicable standards of ANSI C57.12, NEMA TR1, ANSI/IEEE C59.94 and 98, and project specific criteria. The power transformer will be designed, fabricated, and tested in accordance with ANSI C57.12 series, NEMA TR 1, and project specific criteria.

The foundation will be designed to resist the loading furnished by the manufacturer and will be constructed of reinforced concrete.

10 B4.3.3.1 Foundation Loads

Foundation loads will be furnished by the power transformer manufacturer and will be superimposed with loads for the foundation itself. Typical loadings supplied by the manufacturer include the following.

- Dead loads
- Live loads
- Wind loads
- Seismic loads

A typical transformer foundation is indicated on Figure 10B4.3-1.

10 B4.3.3.2 Induced Forces

Power transformers, transformer equipment, and accessories will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10 B4.3.3.3 Structural System

The transformer will be regarded as a rigid body for foundation design purposes.

10 B4.3.3.4 Structural Criteria

Power transformers, transformer equipment, and accessories will be designed to resist project specific design loads, UBC specified loads, and loads from applicable codes and standards.

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix 10.1A, Section 10.1A3.1 Foundations and Section 10B3.4 Concrete. The foundation will likely be a soil supported rigid mat. The foundations will incorporate an interconnected integral containment basin capable of holding 110 percent of the transformer coolant contents prior to passage through an oil/water separator.

Environmental loading will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3 Wind Loads, multiplied by the appropriate pressure coefficients from UBC Table No.16-H.

Seismic loading and design of the power transformers, transformer equipment, accessories, and foundations will be in accordance with project specific criteria and UBC Chapter 16. Loading will be approximated using equivalent lateral forces applied to the center of gravity of the equipment or component using the criteria specified in Section 10B3.6 Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with UBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with UBC Table16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the foundation system will be designed for the same seismic load as the equipment. Load combinations will be as indicated in Subsection 10B3.2.10 Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections will remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 10B3.2.11 Allowable Stresses.

10 B4.3.3.5 Analytical Techniques

Power transformers, transformer equipment, and accessories will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix - 10D, Electrical Engineering Design Criteria.

The power transformer foundation will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlements and bearing pressure or pile loading criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The factors of safety against overturning and sliding will be 1.5 and 1.5, respectively.

10 B4.3.4 Miscellaneous Equipment

Where possible, all miscellaneous equipment will be designed to project specific criteria. This miscellaneous equipment includes, but is not limited to, motor control centers, batteries, low voltage power and lighting systems, isolated bus ducts, pumps, lube oil cooling units, fire detection and protection systems, and switchgear. Standardized components such as motors, pumps, small fans, and other similar products that represent manufacturers' standard stock items will not be designed to meet project specific seismic loading criteria.

Miscellaneous equipment will meet all applicable codes and standards as well as the individual manufacturer's standards.

All equipment foundations and supports will be designed to resist project specific loading and the loading furnished by the equipment manufacturer.

10 B4.3.4.1 Foundation Loads

Foundation loads will be furnished by the equipment manufacturers and will be superimposed with loads for the foundation itself. Typical loadings supplied by the manufacturer include the following.

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads (as applicable)

10 B4.3.4.2 Induced Forces

All miscellaneous equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10 B4.3.4.3 Structural System

Each individual piece of equipment will have its own unique structural system, and it is the responsibility of each manufacturer to assure its adequacy.

10 B4.3.4.4 Structural Criteria

All miscellaneous equipment will be designed to resist project specific and UBC specified loads where possible and loads from applicable codes and standards.

Seismic loading and design of miscellaneous equipment will be in accordance with project specific criteria and UBC Chapter 16, if possible.

Seismic loading will be calculated using equivalent lateral forces applied to the center of gravity of the equipment or component in accordance with the criteria specified in, Section 10B3.6 Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with UBC Section 1632 with Z equal to 0.4, I equal to 1.0, and a_p and R_p in accordance with UBC Table16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10 Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections shall remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 10B3.2.11 Allowable Stresses.

10 B4.3.4.5 Analytical Techniques

All miscellaneous equipment and accessories will be designed and constructed in accordance with applicable requirements of codes and standards.

All structural supports required for the miscellaneous equipment will be designed using static analysis techniques.

10 B5 HAZARD MITIGATION

RCEC 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.

