

APPENDIX 2-1
CIVIL ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

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

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Startup, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the Project. The general foundation and civil engineering design criteria defined herein form the basis of the design for the foundation and civil systems of the Project. More specific design information will be developed during preliminary and detailed design to support equipment procurement and construction specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes, standards laws and ordinances and Section 3.0 includes the general criteria for foundations, design loads, and general site information.

2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

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 with the applicable local codes and ordinances. The following laws, ordinances, codes, and standards have been identified as applying to civil engineering design and construction.

When an edition date is not indicated the latest edition and addenda at time of plant design and construction shall apply.

2.1 FEDERAL

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.
- Title 40, CFR Section 112 et seq., US Environmental Protection Agency (EPA), requires a Spill Prevention Control and Countermeasure (SPCC) plan of facilities storing oil in excess of 660 gallons in any single above ground storage tank; 1,320 gallons in aggregate tanks above ground; and 4,200 gallons below ground.

2.2 STATE

- Business and Professions Code Section 6704, et seq., Sections 6730 and 6736, requires state registration to practice as a Civil Engineer or Structural Engineer in California.
- Vehicle Code Section 35780, et seq., requires a permit from Caltrans to transport heavy loads on state roads.
- 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 of any building; structure, false work or scaffolding which is more than three stories high or equivalent.
- Design will conform to the requirements of California Occupational Safety and Health Administration (CALOSHA).
- State of California Department of Transportation (Caltrans), Standard Specifications.
- Title 24, California Administration Code (CAC) Section 2-111, et seq.; Sections 3-100, et seq.; Section 4-106, et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6-T8-3233, et seq.; Section 6-T8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6-T8-5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq., adopts current edition of Uniform Building Code (UBC) as minimum legal building standards.
- Title 8, CAC, Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq., describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.

2.4 INDUSTRY CODES AND STANDARDS

The following general design requirements and procedures will be followed in development of project specifications regarding the use of Codes and Industry Standards. Codes and standards version or edition available at the time of start of preliminary design will be used.

- Specifications for materials will generally follow the standard specification for 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 the recommended practices and the latest version of the American Concrete Institute Code (ACI) and the Concrete Reinforcing Steel Institute (CRSI).
- Welding procedures and qualifications for welders will follow the 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 the specific instructions of the coatings manufacturer.
- Plumbing will conform to the International Plumbing Code (IPC).

The following Codes and Industry Standards shall be used:

- International Building Code, 2006 Edition.
- California Building Code 2001 Edition or later if adopted.
- American Association of State Highway and Transportation Officials (AASHTO), “A Policy on Geometric Design of Highways and Streets.”
- Hydraulic Institute Standards
- American Water Works Association (AWWA).
- “Standard Specification for Cast Iron Soil Pipe and Fittings”–(ASTM A 74)
- “Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe”–(ASTM C 76)
- “Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]”–(ASTM C 76M)
- “Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated”–(ASTM C 700)
- “Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings”–(ASTM F 405)
- “Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings”–(ASTM F 667)

- Asphalt Institute, Pacific Coast Division, Asphalt Institute Handbook.

3.0 CIVIL DESIGN CRITERIA

3.1 FOUNDATIONS

3.1.1 Geotechnical Investigation

A detailed geotechnical investigation will be conducted during the project preliminary engineering phase.

3.1.2 Foundation Design criteria

Detailed foundation design criteria, including allowable soil bearing pressures and dynamic soil properties will be developed for the project based on the results of the geotechnical investigation.

3.2 DESIGN LOADS

Design loads for structures and equipment foundations are discussed in Appendix 2-2. Design loads for pavements and buried items will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

3.2.1 Wheel and Crawler Loads

Loads exerted on roadway pavements, buried piping, box culverts, and embankments will be reviewed and selected prior to design of the underlying items. Typically, AASHTO HS-20 truckloads will be used for the design of roadway subgrades. Loads such as loaded scrapers, crawler cranes, equipment transport trailers, etc., may exceed the more typical HS-20 loadings and will be considered where appropriate.

