ATTACHMENT A PROJECT DESCRIPTION MATERIALS

- FACILITY DESCRIPTION AND LOCATION
  (SECTION 3.0 FROM 99-AFC-7)
- SAFETY AND RELIABILITY
  (SECTION 4.0 FROM 99-AFC-7)
- CIVIL ENGINEERING DESIGN CRITERIA
  (APPENDIX C FROM 99-AFC-7)
- STRUCTURAL AND SEISMIC ENGINEERING DESIGN CRITERIA
  (APPENDIX D FROM 99-AFC-7)
- MECHANICAL ENGINEERING DESIGN CRITERIA
  (APPENDIX E FROM 99-AFC-7)
- ELECTRICAL ENGINEERING DESIGN CRITERIA
  (APPENDIX F FROM 99-AFC-7)
- CONTROL SYSTEMS ENGINEERING DESIGN CRITERIA
  (APPENDIX G FROM 99-AFC-7)
- CHEMICAL ENGINEERING DESIGN CRITERIA
  (APPENDIX H FROM 99-AFC-7)
- ELECTRIC AND MAGNETIC FIELDS CALCULATIONS
  (APPENDIX P FROM 99-AFC-7)

FACILITY DESCRIPTION AND LOCATION
(SECTION 3.0 FROM 99-AFC-7)

3.1 INTRODUCTION

The Pastoria Energy Facility (PEF) is a nominal 750 MW merchant-class electrical generating facility. The plant is conceptualized as three combustion turbine generators (CTGs) operating in combined cycle mode utilizing a two-on-one configuration plus a one-on-one configuration. The three CTGs are single-fueled natural gas-fired. Each exhausts to its own heat recovery steam generator (HRSG) and stack. The plant configuration is illustrated on Figures 3.1-1, 3.1-2, 3.1-3, and 3.1-4.

As a pure merchant plant competing in the deregulated California energy market, PEF provides strong synergies to Kern County and the State of California. PEF is designed as a good neighbor and is the target application for an exciting new emission control technology.

In addition to incorporating the efficiencies of F-Class, combined cycle, gas turbine power generation, PEF's list of commitments and benefits include:

- XONON™ Emission Control Technology

  In conjunction with Catalytica and General Electric, Enron North America Corp. (ENA) has embarked on an extremely aggressive development and testing program to support application of the XONON™ catalytic emission control technology to the F-Class turbines slated for the PEF project. Preempting the need for gas turbine exhaust clean-up, XONON™ operates within the gas turbine to reduce the formation of NO_x and CO to levels that require no downstream reduction. Using XONON™, the F-Class gas turbine exhaust will satisfy permitted stack levels for NO_x and CO.

  The XONON™ development schedule establishes a number of program milestones. Conceptual XONON™ design for a GE PGT 10B is scheduled to be completed in the first quarter of 2000. Prototype testing of XONON™ with the F Class turbine (7FA) is scheduled to be completed in the first quarter of 2003. It is anticipated that XONON™ combustors will be installed in the field as the plant nears completion.

- Location

  Sitting just north of the Tehachapi Mountains, the PEF:

  – Makes beneficial use of land located approximately 0.5 mile north of an abandoned gravel quarry and adjacent to an active gravel quarrying operation. Additionally, the

site makes use of a small area that is outside the range of either row or permanent crops.

- Uses its connection to the SCE transmission system at the Pastoria Substation to provide power to Southern California. Connecting at Pastoria, the flow of electricity will travel predominantly to the south without affecting Path 15 or Path 26.

- Makes use of its proximity to the Kern River-Mojave natural gas pipeline backbone to provide PEF with a reliable supply of high pressure natural gas. Based on expected line pressure, PEF may employ a turboexpander to capture "free" energy obtained in the pressure let-down process.

- Provides close proximity to the Department of Water Resources Edmonston Pumping Station to allow the State of California to contract for the economical supply of electricity in the future.

PEF will be located on an approximately 30-acre parcel of land that is owned by Tejon Ranchcorp and committed by lease option to Pastoria Energy Facility, LLC. The site is illustrated on Figures 3.1-5, 3.1-6 and 3.1-7. Although the site is under the Williamson Act, no active agricultural crop production activities are occurring on the site. The site is approximately 30 miles south of downtown Bakersfield, California, and approximately 6.5 miles east of Grapevine, California. No known urban type of development is presently planned within 5 miles of the plant site. Access to the power plant site will be provided from Edmonston Pumping Plant Road via a new Plant Access Road that will be constructed with the project.

Pastoria Energy Facility, LLC, herein referred to as Applicant, will develop, design, construct, own, and maintain the power plant. Electrical energy will be sold into the California Power Exchange.

PEF is located within the service area of the Wheeler Ridge-Maricopa Water Storage District (WRMWSD) which will meet the project's water needs from the California Aqueduct and underground water storage banks. The aqueduct passes through Tejon Ranch property, approximately 1 mile south of the PEF site, and has a surface elevation approximately 170 feet higher than the site elevation. The project will install a new 0.05-mile interconnection pipeline from the site to connect to the District's proposed 54-inch diameter water main west of the site.

Most of the water supplied by WRMWSD to the project will be used for makeup to a mechanical draft wet cooling tower. The balance of consumption will be for potable water, plant service water, demineralized water makeup to the HRSGs, and CTG inlet evaporative cooling.

PEF will produce potable water by operating an onsite certified water treatment unit utilizing raw water supplied from WRMWSD. Potable water will be used for safety showers, drinking, personnel showers and kitchen facilities. A small quantity of onsite potable water storage will be provided.

The project is considering two approaches to the processing of wastewater. The plant's wastewater will consist primarily of cooling tower blowdown and water treatment system discharge. To the extent capacity is available, the project will inject the wastewater stream into existing oil wells. The existing wells are located approximately 1.5 miles north-northwest of the site on Tejon Ranch property. A zero wastewater discharge (ZD) alternative is also being considered for the project. This alternative would require the addition of major equipment for the physical and chemical separation of dissolved and suspended solids from the wastewater stream. The ZD facility would require steam and/or electric power to operate and would produce a potentially saleable salt cake by-product. Pending the results of ongoing analysis, one of these processes, or a hybrid utilizing a combination of both processes, will be selected.

Stormwater will be controlled and collected onsite using surface drainage as well as a possible underground drainage and collection system. An oil-water separator will be incorporated into the collection system as required to process runoff from parking areas and equipment locations. Stormwater will be discharged to an onsite Storm Water Detention Pond. Stormwater that does not infiltrate into the soils or evaporate will be discharged to Pastoria Creek in accordance with applicable regulations and in coordination with Tejon Ranch.

Stormwater and wash water collected from plant equipment drains that may contain miscible chemicals will be directed to a small, enclosed, skid-mounted oil-water separator. Skimmed oil from this oil-water separator will be collected and sent off-site for disposal. Clear water will be discharged to the wastewater collection and processing system.

Sizing of the ponds and separator will be in conformance with applicable state and local standards.

Sanitary waste will discharge to an on-site treatment system. The system will consist of an underground septic tank and a parallel series of perforated pipes in a leaching field. An authorized hauler will periodically remove solids from the septic tank for transport and suitable disposal.

A new 230 kilovolt (kV) switchyard will be constructed at the project site. A new 1.38-mile long, double circuit, 230 kV overhead electric transmission line will connect the project to Southern California Edison's (SCE) electrical transmission system. Connection to SCE's

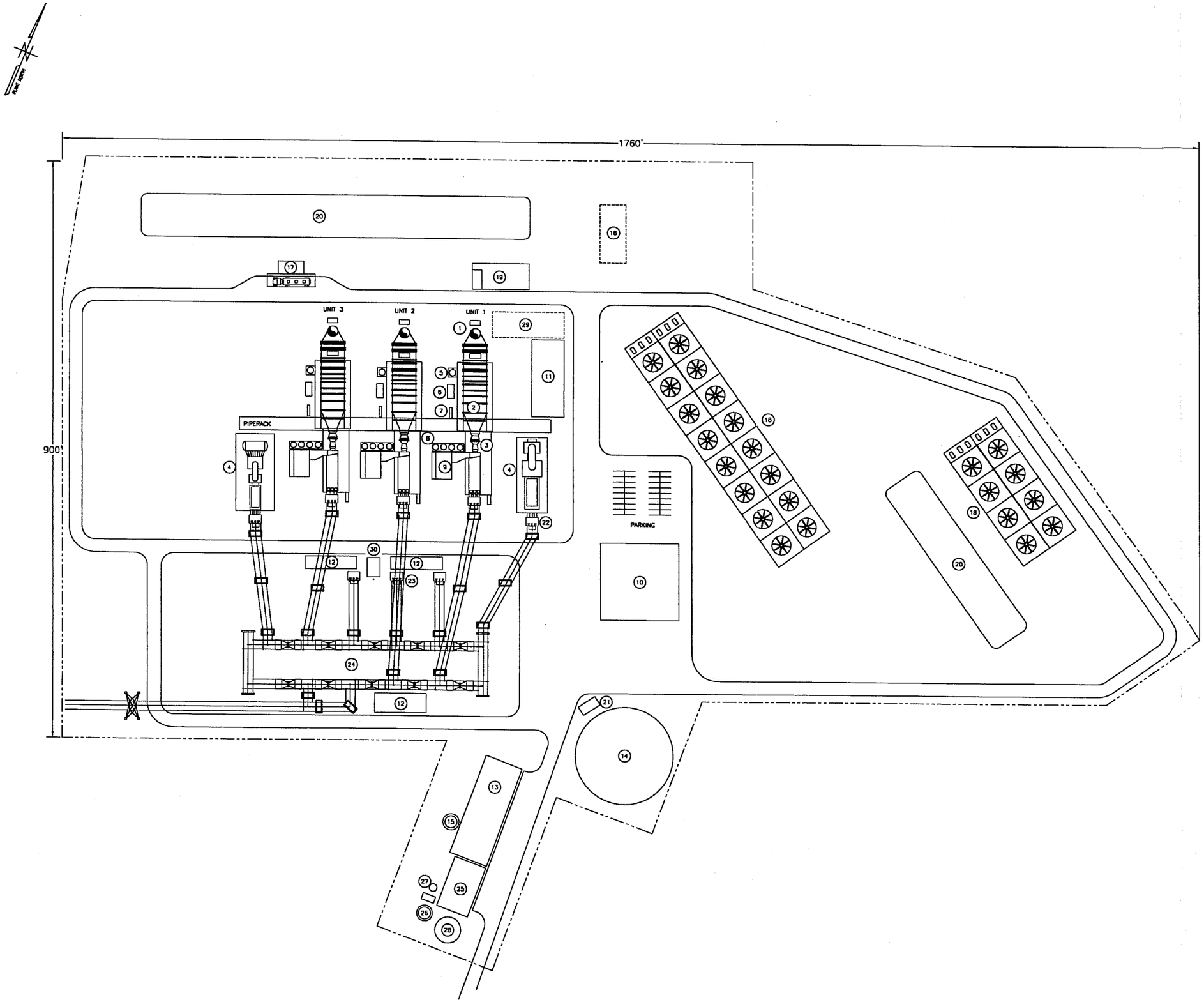
transmission system will occur at the existing Pastoria Substation, which is located south-southwest of the project. The new transmission line will run adjacent to and parallel with several existing SCE transmission lines.