10 B5.1 Seismic Hazard Mitigation Criteria

Section 8.15 provides the description of the regional seismicity and the seismic risk associated with each of the major faults considering historical magnitude and probability of occurrence. Geologic hazards associated with these faults, when considered in concert with results and recommendations of the future geologic investigation to be provided in Appendix 10G (at a future date) will be consistent with the design capabilities provided for the facility. The seismic design criteria are implemented through meeting the requirements of Seismic Zone IV of the UBC.

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

- 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.
- All equipment will be positively anchored to its supporting structure. Nominal uplift capacity will be provided in the absence of calculated overturning forces.
- Anchorages will be designed to resist the project specific seismic loadings.
- Foundation systems will be selected and designed to minimize the effects of soil liquefaction.
- 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.

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

- 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 minor repairs.

10 B5.2 Meteorological and Climatic Hazard Mitigation

Meteorological and climatic data will form the design basis for RCEC. Portions of the data and the design bases that pertain to structural engineering have been provided in this Appendix.

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

- 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.
- A storm water system with a retention basin will be designed maintain pre-development flow patterns to extent possible. The existing drainage from the site flows to offsite areas southwest of the site. The discharge from the retention basin will also discharge to this area. The basin shall be designed in compliance with all local codes and regulations and to minimize the impacts of increased runoff to offsite areas due to the development. At a minimum, discharge flow rates from the site shall be maintained at or below pre-development rates for storm events up to and including the 25-year, 24-hour storm. The basin shall also be designed to safely pass the peak discharge from the 100-year, 24-hour storm without overtopping the basin embankment.
- Plant drainage systems will be designed to convey the runoff from a rainfall event with a 25-year recurrence interval. Modifications to the system will be incorporated to minimize ponding in localized areas and preclude flooding of any buildings.
- Ground floor levels of structures will be placed above the 100-year flood level of 7.0 feet.
- Plant mechanical and electrical equipment will be placed on elevated equipment bases when required.
- The plant site will be graded to convey runoff away from structures and equipment.

The foregoing design features will be incorporated in accordance with 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.

Russell City Energy Center

Appendix 10-C
Mechanical Engineering Design Criteria

May 2001

APPENDIX 10C
MECHANICAL ENGINEERING DESIGN CRITERIA

10 C1 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 Russell City Energy Center (RCEC). More specific project information will be developed prior to construction of RCEC to support detailed design, engineering, material procurement specifications, and construction specifications as required by the California Energy Commission.

10 C2 CODES AND STANDARDS

Design of the mechanical systems and components will be in accordance with the laws and regulations of the federal government, state of California, and industry standards. The current issue or revision of the documents at the time of the filing of this AFC will apply, unless otherwise noted. If conflicts arise 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:

- Uniform Building Code
- Uniform Mechanical Code
- Uniform Plumbing Code
- ASME Boiler and Pressure Vessel Code
- ASME/ANSI 1331.1 Power Piping Code
- ASME Performance Test Codes
- ASME Standard TDP-1
- ANSI B16.5, B16.34, and B133.8
- American Boiler Manufacturers Association (ABMA)
- American Gear Manufacturers Association (AFMA)
- Air Moving and Conditioning Association (AMCA)
- American Petroleum Institute (API) – except for electrical requirements
- 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)

10 C3 MECHANICAL ENGINEERING GENERAL DESIGN CRITERIA

10 C3.1 General

Systems, equipment, materials, and their installation will be designed in accordance with applicable codes, industry standards, and local, state, and federal regulations. They will also conform to 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 specified by Bechtel. Equipment vendors will be responsible for using construction materials best suited for the intended use.

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.

10 C3.2 Pumps

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

10 C3.3 Tanks

Large outdoor storage tanks will not be insulated.

The demineralized water storage tank will be constructed of carbon steel with an internal coating selected from manufacturers such as Plasite, Carboline, Sherwin Williams, International Paint or Hempel. Two coats will be applied with a dry film thickness (DFT) as recommended by the coating manufacturer.

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

Water tanks will be designed, constructed, and certified to American Water Works Association (AWWA) Standards. Bolted construction for water tanks is acceptable.

Manholes, where provided, will be at least 18 in. 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.

10 C3.4 Heat Exchangers

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

Heat exchangers will include thermal relief valves as required.