3.3 SITE

3.3.1 Site Arrangement

The site arrangement will conform to applicable laws, regulations, and environmental standards. The principle elements in the selection of site arrangement criteria are the physical space requirements and relationships dictated by each of the major plant systems. Distances between various systems will be minimized for economy. However, adequate clearance between various systems will be provided as needed for construction, operations, maintenance, and fire protection. The plant will be located and oriented to minimize costs of construction, while remaining operationally efficient. Utility interconnections will be optimized as much as practical. Aqueous ammonia storage tanks will be provided for the facility. Spill containment measures will be provided. Treatment systems will be provided for facility wastewater streams. A sanitary wastewater disposal system will be provided.

The facility internal access roads will be provided. The site arrangement will be developed to minimize fill and/or excavation costs while maintaining efficiency of plant construction, operation, and maintenance. Area inlets will collect site storm water runoff to a storm drain system that discharges to a detention pond.

The following criteria will be followed regarding site infrastructure:

- Surfaces will be graded to drain.
- Roads will be designed for ease of construction and operational access.
- Oil and chemical storage areas will be designed to contain spills.
- Culverts and storm drain systems will be installed as required.
- Sanitary sewer system will be installed as required.
- Location and requirements for fencing or walls will conform to local laws and regulations.

3.3.2 Site Preparation

Site preparation will consist of clearing, stripping and grubbing, the excavation of soils to design grade. Cut and fill slopes and embankments will be designed to be stable and capable of carrying anticipated loads from either equipment or structures. Root mats or stumps, if any, will be removed. Holes will be refilled with material suitable for embankment and compacted. Materials from clearing, stripping and grubbing operations will either be removed from the site or, if suitable, reused on site.

3.3.3 Excavation and Fill

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

Materials suitable for backfill will be stored in stockpiles at designated locations using proper erosion protection measures. Excavated material that meets the design requirements will be used as general site fill where possible. Other excess non-contaminated material will be removed from the site and disposed of at an acceptable location. Disposal of contaminated material if encountered during excavation will comply with all applicable federal, state and local regulations.

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

Excavation and fill will be balanced with on site material to the maximum extent possible. Topsoil (estimated upper 6-inch layer) will be stockpiled on site.

3.3.4 Grading and Embankments

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

Final earth grade adjacent to buildings will be at least 6 inches below finished floor slab and will be sloped away from the building to maintain proper drainage.

Slopes for embankments will be no steeper than 2:1 (horizontal to vertical).

3.3.5 Backfilling and Compaction

Areas to be backfilled will be prepared by removing unsuitable material and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill. The material will be placed and compacted to the grades and density determined by the design. At least 95 percent compaction (ASTM 1557 method) will be provided under and in close proximity to foundations and under roads and 90 percent for the remainder.

Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve the specified density. In order to verify compaction, representative field density and moisture-content tests will be taken during compaction.

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

Approximately 6 inches of topsoil will be placed on fill in any areas that are to be seeded or otherwise landscaped.

3.3.6 Site Drainage

The site drainage system will be designed to comply with all applicable federal, state, and local regulations. The general site grading will establish a working surface for construction and plant operating areas, provide positive drainage from buildings and structures, and provide adequate soil coverage for underground utilities,

On site drainage will be accomplished through gravity flow where ever possible. The surface drainage system will consist of mild slopes. The slope of the graded areas away from structures will be a minimum of 1 percent. A storm sewer system with inlets and underground pipes will be provided in areas where ditches are not feasible.

Site drainage facilities will be designed to prevent flooding of permanent plant facilities resulting from a 10-year storm. Temporary facilities will be designed for a 2-year storm. The main plant area will be graded with moderate slopes (1 percent minimum preferred) for effective drainage.

Runoff from possible oil and chemical use areas, such as transformer areas and chemical storage areas, will be contained. Storm water contained in these areas will be routed through an oily water separator and a waste water collection system to a zero liquid discharge system for recovery and reuse.

The facility property will be preserved undisturbed where practical.