If a contract is completed for the PEF to sell electric power directly to the Department of Water Resources' Edmonston Pumping Station, a new line may be required from the Pastoria Substation to the pumping station switchyard. This new line will require the Applicant to submit an amendment to the Application for Certification.

Fuel gas will be provided to the plant from the interstate pipeline owned jointly by the Kern River Gas Transmission Company and the Mojave Pipeline Company. The project will install a new 16- to 20-inch diameter line that will go north from the plant to the tie-in point. The proposed route is approximately 11.8 miles long. Several alternative routes are under consideration.

Figures 3.1-8 and 3.1-9 are photo simulated renderings of the site and adjacent area with the plant superimposed. Views are looking North and East, respectively.

The Applicant has reserved space for a fourth CTG, in one-on-one configuration, which may be added at a future date. The Applicant understands that adding an additional CTG will require a new Application for Certification.



1. STACK
2. HRSG
3. COMBUSTION TURBINE & GENERATOR
4. STEAM TURBINE & GENERATOR
5. AQUEOUS AMMONIA TANK
6. AMMONIA INJECTION SKID
7. FUEL GAS CONTROL SKID
8. GLYCOL & OIL COOLER
9. INLET AIR FILTER
10. WAREHOUSE
11. ADMINISTRATION AND CONTROL BUILDING
12. ELECTRICAL CONTROL BUILDING
13. WATER TREATMENT AREA
14. MAKE-UP WATER STORAGE TANK
15. DEMIN WATER TANK
16. LEACHING FIELD
17. AMMONIA UNLOADING
18. COOLING TOWER
19. FUEL GAS FILTER-SEPARATOR, METERING & TURBO-EXPANDER
20. STORM WATER DETENTION BASIN
21. FIRE WATER PUMP SKID
22. STEP-UP TRANSFORMER
23. AUXILIARY TRANSFORMER
24. 230 KV SWITCHYARD
25. MAKE-UP WATER TREATMENT BLDG
26. MAKE-UP WATER REACTOR
27. MAKE-UP WATER RAPID MIX TANK
28. MAKE-UP WATER CLARIFIER
29. (ZERO DISCHARGE OPTION)
30. STANDBY GENERATOR BUILDING

NOTES:

1. PLANT GENERAL ARRANGEMENT SUPPORTS APPLICANTS AFC FOR A 750 MW FACILITY.
2. OPEN AREAS AND SITE ARRANGEMENT PROVIDE OPPORTUNITY FOR FUTURE GROWTH.

0 50 100
SCALE IN FEET

FIGURE 3.1-1

REV. NO.	DATE	DESCRIPTION	DRW BY	DATE	CHK'D	PROJ ENG'R	APPR.
E	11/15/99	ISSUE FOR AFC	MCB	CJP			
D	10/18/99	REVISED BUILDINGS	MCB	CJP			

PASTORIA ENERGY FACILITY,LLC

CONCEPTUAL PLANT LAYOUT
2X1 & 1X1 "F" CLASS CONFIGURATION

• ENGINEERING •
1261 TRAVIS BLVD.
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: (707)435-9994
FAX: (707)435-9991
EMAIL: PATCH@PATCHINC.COM

SCALE: AS NOTED
JOB NO: 9880
DRAWING NO. 9880-2044
REV E

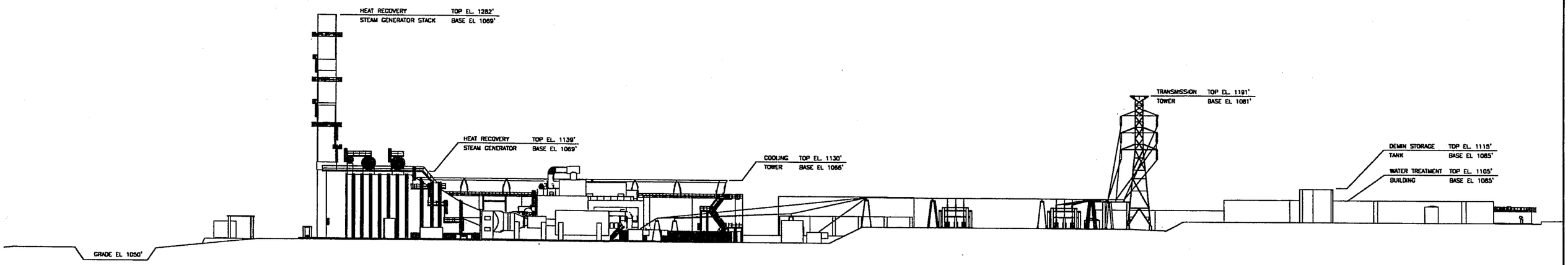


FIGURE 3.1–2

REV. NO.	DATE	DESCRIPTION	DRN BY	CHK'D BY	CHK'D	PROJ CHK'D	APPR.
B	11/15/99	ISSUED FOR AFC	MCR	CW			
A	10/22/99	PRELIMINARY	MCR	CJP			

PASTORIA ENERGY FACILITY,LLC

ELEVATION
2X1+ 1X1 "F" CLASS CONFIGURATION

• ENGINEERING •
1261 TRAVIS BLVD.
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: (707)435-9994
FAX: (707)435-9991
EMAIL: PATCH@PATCHINC.COM

SCALE:	NONE	DRAWING NO.	REV
JOB NO:	9880	9880–2045	B

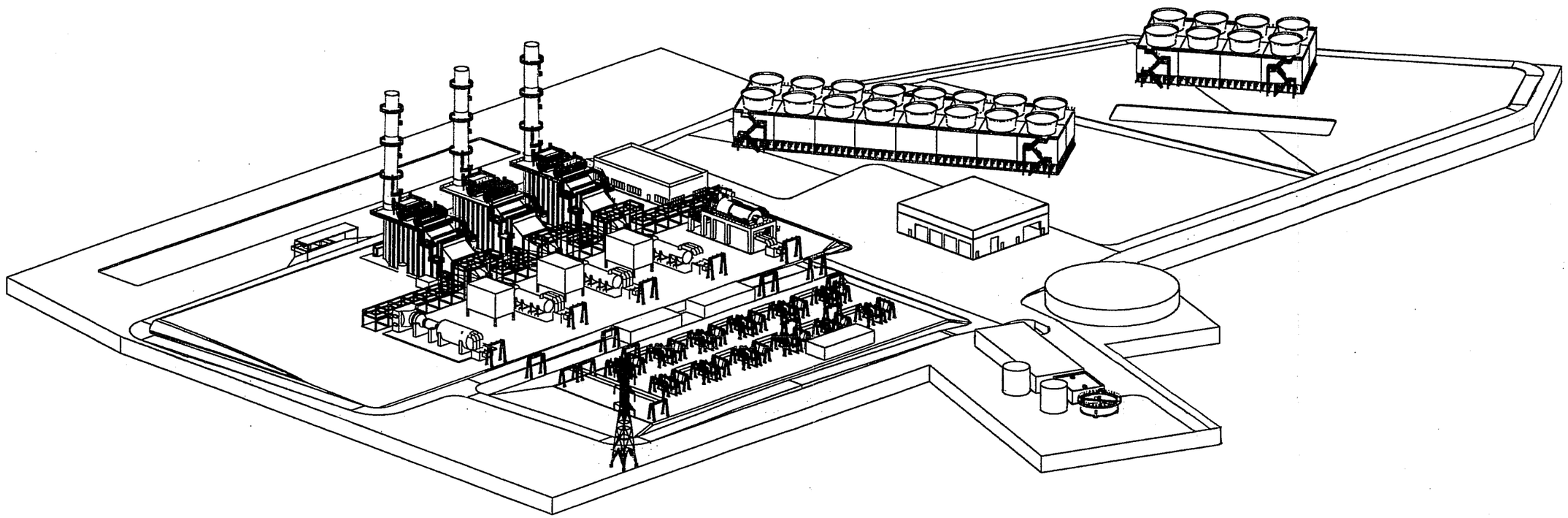


FIGURE 3.1-3

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DATE	CHECK'D	PROJ. CHK'D	APPR.
B	11/13/99	ISSUED FOR AFC	MCR	CW	CJP		
A	10/22/99	PRELIMINARY	MCR	CJP			