10 C3.5 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 more than 18 in. on center
- Relief valves in accordance with the applicable codes

10 C3.6 Piping and Piping Supports

Stainless steel pipe may be Schedule 5S or 10S where design pressure permits. Underground piping may be high-density polyethylene (HDPE) where permitted by code, operating conditions, and fluid properties. In general, water system piping will be HDPE where embedded or underground, and carbon steel where above ground.

Piping systems containing steam will be of welded construction. Threaded joints will not be used in piping used for steam, lubricating oil, or CTG natural gas service. Natural gas piping components will not use synthetic lubricants. Victaulic or equivalent couplings will be used for low energy aboveground piping, where feasible.

Piping systems will have high point vents and low point drains. Drains with restricting orifices or steam traps with startup and blowdown drains and strainers/crud traps will be installed in low points of steam lines where condensate can collect during normal operation.

Steam piping systems and steam drain lines in the plant will be sloped in the direction of steam flow. Condensate collection in piping systems will be avoided by installing automatic drain devices and manual devices as appropriate.

Steam lines fitted with restricting devices, such as orifices in the process runs, will include adequate drainage upstream of the device to prevent water from collecting in lines.

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

Stainless steel piping will be used for the steam turbine and combustion turbine lubricating oil system feed piping.

10 C3.7 Valves

10 C3.7.1 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.

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.

Stops limiting 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.

10 C3.7.2 Drain and Vent Valves and Traps

Drains and vents in 900-pound class or higher piping and 500° F or higher service will be double valved.

Drain traps will include an air cock and easing mechanism. Internal parts will be constructed from corrosion-resistant materials and will be renewable.

Trap bodies and covers will be cast or forged steel and will be suitable for operating at the maximum working pressure and temperature of the piping to which they are connected. Traps will be piped to drain collection tanks or sumps and returned to the cycle if convenient.

10 C3.7.3 Low Pressure Water Valves

LP water valves will be the butterfly types of cast iron construction. Cast iron valves will have cast iron bodies, covers, gates (discs), and bridges; the spindles, seats, and faces will be bronze. Fire protection valves will be UL-approved butterfly valves meeting NFPA requirements.

10 C3.7.4 Instrument Air Valves

Instrument air valves will be the ball type of bronze construction, with the valve face and seat of an approved wear-resistant alloy.

10 C3.7.5 Nonreturn Valves

Nonreturn valves for steam service will be in accordance with ANSI standards and will be properly drained. Nonreturn valves in vertical positions will have bypass and drain valves. Bodies will have removable access covers to enable the internal parts to be examined or renewed without removing the valve from the pipeline.

10 C3.7.6 Motor-Actuated Valves

Motor-actuated valves will be fitted with both hand and motor operating gear. The hand and motor actuation mechanisms will be interlocked so that the hand mechanism is disconnected before the motor is started.

Motor actuators will include torque switches to stop the motor automatically when the valve gate has reached the "full open" or "full closed" position.

The motor actuator will be placed in a position relative to the valve that prevents leakage of liquid, steam, or corrosive gas from valve joints onto the motor or control equipment.

10 C3.7.7 Safety and Relief Valves

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

10 C3.7.8 Instrument Root Valves

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

10 C3.8 Heating, Ventilating, and Air Conditioning

HVAC system design will be based on site ambient conditions specified in Section 1.0.

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

Air conditioning will include both heating and cooling of the inlet filtered air. Air velocities in ducts and from louvers and grills will be low enough not to cause unacceptable noise levels in areas where personnel are normally located.

Fans and motors will be mounted on anti-vibration bases to isolate the units from the building structure. Exposed fan outlets and inlets will be fitted with guards. Wire guards will be specified for belt-driven fans and arranged to enclose the pulleys and belts.

Air filters will be housed in a manner that facilitates removal. The filter frames will be specified to pass the air being handled through the filter without leakage.

Ductwork, filter frames, and fan casings will be constructed of mild steel sheets stiffened with mild steel flanges and galvanized. Ductwork will be the sectional bolted type and will be adequately supported. Duct joints will be leaktight.

Grills and louvers will be of adjustable metal construction.