3.3.6.1 Drainage Ditches

Drainage ditches will be designed to convey the 10-year rainfall runoff flow without producing a headwater elevation above the bottom of the roadway base course. Erosion protection for ditches will be provided where peak runoff velocities will be greater than 4 feet per second (fps). These ditches will be protected by erosion control fabric, riprap, concrete paving, or soil-cement.

3.3.6.2 Drainage Culverts

Drainage culverts will be provided at the intersection of ditches and embankments. Culverts will be constructed of reinforced concrete, corrugated HDPE pipe or corrugated metal pipe. Reinforced concrete box culverts will be provided where necessary.

The minimum cover requirement of culverts will be 12 inches. All culverts will be designed to handle AASHTO HS20 truck loads and construction equipment loadings as applicable to the design. Allowance for corrosion protection over the expected life of the plant will be accounted for in the design and selection of culvert materials. Culverts will have beveled end sections compatible with the ditch side slopes or concrete headwalls at both the inlet and outlet. The inlets and outlets of all culverts will be protected from erosion by the installation of riprap.

3.3.6.3 Storm Water System

Storm water runoff will be collected on site and drained via plant drainage system to a retention basin. Inlets will be constructed of cast-in-place or precast concrete with top grates. Storm sewer pipes will be sized to limit flow velocities resulting from the 10-year storm to a maximum of 8 fps. A minimum design velocity of 2 fps will be used to facilitate cleaning. The minimum cover requirement, loading, and material selection for pipes will be as specified for culverts.

The retention basin will be sized to retain runoff from the 25 year, 24 hour storm With a minimum depth of two feet. It will be an unlined earth diked structure. The basin inside slopes will be stable under all possible design conditions. Water will be discharged either through evaporation or percolation.

3.3.7 Erosion and Sedimentation Control

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

The proposed site development will slightly alter the land use areas of the site. Any remaining agricultural vegetation will be removed as required during site preparation. The general

preparation of the overall site will be followed by earthmoving activities required for the construction of the plant. Final finish grading will begin when all other grading operations are complete. Final grading may include seeding disturbed areas not occupied by plant facilities or surfaced with concrete, asphalt or crushed aggregate.

Temporary erosion and sedimentation control measures to be used during construction will be designed to prevent sediments from being displaced and carried off-site by storm water runoff.

Prior to beginning excavation activities, a silt fence or straw bales will be installed along the perimeter of the project site where runoff to off-site areas could occur. The silt fence will filter sediments from construction runoff. During construction, the extent of earth disturbances will be minimized as much as practical.

Diversion ditches and/or berms will be constructed as necessary to divert runoff from off-site areas around the construction site. Temporary control measures will be maintained as necessary throughout the construction period.

Permanent erosion and sedimentation control measures within the project plant site will include the runoff collection system (ditches, inlets, culverts, drainage piping) and retention basin, surfaced traffic and work areas.

3.3.8 Roads

Access to the plant will be via a new road that will extend from an existing road on the north to the plant entrance. All plant roads will be appropriately maintained during the construction period. Periodic watering or applications of a dust palliative material will be used to minimize dust problems. Vehicular traffic into and out of the site will be limited as much as practical to daylight hours on Monday through Friday.

3.3.9 Fencing and Security

Chain link security fencing will be provided around the plant and other areas requiring controlled access. Fencing heights will be in accordance with applicable codes and regulatory requirements. A controlled access gate will be located at the main entrance to the secured area.

3.3.10 Landscape Plan

Landscaping will be planned as follows:

- The landscape plan will rely on site topography, concentrating on those viewpoints visible to the general public.
- All landscape material used will be selected with due consideration for the climatic and soil conditions on the site. The theme for the planting plan will be derived from an assessment of naturally occurring plant materials and an evaluation of the need for dense, hardy screening.

3.3.12 Sanitary Waste System

The sanitary waste system will be connected to a septic tank and with leachfield. The design will be in accordance with applicable codes, regulations and Uniform Plumbing Code. The total quantity of flow used in sizing the sanitary waste system will be calculated based on the total equivalent fixture units provided. Pipe will be sloped in accordance with the Uniform Plumbing Code.