PASTORIA ENERGY FACILITY,LLC

ISOMETRIC VIEW
2X1 +1X1 "F" CLASS CONFIGURATION

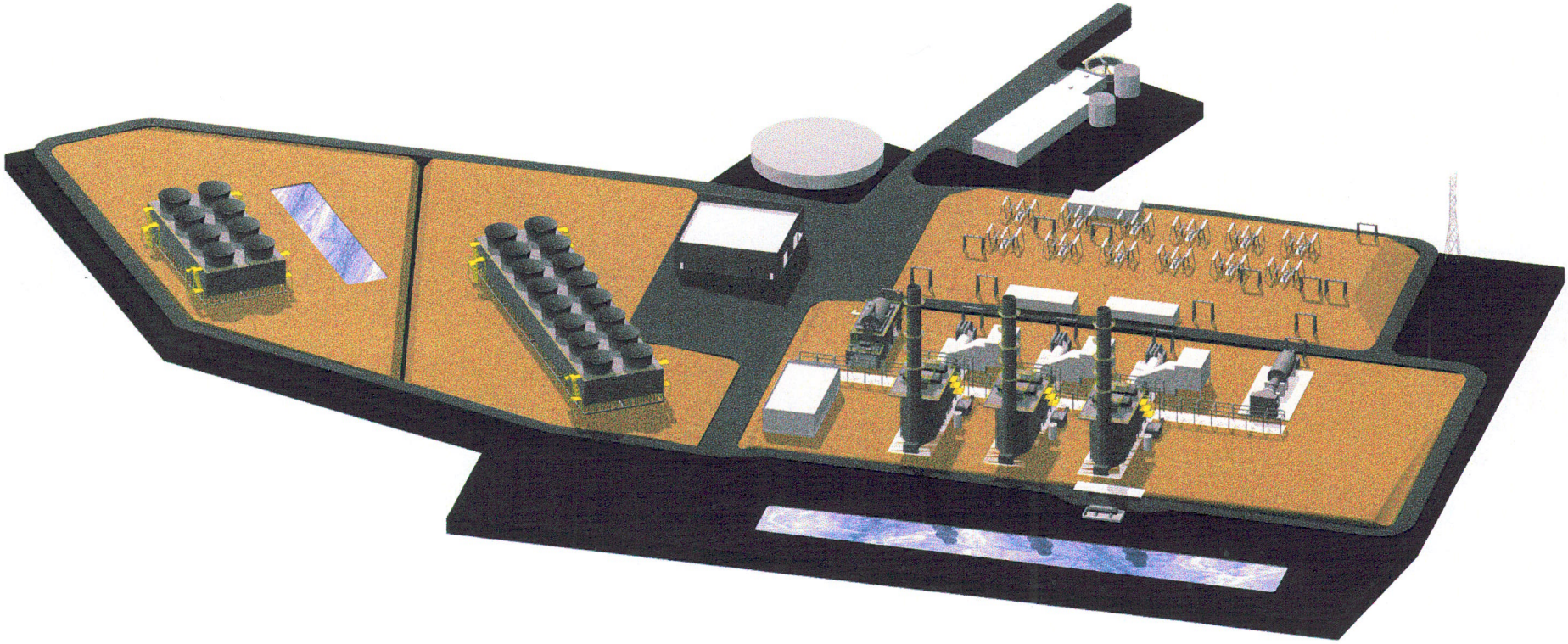
• ENGINEERING •
1261 TRAVIS BLVD.
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: (707)435-9994
FAX: (707)435-9991
EMAIL: PATCH@PATCHINC.COM

SCALE: NONE

DRAWING NO.

REV



PASTORIA ENERGY FACILITY, LLC
FIGURE 3.1-4
PLANT RENDERING,2X1 + 1X1 CONFIGURATION

GRAPHIC SCALE

(IN FEET)
1 inch = 400 ft.

FIGURE 3.1-5

REV	DATE	DESCRIPTION	DRAWN BY	CHK BY	DATE	PROJECT ENGR	APPR'D BY
E	11/15/99	FOR AFC	JRM				
D	11/09/99	WATER LINE REVISION	JRM				
C	10/21/99	GENERAL ARRANGEMENT	JRM				
B	10/13/99	WATER LINE ADDITION & GENERAL ARRANGEMENT	JRM				
A	10/11/99	GENERAL DISTRIBUTION	JRM				

PASTORIA ENERGY FACILITY, LLC

AREA PLAN

• ENGINEERING •
1261 TRAVIS BLVD
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: 707-433-0904
FAX: 707-433-0991
EMAIL: PATCH@patchline.com

SCALE: 1"=400'

DRAWING NO. D-9880-2051 REV. 5

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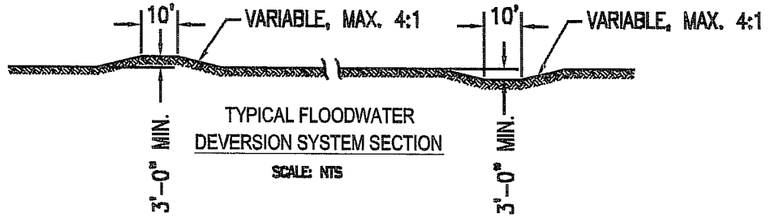


TYPICAL FLOODWATER DEVERSION SYSTEM SECTION

SCALE: NTS

NOTES:

1. DISTURBED AREAS SHALL BE RESEEDED WITH NATIVE GRASSES.
2. SLOPES WILL VARY SO AS TO PROVIDE A NATURAL APPEARANCE.

EXISTING 24"ϕ WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT WATER LINE

DRAINAGE SWALE

DRAINAGE SWALE

BERM

TEMPORARY CONSTRUCTION WATER LINE

BERM

PROJECT WATER SUPPLY LINE

CULVERT
ROAD EL= 1116.0
PIPE FL EL= 1113.0

BERM

DRAINAGE SWALE

PLANT ACCESS ROAD

CULVERT
ROAD EL= 1130.0
PIPE FL EL= 1126.0

DRAINAGE SWALE

CONNECT TO EXISTING SWALE

PROJECT WATER SUPPLY LINE

CONNECT TO EXISTING SWALE

220 KV TRANSMISSION LINE

EDMONSON PUMP STATION ROAD

PROPOSED 54"ϕ WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT WATER LINE

PLANT NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 200 ft.

FIGURE 3.1-6

REV	DATE	DESCRIPTION	DRAWN BY	CHK'D BY	CHK'D	PROJECT CHK'D	APPR'D BY
E	11/15/99	FOR ATC	JRM				
D	11/09/99	WATER LINE REVISION	JRM				
C	10/21/99	GENERAL ARRANGEMENT	JRM				
B	10/13/99	WATER LINE ADDITION & GENERAL ARRANGEMENT	JRM				
A	10/11/99	GENERAL REVISION	JRM				

PASTORIA ENERGY FACILITY, LLC

SITE ACCESS PLAN

ENGINEERING CONSTRUCTION
1261 TRAVIS BLVD
SUITE 105
FAIRFIELD, CALIFORNIA 94533
PHONE: 707-439-8994
FAX: 707-439-8991
EMAIL: PATCH@patchinc.com

SCALE: 1"=200'

DRAWING NO. D-9880-2050

REV E

ile: \\patchserv ings\land projects\9880-PASTORIA\dwg\9880-2050-C-11X17.dwg Plotted: 1999-11-1 :22

EXISTING 24"ø WHEELER RIDGE–MARICOPA WATER STORAGE DISTRICT WATER LINE

TEMPORARY CONSTRUCTION WATER LINE

BERM

DRAINAGE SWALE

STORM WATER DISCHARGE

STORM WATER DETENTION BASIN RIM EL= 1060.0, BOTTOM EL= 1050.0±

DISCHARGE TO EXISTING SWALE

PROPOSED 54"ø WHEELER RIDGE–MARICOPA WATER STORAGE DISTRICT WATER LINE

CULVERT

STORM WATER DISCHARGE

STORM WATER DETENTION BASIN RIM EL= 1066.0 BOTTOM EL= 1056.0±

DRAINAGE SWALE

CULVERT

EL= 1069

EL= 1066

BERM

PROJECT WATER SUPPLY LINE

PROJECT WATER SUPPLY LINE

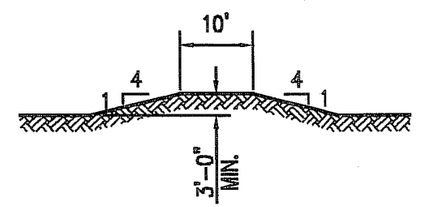
CONNECT TO EXISTING SWALE

BERM

220 KV TRANSMISSION LINE

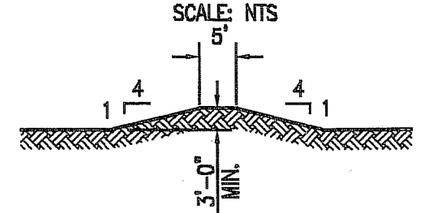
PLANT ACCESS ROAD

+1059 +1060 +1063 +1064 +1064.5 +1066 +1068 +1069 +1070 +1071 +1073 +1073.5 +1074 +1074.5 +1075.5 +1076.5 +1077.5 +1078 +1080 +1081 +1083 +1086 +1087



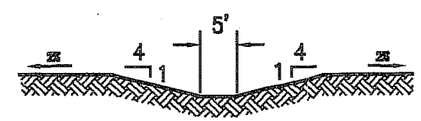
SECTION A-A

SCALE: NTS



SECTION B-B

SCALE: NTS



SECTION C-C

SCALE: NTS

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

FIGURE 3.1–7

REV	DATE	DESCRIPTION	DRAWN BY	CHK BY	CHKD	PROJECT ENGR	APPD BY
E	11/15/99	FOR AFC	JRM				
D	11/02/99	WATER LINE REVISION	JRM				
C	10/21/99	GENERAL ARRANGEMENT	JRM				
B	10/13/99	WATER LINE ADDITION & GENERAL ARRANGEMENT	JRM				
A	10/11/99	GENERAL DISTRIBUTION	JRM				

PASTORIA ENERGY FACILITY, LLC

SITE GENERAL ARRANGEMENT

• ENGINEERING •
1261 TRAVIS BLVD
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: 707–435–9894
FAX: 707–433–2991
EMAIL: PATCH@patchinc.com

SCALE: 1"=100'

DRAWING NO. D-9880-2049

REV E

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PASTORIA ENERGY FACILITY, LLC
FIGURE 3.1-8
PHOTO SIMULATED RENDERING