10 C3.9 Thermal Insulation and Cladding

Parts of RCEC 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, based on 80°F ambient temperature and 1 mph/hr air velocity. Other insulation minimums will be designed to limit the heat loss to approximately 80 Btu/hr-ft^2 based on an 80°F ambient condition and an air velocity of 20 mph/hr.

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 materials will be prohibited. An aluminum jacket or suitable coating will be provided on the outside surface of the insulation. Where a hard-setting compound is used as an outer coating, it will be nonabsorbent and noncracking. Thermal insulation will be chemically inert even when saturated with water. Insulation system materials, including jacketing, will have a flame spread rating of 25 or less when tested in accordance with ASTM E 84.

Insulation at valves, pipe joints, 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. Steam trap stations will be "boxed" for ease of trap maintenance and freeze protection.

Above ground insulated piping will be clad with pebbled or corrugated aluminum of not less than 30 mil thickness and frame reinforced. At the joints, the sheets will be sufficiently overlapped and corrugated to prevent moisture from penetrating the insulation.

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

Outdoor and underground insulation, if required, will be moisture resistant.

10 C3.10 Testing

Hydrostatic testing, including pressure testing in accordance with the ASME Code, will be specified and performed for pressure boundary components where an in-service test is not feasible or permitted by code.

10 C3.11 Welding

Welders and welding procedures will be certified in accordance with requirements of the applicable codes and standards before performing any welding. Bechtel will maintain indexed records of welder qualifications and weld procedures.

10 C3.12 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 painted.

10 C3.13 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 provided by the equipment manufacturer and will be the 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 splash lubricated, force lubricated, or self-lubricated. Oil cups will be provided as necessary. 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.

Russell City Energy Center

Appendix 10-D
Electrical Engineering Design Criteria

May 2001

Russell City Energy Center AFC

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APPENDIX 10D

ELECTRICAL ENGINEERING DESIGN CRITERIA

10 D1 INTRODUCTION

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

10 D2 CODES AND STANDARDS

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

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

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

10 D3 SWITCHYARD AND TRANSFORMERS

10 D3.1 Switchyard

The switchyard will be air-insulated. The switchyard will consist of SF6 circuit breakers for the transformers and lines to the grid, with disconnect switches on each side of the breakers. Each line will be equipped with the appropriate instrument transformers for protection and metering. Instrument transformers will also be used for generator synchronizing. Surge arresters will be provided for the outgoing lines in the area of the takeoff towers.

The 230 kV switchyard will be located on the north end of the site. Two lines will run from the switchyard to a take-off tower located in the northeast corner of the site.

The SF6 breakers may be of either the dead or live tank design with two bushing current transformers on each bushing. Disconnect switches shall be vertical. Switches will be located on each side of the breakers to isolate the breaker, and one switch will be located at each line termination or transformer connection for maintenance. Instrument transformers (current and capacitive voltage transformers) will be included for protection. Separate instrument transformers will be used for metering.

Aluminum alloy tubular bus will be used. Cable connections between the tube bus and equipment will be ACSR cable. Tube and cables will meet all electrical and mechanical design requirements.

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

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

Shield wires and/or lightning masts will provide lightning protection. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults shall be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to insure the safety of Equipment, Personnel, and the Public. Protective relaying will meet IEEE requirements and will be coordinated with the utility's requirements.

Each bus will be provided with a redundant high impedance differential relay system. Each outgoing line will be provided with redundant high speed relay systems with transfer trip capability. Transmission lines will have primary and backup microprocessor-based distance relays with communication capability to the remote substation. Relay equipment for the remote ends is not included.

Each circuit breaker will be provided with independent breaker failure relay protection schemes. Breaker failure protection will be accomplished by fault detector relays and timing relays for each breaker. Each high voltage breaker will have 2 redundant trip coils.

Interface with the utility supervisory control and data acquisition (SCADA) system will be provided. Interface will be at the interface terminal box and RTU. Communication between the facility switchyard and the substation at the other end of the overhead transmission lines will be included. Remote Terminal Units (RTUs) will allow interface and remote control of the switchyard.

Revenue metering will be provided on the 230 kV outgoing lines, recording net power to or from the switchyard (bi-directional). Meters and the metering panel will be provided.