PASTORIA ENERGY FACILITY, LLC
FIGURE 3.1-9
PHOTO SIMULATED RENDERING

PATCH

3.2 FACILITY LOCATION

3.2.1 General Location

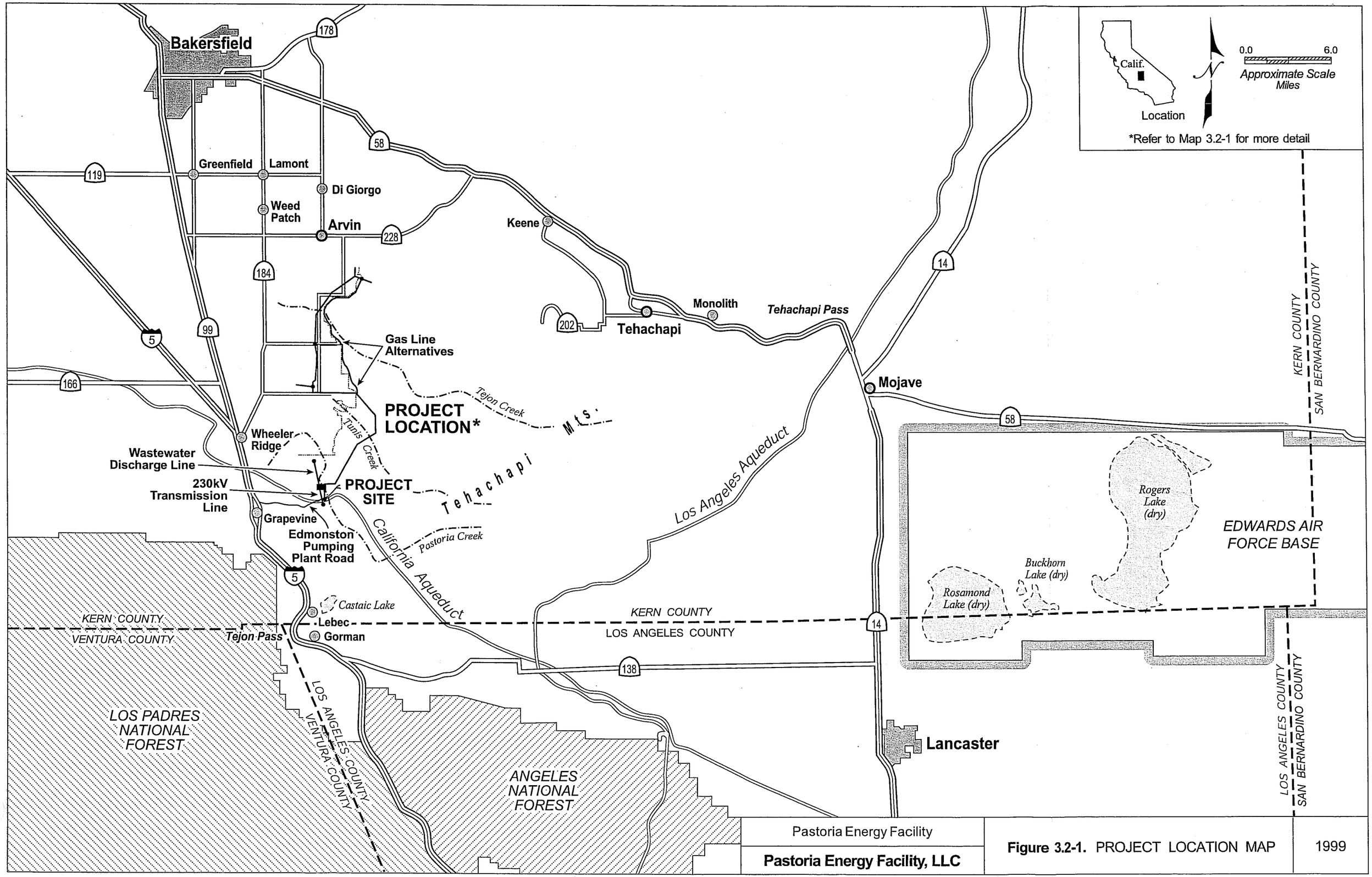
The PEF site is located on Tejon Ranch Property and is approximately 30 miles south of Bakersfield, California and 6.5 miles east of Grapevine, California. The PEF project includes a new Plant Access Road that will tie into Edmonston Pumping Plant Road and provide access to the plant. Edmonston Pumping Plant Road is accessible from Interstate 5 (see Figure 3.2-1 and Map 3.2-1).

3.2.2 Legal Description for Pastoria Energy Facility

All that real property situated in the county of Kern, State of California, described as follows:

A parcel of land being a portion of parcel 14-13, in the unincorporated area of the County of Kern, State of California, as shown on Assessor Parcel Map no. 3338, filed January 7, 1977, in book 17, page 78 of parcel maps in the office of the County Recorder of said county and that portion of lot 37 of Rancho El Tejon, of projected Section 18, Township 10 North, Range 18 West, San Bernardino Base and Meridian, in the unincorporated area of the County of Kern, State of California, patented to Jose Antonio adjure and Ignacio Del Vale by patent recorded in book 2, page 24 of patents in the Office of the County Recorder of said county, more particularly described as follows:

Commencing at the southwest corner of projected Section 7, Township 10 North, Range 18 West, San Bernardino Base and Meridian; thence east, 1300 feet more or less to a point; said point being the point of beginning. Thence south, 180.79 feet more or less to a point; thence west, 156.40 feet more or less to a point; thence south, 284.67 feet more or less to a point; thence west, 190.45 feet more or less to a point; thence north, 304.94 feet more or less to a point; thence south 69°32’41” west, 596.17 feet more or less to a point; thence north 20°27’19” west, 682.59 feet more or less to a point; thence north 11°03’47” west, 222.23 feet more or less to a point; thence north 69°32’41” east, 1033.11 feet more or less to a point; thence south 20°27’19” east, 195.81 feet more or less to a point; thence north 87°38’11” east, 429.02 feet more or less to a point; thence south 55°27’19” east, 497.44 feet more or less to a point; thence south 34°26’47” west, 177.82 feet more or less to a point; thence south 69°32’41” west, 627.13 feet more or less to a point; thence south, 103.88 feet more or less to the point of beginning, containing 31.07 acres more or less.

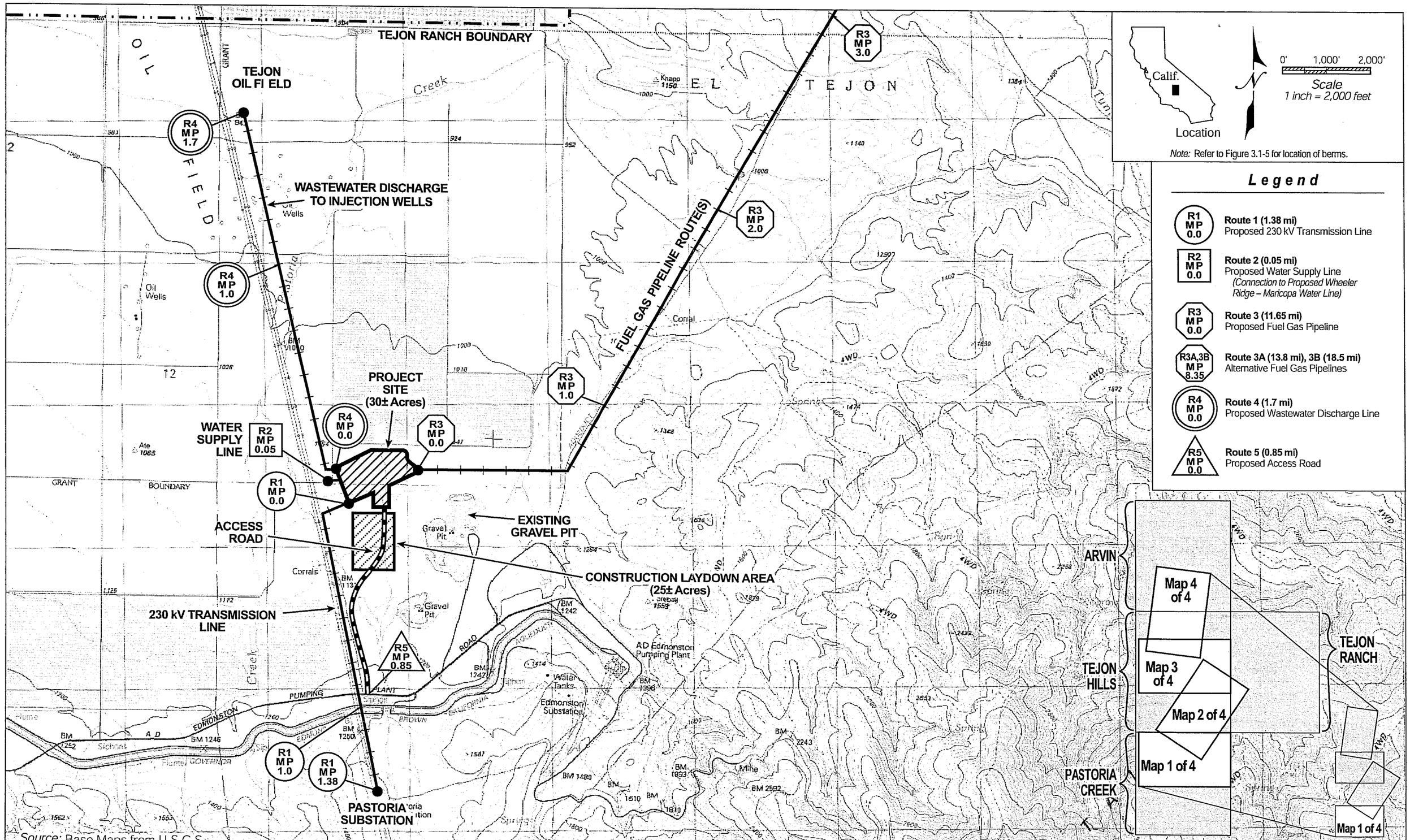


Pastoria Energy Facility

Pastoria Energy Facility, LLC

Figure 3.2-1. PROJECT LOCATION MAP

1999



Source: Base Maps from U.S.G.S. 7.5 Minute Topographic: Pastoria Creek, CA; Tejon Ranch, CA; Tejon Hills, CA; and Arvin, CA
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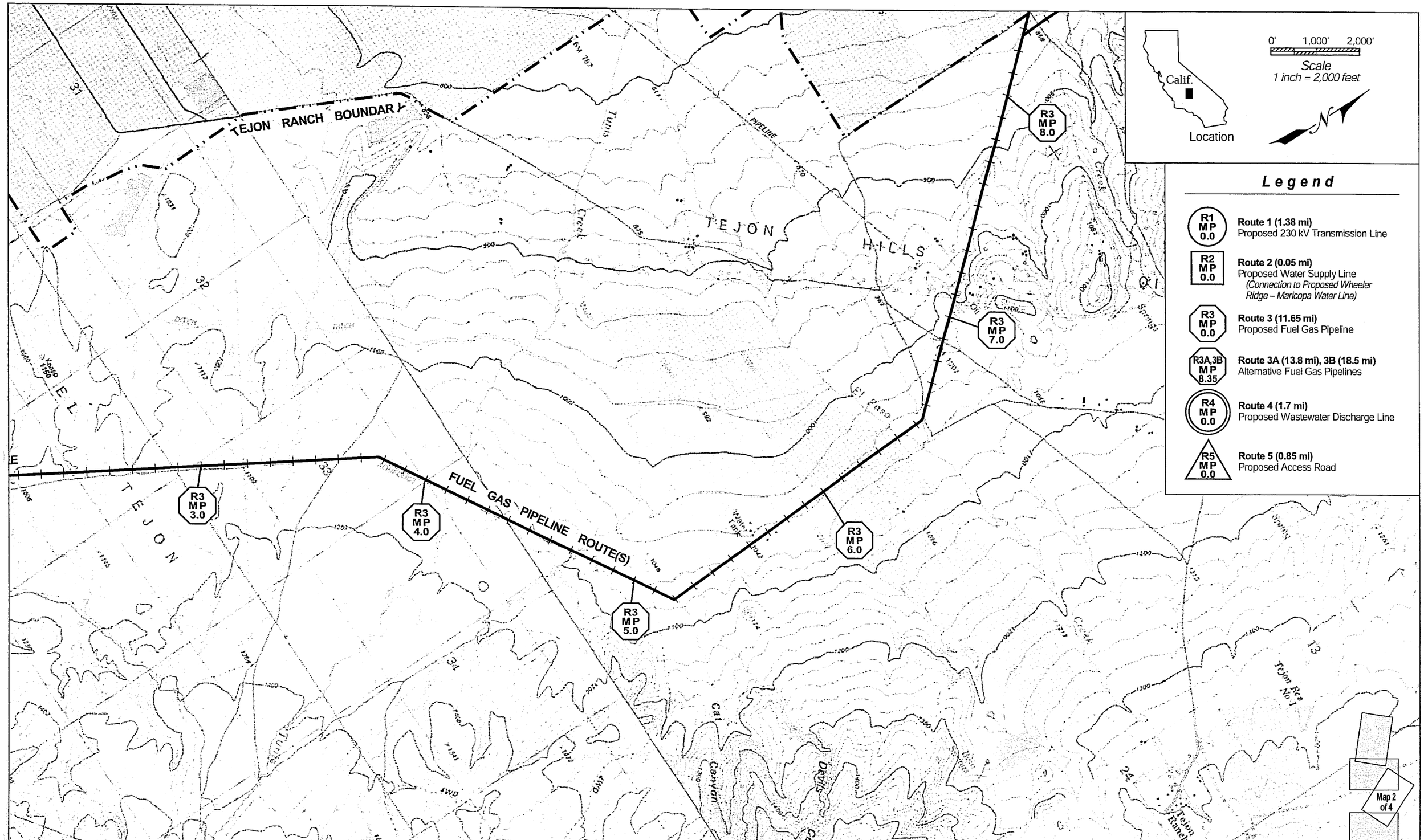
Pastoria Energy Facility