10 D3.2 Transformers

Each generator will be connected to the 230kV switchyard through a separate main 18 kV to 230 kV step-up transformer. The step-up transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116. The main transformers will be two winding, delta-wye, OA/FA/FA. The neutral point of the HV winding will be solidly grounded. Each main step-up transformer will have metal oxide surge arresters adjacent to the HV terminals and will have manual de-energized ("no-load") tap changers located in the HV windings.

Facility power will be supplied through two unit auxiliary transformers, each connected upstream of the CTG Breakers. The unit auxiliary transformers will be two winding, delta-wye 18 kV to 4.16 kV transformers

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Appendix 10-E
Control Engineering Design Criteria

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APPENDIX 10E

CONTROL ENGINEERING DESIGN CRITERIA

10 E1 INTRODUCTION

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and installation for 10F.1 instrumentation and controls for the Facility. More specific project information will be developed prior to construction of RCEC to support detailed design, engineering, material procurement specifications, and construction specifications as required by the California Energy Commission.

10 E2 CODES AND STANDARDS

Design specifications for all work performed will be in accordance with the laws and regulations of the federal government and the State of California. A summary of general codes and industry standards applicable to design and construction follows.

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

10 E3 CONTROL SYSTEMS DESIGN CRITERIA

10 E3.1 General Requirements

Pneumatic signal levels, where used, will be 3–15 psig for pneumatic transmitter outputs, controller outputs, electric-to-pneumatic converter outputs, and valve positioner inputs.

Instrument analog signals for electronic instrument systems shall be 4 to 20 ma dc.

The primary sensor full-scale signal level, other than thermocouples, will be between 10 mV and 125 V.

10 E3.2 Pressure Instruments

Pressure instruments will have linear scales with units of measurement in pounds per square inch gauge.

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

Pressure gauges on process piping will be corrosion resistant and weatherproof.

Steam pressure sensing transmitters or gauges mounted above the steam line will be protected by a loop seal or siphon.

Pressure test points will have isolation valves and caps or plugs. Pressure devices on pulsating services will have pulsation dampers. Pressure devices subject to shock during equipment starts, stops, or transient conditions will be installed on an isolated gauge panel.

10 E3.3 Temperature Instruments

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

Dial thermometers will have 4½ or 5-inch diameter (minimum) dials and white faces with black scale markings, and will be every-angle type and bimetal actuated. Dial thermometers will be corrosion resistant and weatherproof.

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

RTDs will be either 100ohm platinum or 10ohm copper, ungrounded, three-wire circuits (R_{100}/R_0=1.385). The element will be spring-loaded, mounted in a thermowell, and connected to a cast iron head assembly.

Thermocouples will be single-element, grounded, spring-loaded, Chromel-Constantan (ANSI Type E) for general service. Chromel-Alumel (ANSI Type K) may be used for flue gas temperature measurement and high temperature applications (exceeding 1100°F). Thermocouple heads will be the cast type with an internal grounding screw.

10 E3.4 Level Instruments

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

Gauge glasses used in conjunction with other level instruments will cover the full range that is covered by the complementary instruments. Level gauges will be selected so that the normal vessel level is approximately at gauge center.

A single remote water level indicating system will be provided for each HRSG drum.

10 E3.5 Flow Instruments

Flow transmitters will be the differential pressure types with the range matching the primary element. In general, linear scales and trend displays will be used for flow indication.

The flow element for HP and IP feedwater flow to each HRSG will be laboratory calibrated venturi flow nozzles or low-loss flow tubes.

Feedwater flow meters will be temperature compensated when the water temperature is greater than 250°F. Critical steam flow meters will be temperature and pressure compensated. Airflow measurements will be temperature compensated.

10 E3.6 Control Valves

Control valves in throttling service will generally be the globe-body cage types with body materials, pressure rating, and valve trims suitable for the service involved. Other style valve bodies (e.g., butterfly, eccentric disk) may also be used when suitable for the intended service.

Valves will be designed to fail in a safe position.

Control valve body size will not be more than two sizes smaller than line size, unless the smaller size is specifically reviewed for stresses in the piping.

Control valves in 600-class service and below will be flanged where economical. Where flanged valves are used, minimum flange rating will be ANSI 300 Class.

Critical service valves will be defined as ANSI 900 Class and higher valves in sizes larger than 2 inches.

Severe service valves will be defined as valves requiring anticavitation trim, low noise trim, or flashing service, with differential pressures greater than 100 psid.