Pastoria Energy Facility, LLC

Map 3.2-1. LOCATION OF PASTORIA ENERGY FACILITY PROJECT COMPONENTS

Map 1 of 4

1999



Source: Base Maps from U.S.G.S. 7.5 Minute Topographic: Pastoria Creek, CA; Tejon Ranch, CA; Tejon Hills, CA; and Arvin, CA
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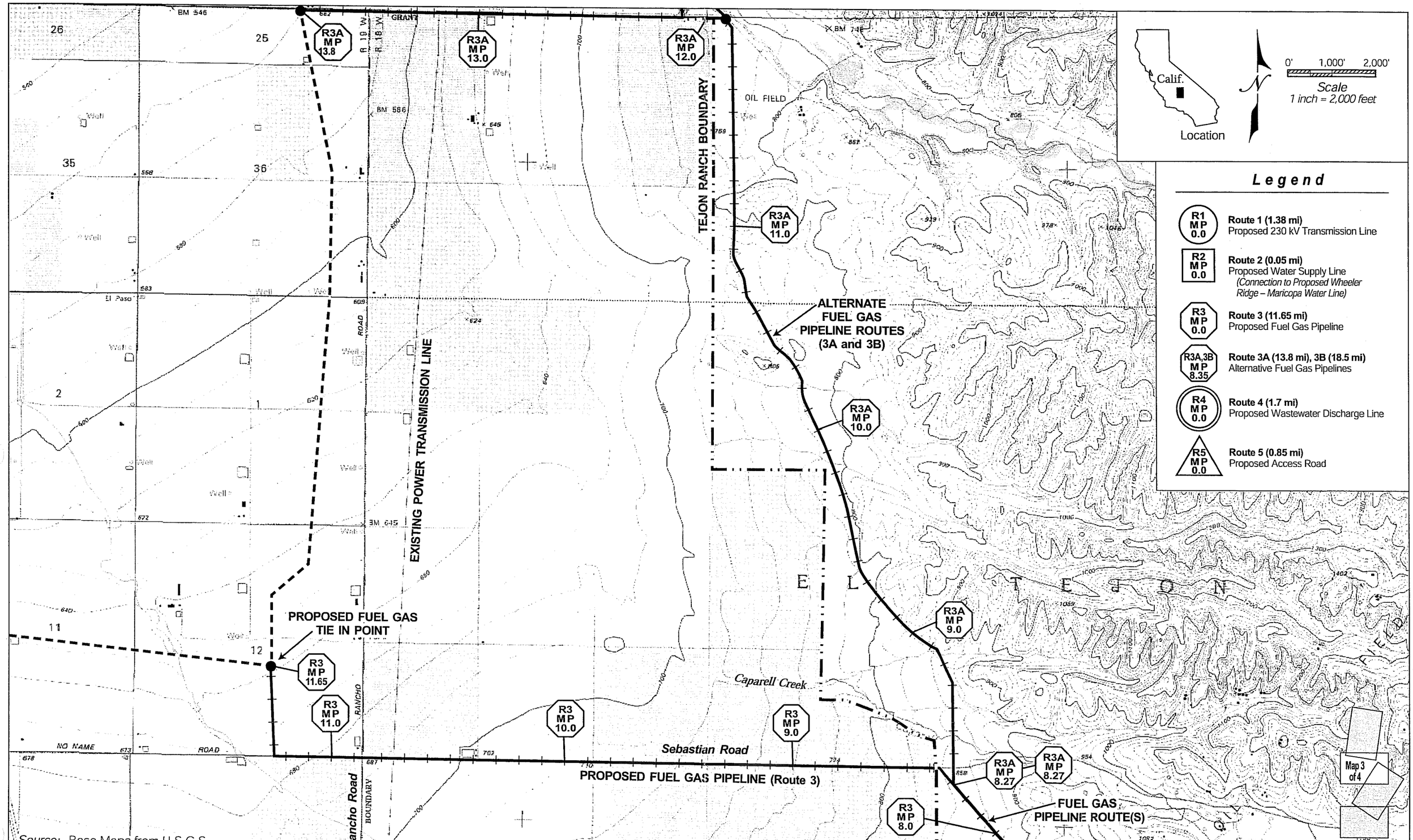
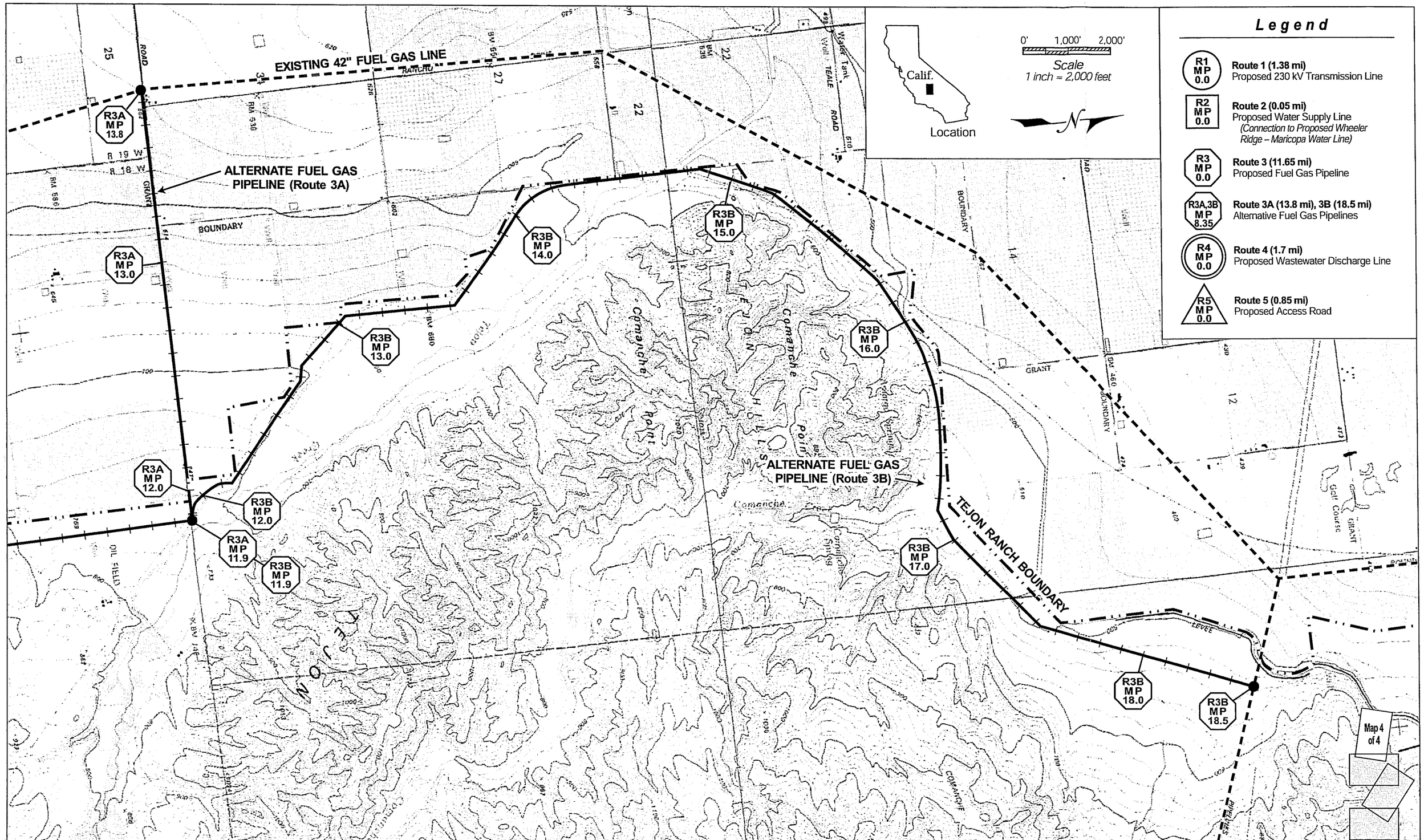
Pastoria Energy Facility **Pastoria Energy Facility, LLC**	**Map 3.2-1.** LOCATION OF PASTORIA ENERGY FACILITY PROJECT COMPONENTS	Map 2 of 4 1999



Source: Base Maps from U.S.G.S.
7.5 Minute Topographic:
Pastoria Creek, CA; Tejon Ranch, CA; Tejon Hills, CA; and Arvin, CA
Copyright (c) 1997 Horizons Technology, Inc.

Pastoria Energy Facility	**Map 3.2-1.** LOCATION OF PASTORIA ENERGY FACILITY PROJECT COMPONENTS	Map 3 of 4
Pastoria Energy Facility, LLC		1999



Legend

- **R1 MP 0.0** — **Route 1 (1.38 mi)** Proposed 230 kV Transmission Line
- **R2 MP 0.0** — **Route 2 (0.05 mi)** Proposed Water Supply Line *(Connection to Proposed Wheeler Ridge – Maricopa Water Line)*
- **R3 MP 0.0** — **Route 3 (11.65 mi)** Proposed Fuel Gas Pipeline
- **R3A,3B MP 8.35** — **Route 3A (13.8 mi), 3B (18.5 mi)** Alternative Fuel Gas Pipelines
- **R4 MP 0.0** — **Route 4 (1.7 mi)** Proposed Wastewater Discharge Line
- **R5 MP 0.0** — **Route 5 (0.85 mi)** Proposed Access Road

Source: Base Maps from U.S.G.S. 7.5 Minute Topographic: Pastoria Creek, CA; Tejon Ranch, CA; Tejon Hills, CA; and Arvin, CA
Copyright (c) 1997 Horizons Technology, Inc.

Pastoria Energy Facility	**Map 3.2-1.** LOCATION OF PASTORIA ENERGY FACILITY PROJECT COMPONENTS	Map 4 of 4
Pastoria Energy Facility, LLC		1999

3.3 SITE DESCRIPTION

3.3.1 Topography

The PEF plant site is located at the southerly end of the San Joaquin Valley at the foot of the Tehachapi Mountains on property owned by the Tejon Ranch Company. Sitting in the valley near the 1070-foot elevation, the plant site is approximately 1.5 miles northwest of the Department of Water Resources Edmonston Pumping Plant and approximately 1-mile north of the California Aqueduct.

The project site is relatively flat, with a 4 percent average slope running from the southeast to the northwest. The existing elevation of the site varies between 1058 and 1088 feet. Based on this location, the average final site grade will be approximately elevation 1070 feet.

Pastoria Creek, located approximately 1000 feet west of the site, is the natural drainage path for winter and spring runoff. Based on published Flood Insurance Rate Maps, the site has been designated to be within the 100-year flood area. However, a study prepared for PEF has determined that the site is outside of the flood plain. Refer to Subsection 3.5.8 "Site Flooding Issues" for more information. Site grading contours will provide for control of both stormwater drainage and proper channeling of winter and spring runoff flows. (Refer to Subsections 3.5.7 "Site Grading and Drainage", and 3.5.10 "Earthwork" for more information concerning site preparation and drainage.)

3.3.2 Geological Setting and Seismology

The geology, seismic setting, and soil conditions at the site and along the transmission line corridor are discussed in detail in Section 5.3, and are summarized below.

The PEF site area, including the plant site and linear facilities, is located at the southern end of the Great Valley Physiographic Province of California. Information on the Great Valley Province and surrounding physiographic provinces is included in Section 5.3. Section 5.3 also details the major active and potentially active geologic faults and instrumentally recorded earthquakes within about 100 kilometers from the site. A geotechnical investigation was also conducted for the project area. The results of the investigation are included as Appendix L.

3.3.2.1 <u>Subsurface Conditions</u>

A subsurface exploration program consisting of 7 borings (35 to 100 feet deep) and 9 test pits (10 to 14 feet deep) was completed at the PEF site in November, 1999. A report of the investigation, which also included downhole seismic velocity measurements in one of the 100-foot borings and an infiltration test in a 10th shallow pit, is presented as Appendix L.

All of the borings and test pits encountered gravelly sands that make up the alluvial fan of Pastoria Creek. These deposits consist mainly of well graded, coarse-grained sands with a gravel content of 30 to 60 percent. Gravels observed in borings, which were drilled by percussion casing hammer methods, ranged in size up to 6 inches. Larger gravels, up to 18 inches across, were observed in test pits. Some thin layers of silty sand, with very little gravel, were observed in the borings.

Blow count values from sampling in borings indicated that the soil was dense to very dense below a thin surficial layer of less denser soil (less than 5-feet thick). Because blow count values are often inaccurate in gravelly soils, a downhole seismic survey was conducted. The results of that survey are as follows:

Depth, feet	Compressional Wave Velocity, fps	Shear Wave Velocity, fps
5-16	1,350	600
16-60	2,350	1,540
60-100	3,950	2,170

The velocities shown above indicate that soils below 16 feet are considered to be dense. Soils in the upper 16 feet are not as dense as suggested by the blow counts.

The infiltration test, conducted at a depth of 2 feet at the site of the proposed septic tank leach field, produced a vertical infiltration rate of about 10 feet per day.

Refer to Section 5.3 and Appendix L for more information on the geology and subsurface conditions at the project site.

3.3.2.2 Seismic Conditions

The site seismicity is discussed in detail in Section 5.3 of the AFC.

Several large active faults are located within the site region. Strong seismic shaking has been experienced in the site vicinity due to previous earthquakes associated with several of those active faults. It is virtually certain that the site will experience strong seismic shaking due to future earthquakes.

The strongest earthquake recorded in the region, referred to as the Bakersfield Earthquake, occurred in July 1952 and was centered between the site and Bakersfield on the White Wolf Fault.

The Bakersfield Earthquake caused heavy damage to structures in populated areas, broke pipelines, bent railroad rails beyond use, and caused ground rupture in several places. The ground rupture was due primarily to reverse left lateral movement on the White Wolf Fault zone, which in some areas was observed to be several hundred feet wide. Other ground failures were associated with landslides caused by the shaking, liquefaction in areas of shallow groundwater, loose soils, including those crossing lower Comanche Creek (on Route 3), and differential settlement in areas of variable density soils.

Significant shaking has occurred in the site area as a result of other earthquakes such as the 1857 Magnitude 8+ Fort Tejon Earthquake and the 1994 Magnitude 6.8 Northridge Earthquake. The population of the area was nearly zero in 1857; consequently, if ground failure did occur, it was unreported. During the 1994 earthquake, shaking intensity of VII (very strong) was reported south of Bakersfield. No damage was reported.

3.3.3 Hydrological Setting

The average annual rainfall, as measured at a station in Lebec, is 11.21 inches. The wettest month is March with an average rainfall of 2.0 inches. The 50-year maximum one-day rainfall is estimated to be 2.0 inches. July is the driest month, averaging 0.05 inch (source: "Hydrology Manual," Kern County, Department of Planning & Development Services).

3.3.3.1 Surface Water

Rainfall produces surface water runoff from the site and surrounding areas. The site is on the alluvial fan of Pastoria Creek. Pastoria Creek is a small stream that drains out of the Techachapi Mountains; its primary channel runs in a northerly direction west of the site. The site sheet flows to the north and west.

The Federal Emergency Management Agency (FEMA) has identified this area as subject to flooding but has not completed sufficient work to calculate the expected depth of floodwaters. The FEMA study, although adequate for evaluation of risk to agricultural land use, was not completed with sufficient scientific rigor to be used to evaluate the risk to the project. As part of the development of the site, PEF has prepared a hydrological study to more accurately define flood limits and elevations. This study, provided as Appendix M, is used to more accurately define the flood plain limits and to develop grading and drainage strategies to protect the site.

3.3.3.2 Groundwater

Groundwater levels in the area of the project are generally greater than 180 feet deep. The adjacent gravel pit is approximately 100 feet deep and has not encountered groundwater.

Onsite geotechnical investigations have drilled to a depth of 100 feet and have not encountered groundwater.

3.4 FACILITY DESCRIPTION

3.4.1 Overview

The proposed PEF project incorporates three, natural gas fired, F-Class combustion turbine generators (CTGs) operating in combined cycle mode in two power blocks. Two CTGs are installed in a "two-on-one" configuration with one steam turbine generator (STG). One CTG is installed in "one-on-one", non-common shaft configuration with one STG. Figures 3.1-1, 3.1-2, 3.1-3 and 3.1-4 illustrate this "two-on-one" plus "one-on-one" arrangement. Tables 3.4.1-1 and 3.4.1-2 list Major Equipment and Significant Structures required for the plant.

Use of the new and innovative XONON™ catalytic emission control technology is proposed for this project. XONON™ controls emissions internal to the turbine combustion process and is currently under development for application with the large F-Class combustion turbines. Completion of testing of the XONON™ system for GE 7FA turbines is scheduled to occur during the first quarter of 2003.

The hot exhaust gas from each CTG flows through a heat recovery steam generator (HRSG). The HRSG extracts heat from the exhaust to produce the steam that powers the STG. The facility will employ proven gas turbine technology that is currently in use in California and in other locations around the country.

The facility will produce a nominal 750 MW based on a 60°F ambient temperature and 52 percent relative humidity. Each CTG produces approximately 168 MW, the STGs produce approximately 185 MW and 90 MW, respectively, and plant auxiliary equipment consumes approximately 15 MW. The net heat rate of approximately 6900 Btu/kWh, based on the higher heating value (HHV) of natural gas, corresponds to an overall efficiency of approximately 50 percent. The plant is expected to have an overall availability of 95 percent or higher and could operate up to 8760 hours per year.

The plant is located in an undeveloped area approximately 30 miles south of Bakersfield, California. This location and the configuration of the plant have been selected to best match operating needs for the transmission grid and the competitive power market. The site minimizes impact on visual resources and takes advantage of nearby access to a natural gas fuel supply, water for cooling, and a tie-in location to the Southern California Edison Company (SCE) transmission system at the Pastoria Substation.

The plant will use Best Available Control Technology (BACT) to minimize gas turbine emissions. To achieve (BACT), PEF proposes to install Catalytica's XONON™ emission control technology. This innovative technology is being developed and commercialized for the large F-Class gas turbines by Catalytica, Enron North America Corporation, and General Electric. This ongoing development effort is supported by the U.S. Department of

Transportation (USDOT), the California Energy Commission (CEC), and the California Air Resources Board (CARB).

Operating within the gas turbine combustors, XONON™ produces a partially flameless combustion, which is staged across and downstream of the catalyst, to achieve a lower peak temperature. In this way, the formation of NO_x is minimized while CO is consumed as a fuel. By limiting formation of NO_x and CO, XONON™ eliminates the need to use post-combustion emission controls.

Recognizing the inherent risks associated with technology development, PEF proposes an alternate emissions control system, which will be used if XONON™ technology for F-Class turbines is not ready when needed to meet the PEF project schedule. The alternate emissions control system uses state-of-the-art, dry low NO_x (DLN) combustors in combination with post-combustion emission controls located in the HRSGs. These downstream controls include selective catalytic reduction (SCR) to control NO_x and an oxidation catalyst to control CO. The height of the exhaust stack on each HRSG will be 213 feet, or less, as required to satisfy air quality requirements while minimizing visual impact.