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

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

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

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

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

Valve position switches (with input to the DCS for display) will be provided for MOVs and open/close pneumatic valves. Modulating automatic combined recirculation flow control and check valves (provided by the pump manufacturer) or modulating control valves will be used for pump minimum-flow recirculation control.

10 E3.7 Instrument Tubing and Installation

Tubing used to connect instruments to the process line will be 3/8-inch outside diameter copper or stainless steel as necessary for the process conditions. Half-inch O.D. tubing may be used when deemed necessary by the Contractor.

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use so that equipment will be standardized as much as practical throughout the plant.

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

Instrument installation will be designed to correctly sense the process variable. Taps on process lines will be located so that sensing lines do not trap air in liquid service or liquid in gas service. Taps on process lines will be fitted with a shutoff (root or gauge valve) close to the process line. Root and gauge valves will be main-line class valves.

Instrument tubing will be supported in both horizontal and vertical runs as necessary. Expansion loops will be provided in tubing runs subject to high temperatures. The instrument tubing support design will allow for movement of the main process line.

10 E3.8 Pressure and Temperature Switches

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

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

10 E3.9 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. Freeze protection will be provided.

Field-mounted instruments may be grouped on racks when practical. Supports for individual instruments will be prefabricated, off-the-shelf, 2-inch 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.

Local control loops will generally use a locally mounted indicating controller (pressure, temperature, flow, etc.).

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

10 E3.10 Instrument Air System

Branch headers will have a shutoff valve at the takeoff from the main header. The branch headers will be sized for the air usage of the instruments served, but will be no smaller than 3/8 inch. Each instrument air user will have a shutoff valve and filter at the instrument.

Russell City Energy Center

Appendix 10-F
Chemical Engineering Design Criteria

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May 2001

APPENDIX 10F
CHEMICAL ENGINEERING DESIGN CRITERIA

10 F1 INTRODUCTION

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and installation of chemical engineering systems for the Russell City Energy Center (RCEC). More specific project information will be developed prior to RCEC construction to support detailed design, engineering, material procurement specifications, and construction specifications as required by the California Energy Commission.

10 F2 DESIGN CODES AND STANDARDS

The design and specification of all work performed will be in accordance with the laws and regulations of the federal government and the State of California. Industry codes and standards partially unique to chemical engineering design, to be used in design and construction of the RCEC, are summarized below.

- ANSI—American National Standards Institute

  ANSI B31.1—Power Piping Code

- ASME—American Society of Mechanical Engineers

  ASME—Performance Test Code 31, Ion Exchange Equipment

- ASTM—American Society for Testing and Materials.

  ASTM D859-94—Referee Method B for Silica as SiO_2

  ASTM D888-96—Referee Method A for Dissolved Oxygen

  ASTM D513-96—Referee Method D for CO_2

- OSHA—Occupational Safety and Health Administration
- SSPC—Steel Structures Painting Council Standards

  SSPC SP3—Power Tool Cleaning

  SSPC SP7—Brush-Off Blast Cleaning

  SSPC SP1—Solvent Cleaning

  SSPC SP6—Commercial Blast Cleaning

  SSPC SP5—White Metal Blast Cleaning

- UL—Underwriters Laboratories
- AWWA—American Waterworks Association

  WWA 2540-95—Method C for TDS

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.

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.

10 F3 GENERAL CRITERIA

10 F3.1 Design Water Quality

10 F3.1.1 Circulating Water

RCEC will use recycled water from the City of Hayward Waste Water Treatment Plant (WWTP) for circulating water makeup. The WWTP effluent will first be treated on-site in a Title 22 treatment facility, and the effluent produced will then be used as cooling tower makeup.

Data from the City of Hayward WWTP indicate that the effluent has the characteristics defined in Section 8.15, Water Resources.

10 F3.1.2 Service Water

Title 22 effluent will be used to supply RCEC with all general service water requirements such as fire fighting water, plant wash water, and other miscellaneous uses, as well as influent water to the cycle makeup water treatment system to meet the process needs for HRSG, including power augmentation and evaporative cooler water makeup.

A typical water analysis range for this water is presented in Section 8.15.

Water for potable/sanitary uses will be supplied from the municipal water supply. The water will be treated to meet local Public Health requirements.