This combined cycle power plant will produce a small fraction of the amount of air emissions produced by most existing gas fired steam power plants. Correspondingly, the plant will deliver approximately 45 percent more electric power per unit of fuel as compared to steam power plants with stationary gas-fired boilers. A plant heat and mass balance is included in Appendix A. Section 3.4.4.3, Section 3.11, Section 5.2, and Appendix I address plant emissions and emissions controls.

F-Class combustion turbine generators, operating in a combined cycle configuration with one “two-on-one” power block and one “one-on-one” power block, are currently under consideration for this project. Final selection of power block configuration and turbine model will be based on a competitive evaluation of purchase cost, operating cost, flexibility and reliability, performance, and delivery.

3.4.2 Site Access

Access to the site will be provided from the Edmonston Pumping Plant Road. A new plant access road, approximately 1 mile long, will be constructed to the site across Tejon Ranch and California Department of Water Resources property. The plant access road will have a 24-foot wide all-weather surface and will include shoulders and the appropriate drainage systems. Overall roadway width will be approximately 40 feet. The routing of the access road is shown on Figures 3.1-5 and 3.1-6.

3.4.3 Pastoria Energy Facility Site Layout

The site arrangement, illustrated on Figure 3.1-1 and Figure 3.1-7, is designed to optimize land use and to meet regional power needs. The plant will be constructed on approximately 30 acres of land owned by the Tejon Ranch Company. Spacing between equipment is maintained as necessary for safety and for efficient access for operations and maintenance.

Major equipment is arranged to provide operational and maintenance access and to promote economical construction. The three parallel CTG/HRSG trains are located in the northwest portion of the site. Each HRSG continues north from the combustion turbine exhaust to the HRSG exhaust stack.

For the two-on-one configuration, one STG is located directly east of the two Cogs. For the one-on-one configuration, a smaller STG is located just west of the third CTG. The five generators are each connected to the south end of the respective CTG or STG. The plant switchyard is south of the generators. A site for a possible future fourth CTG has been located to the west of the planned units. Should it be determined, in the future, that a fourth CTG unit is economically viable, a new application for certification will be prepared.

The fuel gas filter-separator and metering facilities are located in the north-central area of the site. If used, a turboexpander-generator unit will be located near this location.

The plant control room, administration offices, and personnel facilities are located in a one-story Administration and Control Building in the middle of the site. This location is selected for proximity to the plant entrance, as well as to optimize instrumentation and control cable runs and operator foot travel to the power islands. Separate rooms in the Administration and Control Building house instrumentation hubs, batteries and uninterruptible power supply equipment.

A Warehouse and Shop Building, located in the middle of the site, houses work areas and storage for spare parts and supplies for facility maintenance. The facility meeting and training room and maintenance office are also located in this building.

Two cooling tower banks, one with 16 cells and the other with 8 cells, are placed in the eastern portion of the site. They are placed to optimize airflow to the towers while minimizing time that they are upwind of the switchyard. Provision is made to expand the smaller cooling tower to 16 cells if needed to accommodate a fourth CTG.

The Water Treatment Building, located in the southern portion of the site near the entrance, houses water treatment equipment and provides safe storage areas for water treatment chemicals. The equipment and chemicals are used to treat raw water to provide properties needed for cooling water makeup and for demineralized water makeup to the HRSGs. A

motor control center, for the water treatment equipment and pumps, is located in a separate room in this building.

The Makeup Water Storage Tank is located northeast of the Water Treatment Building. The Demineralized Water Storage Tank is located to the west of the Water Treatment Building. The Makeup Water Storage Tank includes a reserve volume to supply the firewater system. The Firewater Pump Skid is adjacent to the tank.

Paved plant roads will provide access throughout the plant to accommodate truck deliveries, routine maintenance, and fire protection. Areas with less frequent access requirements will be surfaced with crushed rock or gravel.

3.4.4 Combustion Turbine Generators, HRSG, & Steam Turbine Generator(s)

The two-on-one combined cycle power block configuration uses three electric generators, each with its own drive turbine. The HRSGs, installed on the exhaust ends of the two CTGs, are connected by steam supply and condensate return piping to the single STG.

The one-on-one, non-common shaft, combined cycle power block configuration uses two electric generators, each with its own drive turbine. The HRSG, on the exhaust of this CTG, is connected by steam supply and condensate return piping to the STG. Crossover piping may be installed to allow any of the three CTG/HRSG trains to supply steam to either of the two steam turbines.

The proposed equipment configurations efficiently convert chemical energy, contained in natural gas fuel, to electric energy. Air emissions are significantly reduced by the use of natural gas as the single fuel. The proposed use of XONON™ combustion control technology, along with state-of-the-art plant control systems, will significantly reduce gas turbine emissions. Recognizing the inherent timing uncertainties surrounding development of the F-Class XONON™ technology, gas turbine emission control may be provided through the use of proven DLN combustor technology, if required, with SCR and CO catalysts providing post combustion control.

The CTG combusts natural gas fuel in compressed ambient air and converts the thermal energy first to mechanical energy, then to electrical energy. This plant uses three F-Class CTGs, which are each nominally rated at 168 MW at 60°F and 52 percent relative humidity. PEF will incorporate the latest proven gas turbine generating plant technologies in order to maximize plant performance while meeting BACT requirements.

The F-Class CTG can convert approximately 33 percent of the heat energy of its fuel (HHV basis) into electric power. Exhaust gases exit the combustion turbine at a temperature of

approximately 1100°F and a pressure just above atmospheric. The CT exhaust gas retains approximately 67 percent of the heat released through combustion.

The HRSG captures heat from the CTG exhaust gas and produces steam at three pressures. Working together, the CTG/HRSG trains produce steam to power the STGs. The two-on-one power block has a flexible control system to allow the STG to operate with one CTG off and the second CTG/HRSG train operating down to approximately 60 percent load. With only one CTG operating, for the two-on-one configuration or the one-on-one configuration, net output would be approximately 22 percent of total plant capacity.

3.4.4.1 Combustion Turbine Generator (CTG)

The CTG process is illustrated in Figure A-1 (in Appendix A) and described as follows:

- The compressor section draws ambient air into the system, through an inlet air filter and inlet ducting, and compresses the air to approximately 200 psig.

  To cool the incoming air, an inlet evaporative cooler, inlet air fogging system, or mechanical or absorption inlet air chiller is installed before the filters. Cooling the inlet air increases its density, allowing the compressor to draw in a greater mass of air. When ambient air is hot, inlet air cooling significantly increases the power output from the CTG. A moderate improvement in heat rate also results.

- Compressed natural gas fuel is mixed with compressed air and ignited in the combustion chamber.

- Combustion Emissions Control: The XONON™ system combusts the fuel across a catalyst without a flame. This process limits the formation of NO_x and CO to permitted exhaust stack levels. Using DLN technology, combustors mix excess air with fuel to create uniform combustion. The use of excess air reduces peak flame temperatures and thereby the production of NO_x. Combustion with excess air also reduces CO formation.

- Heated, high-pressure gases accelerate as they expand, exit the combustion chamber, and enter the gas turbine. As the hot gas flows through the turbine, turbine blades capture kinetic energy and convert it to rotational energy.

- The first stage of the gas turbine drives the compressor and auxiliary take-off gearing. The other stages of the CTG drive the electric generator via the main drive shaft.

  The turbine generator unit requires a number of auxiliary systems, including:

- Inlet air filter system with inlet evaporative cooling or inlet air chilling
- Closed cooling water system and liquid to air heat exchangers.
- Fuel gas system
- Lubricating and hydraulic oil system
- Duplex lube oil coolers
- Compressor wash system with on-line and off-line capability
- Fire protection system
- Turbine and generator controls.

This system uses 3600 rpm, two-pole, three-phase, synchronous electrical generators. The generators will be cooled by hydrogen or air, which is cooled in turn by an external heat rejection system. The generators are synchronized to run at 3600 rpm and deliver power to the grid at 60 Hz.

3.4.4.2 STG and HRSG Process

In the F-Class, two-on-one configuration, a three stage, single shaft, single-shell condensing steam turbine, rated at approximately 185 MW maximum output, is installed on a separate pedestal. The ST drives a third electric generator which, like the CTGs, is synchronized at 3600 rpm to deliver 3-phase 60 Hz electric power to the grid.

For the F-Class, non-common shaft, one-on-one configuration, a three stage, single shaft, single-shell, condensing steam turbine, rated at approximately 90 MW maximum output, is installed on a separate pedestal. The ST drives a generator which is synchronized at 3600 rpm to deliver 3-phase 60 Hz electric power to the grid.

Each HRSG is expected to be a sliding pressure, unfired, triple-pressure, reheat, natural circulation, drum type with horizontal gas flow. The HRSG includes high pressure, intermediate pressure, and low-pressure paths. Each path feeds a corresponding stage of the steam turbine. Each path contains an economizer (or feedwater preheater for the LP path), an evaporator, an integral deaerator, and a superheat section. The intermediate pressure system also incorporates a reheat loop for the cold, wet exhaust on the high-pressure turbine (HPT). Feedwater is pumped from the steam turbine condenser hot well to the feedwater preheater and from the LP steam drum to the IP and HP economizer.

- The high-pressure section of the HRSG boils feedwater to create steam, which enters the HPT at approximately 1400 to 1800 pounds per square inch gage (psig) and 1000°F. The HPT exhaust is reheated, joins the IP flow, is superheated and enters the intermediate pressure turbine (IPT). Superheated LP steam joins the IP exhaust flow at the entrance to the low-pressure turbine (LPT). The LPT exhausts to the condenser.

- For each HRSG, a condensate pump returns steam condensate from the condenser hot well to the preheater. A piped-in spare pump will be installed at each condenser.

- After the preheater, the integral deaerator removes non-condensable gases before the returned condensate and fresh feedwater enter the LP steam drum. Natural circulation feeds water to the LP evaporator.

- Multi-stage, dual-pressure, HRSG feedwater pumps force hot condensate through the IP economizer and HP economizer to the IP and HP steam drums. Natural circulation from the bottom of each steam drum feeds the respective evaporator. Two full capacity pumps will be installed for each HRSG.

3.4.4.3 Combustion Turbine

3.4.4.3.1 <u>XONON™ Catalytic Combustion Emission Control Technology</u>. The XONON™ catalytic combustion technology, proposed for use for this project, is designed to control the formation of gas turbine emissions to maintain levels at or below permitted stack levels. The XONON™ combustion system improves the gas turbine combustion process by lowering peak combustion temperature to minimize the formation of NO_x. Concurrently, XONON™ avoids the increase in CO and unburned hydrocarbon (UHC) associated with other combustion emissions control technologies. XONON™ results in very low levels of NO_x, CO, and UHC in the CTG exhaust gas and precludes the use of ammonia injection, and resulting ammonia slip and formation of ammonium sulfate associated with use of SCR.