10 F3.1.3 Cycle Makeup

Service water will be supplied to the Cycle Makeup Treatment System (demineralization system). The high quality effluent from the Cycle Makeup Treatment System will serve as makeup to the steam cycle. In addition, cycle makeup water will be used also to supply water for various uses during unit startup.

Water for cycle makeup will be the highest quality practical. Minimum quality requirements for cycle makeup water will be as follows:

- Total dissolved solids--0.1mg/l
- Silica as SiO_2--0.02 mg/l
- Specific conductance at demineralizer effluent--0.2 μS/cm
- pH--6.5 to 7.5

10 F3.1.4 Construction Water

Water for use during construction will be supplied from the Municipal Water supply or on-site wells.

10 F3.1.5 Fire Protection Water

Water for fire protection will be from a dedicated portion of the fire/service water storage tank and the cooling tower basin.

10 F3.2 Chemical Conditioning

10 F3.2.1 Cycle Chemical Conditioning

Condensate-feedwater chemical conditioning will consist of an oxygen scavenger supplemented as required by a volatile, alkaline material such as ammonia for pH control.

HRSG chemical feed will consist of a mixture of sodium phosphates to control boiler water pH, minimize scale formation, and provide boiler water buffering capacity.

10 F3.2.2 Circulating Water System Chemical Conditioning

Circulating water chemical conditioning will consist of chemicals to minimize corrosion and to control the formation of mineral scale and biofouling. Corrosion and scaling will be controlled by the use of sulfuric acid for alkalinity adjustment in conjunction with inhibitors, as required. Chlorination utilizing sodium hypochlorite will minimize biofouling of the condenser tubes and the cooling tower.

10 F3.2.3 Closed-Cycle System Chemical Conditioning

Bypass chemical feeders will provide water-conditioning chemicals to the Closed Cycle Cooling System. Makeup water to the closed systems will be condensate quality and an inhibitor (compatible with demineralized water) will be used for corrosion control.

10 F3.3 Chemical Storage

10 F3.3.1 Storage Capacity

Chemical storage tanks for bulk chemicals will, in general, be sized to store a minimum of 1.5 times the normal bulk shipment. The minimum acceptable volume of the SCR aqueous ammonia storage tank will provide at least 3 days storage.

Specialty chemicals used for makeup cycle water treatment, condensate and feedwater conditioning, circulating water, and miscellaneous uses, will be delivered in totes or specialized containers according to the chemical suppliers.

10 F3.3.2 Containment

Chemical storage tanks containing corrosive and hazardous fluids will be surrounded by curbing. Curbing and drain piping design will allow a full tank capacity spill without overflowing the curbing. For multiple tanks located within the same curbed area, the largest single tank will be used to size the curbing and drain piping.

Alternatively, where curbing is not possible, double-walled chemical tanks will be used for bulk chemicals that are corrosive and hazardous, in lieu of containment.

10 F3.3.3 Closed Drains

Waste piping for volatile liquids and wastes with offensive odors, will use closed drains to control noxious fumes and vapors.

10 F3.3.4 Coatings

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

10 F3.4 Wastewater Treatment

Metal cleaning wastes from pre-operational and operational chemical cleaning of the boiler and preboiler systems of the HRSG will be collected, treated, and disposed offsite by the chemical cleaning contractor. Other maintenance chemical cleaning wastes such as Reverse Osmosis (RO) chemical cleaning wastes and combustion turbine off-line washes will be collected in sumps, tested for compliance with discharge limits, treated, and hauled off-site (if necessary) by a licensed contractor. Cooling tower blowdown will be discharged directly from the circulating water system to the receiving water body (WWTP outfall). RO brine will also be discharged directly from the treatment system to the cooling tower blowdown for combined disposal. Other plant process wastewaters such as floor drains, HRSG blowdown, filter backwash and demineralizer wastes, as well as miscellaneous waste water streams, will be collected in the plant wastewater collection system for offsite discharge. Plant effluent to be discharged off-site will meet all applicable criteria of federal, state, and local permits.

Sanitary wastewater will be collected, treated, and discharged to the on-site package treatment system. Treated effluent from the on-site packaged sanitary treatment system will be discharged with the other plant wastes.

The wastes produced by the Title 22 facility will be discharged under a separate agreement to the receiving body of water.