Nitrogen oxides (NO_x) form at increasingly high levels when nitrogen and oxygen combine at increasingly high temperatures. In conventional combustion, uneven temperature distribution, throughout a flame, creates many points of peak flame temperature at levels that form NO_x. Combustion emissions controls generally aim to decrease NO_x formation by decreasing the occurrence of these temperature peaks.

The XONON™ combustion system is built around a proprietary catalytic component called the XONON™ Module. The Module is an integral part of the specifically designed gas turbine combustor. Within the XONON™ catalyst, combustion of natural gas proceeds without a flame and at a lower speed and temperature than with normal combustion. This extended duration and lower temperature combustion significantly reduces formation of NO_x. The staged combustion is completed in a burnout zone, downstream of the catalyst, without significantly increasing the NO_x level. The gas temperature, downstream of the combustors, remains at the level that optimizes gas turbine performance.

Because of XONON™'s ability to control the formation of NO_x and CO, the traditional SCR and CO catalysts are not required.

3.4.4.3.2 <u>Dry Low NO_x Combustors</u>. In recognition of the timing uncertainties associated with the development and commercialization of the XONON™ technology, PEF is proposing an alternate emission control system which will be used if XONON™ is not ready when needed. This system incorporates state-of-the-art dry low NO_x (DLN) combustors and uses selective catalytic reduction and CO oxidizing catalysts for post-combustion control.

DLN combustors minimize formation of NO_x and CO by achieving a flame with minimal temperature variations. This is achieved through thorough mixing of a lean fuel/air mixture. The emission levels achieved to date with DLN are significantly higher than those achieved with application of XONON™ in smaller combustion turbines. The DLN system for General Electric's F-Class turbines typically controls NO_x emissions at or below 9 ppmvd at 15 percent O_2. The GE system typically controls CO emissions below 9 ppmvd at 15 percent O_2.

3.4.4.3.3 <u>Post Combustion Emissions Controls Integrated with HRSG</u>. CTG exhaust gases are cooled during the production of steam in the HRSG. This enables the use of SCR and CO catalytic emission controls that are not able to withstand gas turbine exhaust gases which enter the CTG enter the HRSG at approximately 1100°F.

An oxidation catalyst, installed in the HRSG, causes CO to combine with O_2, producing CO_2 and reducing the CO concentration to a maximum 3 hour average of 6 ppmvd at 15 percent O_2. The CO oxidizing catalyst also oxidizes volatile organic compounds (VOCs) reducing the concentration in the exhaust by approximately 30 percent to 40 percent.

A selective catalytic reduction (SCR) system is installed in the HRSG. Vaporized aqueous ammonia (NH_3) is introduced upstream of the SCR catalyst. The catalyst causes NH_3 to combine with NO_x, producing N_2 and H_2O. The SCR system reduces NO_x emissions to a maximum 1 hour rolling average of 2.5 ppmvd at 15 percent O_2 while limiting ammonia slip to 10 ppmvd, or less, at 15 percent O_2.

Post combustion control systems are not required with the use of XONON™ emission control technology.

3.4.4.3.4 <u>Emissions Dispersion</u>.

The exhaust gases exit the HRSG through a vertical stack. The stack discharges the gases to the atmosphere at a temperature of approximately 200°F and at a height of 213 feet or less above ground level. At this temperature and elevation, the gases mix with ambient air and are dispersed. Final stack height will be determined by dispersion modeling.

3.4.4.4 Performance Data

Predicted performance data play a major role in the selection of turbine generators. Key elements of the performance data compilation are gross power output, net power output, fuel input and net heat rate. Figure A-1 is a heat and mass balance diagram that provides these data for a representative operating condition.

Performance runs (computer calculations of combustion turbine operating characteristics at specified conditions) were prepared for typical operating conditions at 60 percent, 80 percent and 100 percent rated load and 30°F, 60° F, 90°F, and 110°F ambient inlet air temperatures. Runs were also performed for 100 percent rated load cases using inlet evaporative cooling at 60°F, 90°F, and110^{o}F.

- Gas turbine power output and efficiency are greatly effected by atmospheric conditions and load variations. Power output is roughly proportional to mass flow which increases as the inlet air becomes colder and more dense. Higher humidity makes the air less dense and also decreases the oxygen level per unit mass. Consequently, more fuel can be added and more power is produced at lower temperatures and humidities. Less fuel can be added and less power is produced at higher temperatures and higher humidities. Turbine efficiency decreases as conditions depart from the optimum full-load design point.

- Steam turbine performance is effected by atmospheric conditions in a different manner. In the combined cycle system, steam flow to the turbine is reduced at higher ambient temperatures. LPT power also decreases as the efficiency of the heat rejection system decreases due to high ambient temperature and humidity.

3.4.4.5 Emissions Data

Air emissions are effected by turbine design and operating conditions. Along with the gas turbine performance data, the turbine manufacturers provided predicted emissions levels. Emissions data for these F-Class turbines, before and after post-combustion controls, are provided in Section 5.2 and Appendix I.

To evaluate effects of this facility on ambient air quality (discussed in Section 5.2), refined dispersion modeling was performed for the worst-case scenario from among the two identified CTG manufacturers under consideration. To determine the worst case scenario, dispersion modeling, at a screening level, was performed for each turbine for 100 percent, 80 percent, and 60 percent load conditions and 30°F, 60°F, 90°F, and 110°F ambient temperatures. Screening level modeling was also performed for 100 percent load cases with inlet evaporative cooling at 60°F, 90°F, and 110°F.

Emissions data, as used for this modeling, are representative of levels that manufacturer's currently guarantee. Formal guarantees for this project will be obtained after formal turbine supply proposals are requested.

3.4.5 Heat Rejection System

The steam turbine generator converts approximately thirty-seven percent (37%) of thermal energy from steam into electric power. Except for minor mechanical and electrical losses, the balance must be rejected as heat in the condenser.

PEF will use a two-pass deaerating surface condenser for the steam turbine exhaust. Cold wet steam exits the LPT at between approximately 90°F and 120°F with a pressure between 1.5 and 3.5 inches mercury (HgA). The steam condenses against the condenser tubes and transfers its heat to circulating water. This cooling water, in turn, rejects the heat to atmosphere in a mechanical draft wet cooling tower.

PEF will use 24 cooling tower cells, arranged back-to-back in two tower banks. One bank will contain 16 cells and the other bank will contain eight cells.

The cooling towers are expected to be a standard, induced draft, counter-flow type with fiberglass structure and film fill. The towers will incorporate high efficiency drift eliminators.

In the counter-flow tower, water is distributed over the top of the fill and flows down through it as a thin sheet following the fill surface. The induced draft fan pulls ambient air up through the fill. The air cools the flowing water with convective heat transfer and by evaporating part of the water. The cooled water flows through the fill to be collected in the tower basin. Cooling water pumps circulate the cooled water through the condenser and back to the top of the tower.

Small droplets, created by the splashing action of the water on the fill and carried out of the tower with the airflow, are called drift. Dissolved and suspended solids contained in the drift, and left in the air when the water carrying them evaporates, are a minor source of particulate emissions. High efficiency drift eliminators control the cooling tower drift to significantly less than 0.0005 percent of the circulating water flow rate. At full cooling water flow, this corresponds to a maximum of less than 1 gallon-per-minute of water.

3.4.6 Major Electrical Equipment

The two-on-one plus one-on-one single-line diagram, as shown in Figure 3.4-1, illustrates the overall generation and distribution system for the facility. Power is produced at 18 kV by the

CTGs and STGs. The generator output passes through the plant step-up transformers where the voltage is increased to a transmission level of 230 kV. A double-circuit transmission line connects PEF to the existing SCE grid at Pastoria Substation.

A portion of the plant output is converted to 4160 V and lower voltages to power station auxiliaries. Essential control systems are protected with an AC uninterruptible power supply (UPS). A 125 VDC system provides battery power for the AC UPS and for DC control systems.

3.4.6.1 Step-up Transformers

Each generator is connected to a separate, two-winding, oil-filled, 18 kV to 230 kV step-up transformer. Connection to the step-up transformer is made through an isolated phase bus. The transformers are anchored on concrete foundations that also provide oil containment. The high side of each step-up transformer is terminated at the plant 230 kV switchyard. Surge arrestors are installed on the high voltage bushings of each transformer to protect the transformer from surges due to lightning strikes, switching or other disturbances on the 230 kV system. A fire detection and protection system is provided for each transformer. A concrete firewall separates each transformer from other transformers and critical equipment.

3.4.6.2 230 kV Switchyard

Each step-up transformer is connected to the grid through a 230 kV switchyard. The switchyard contains ten (10) 230 kV SF6 circuit breakers arranged in a ring bus scheme using two bays. The incoming bay has six circuit breakers arranged such that each terminal is connected to the bus between two circuit breakers. The outgoing bay has 4 breakers with a provision for adding 2 additional breakers for future expansion. A motorized disconnect switch is at the end of each breaker.

A double-circuit, 230 kV transmission line will be installed to connect the plant switchyard to the existing SCE grid at the Pastoria Substation.

The ring bus arrangement provides high reliability. In the case of a fault, only the faulted circuit is lost. The balance of the plant remains unaffected. A Capacitor Coupled Voltage Transformer (CCVT) is installed at each end of the step-up transformer connected busses to synchronize the circuit. A CCVT will be installed on each main bus. A CCVT will be installed on the outgoing 230 kV transmission line section for metering and relaying.

3.4.6.3 AC Power Distribution

Plant auxiliaries are powered at 4160 V, 480 V, and 208/120 V.

Three 230 kV to 4160 V auxiliary transformers are used to power the plant electrical distribution system for the three CTGs. A fire detection system is provided for each transformer.

A double-ended 4160 V switchgear, off of each auxiliary transformer, in turn feeds two 4160 V to 480 V transformers, the CT starting equipment, and a 4160 V motor control center (MCC) for motors larger than 200 HP. Each CTG/HRSG train has dedicated double-ended 480 V switchgear. Low voltage (480 V) MCCs at each CTG/HRSG train feed CT, ST, generator and balance of plant 480 V motor loads, low voltage distribution, and the DC power system.

The AC Power Distribution System is designed so that loss of one unit auxiliary transformer will not limit plant output capability. The 4160 V switchgear will be equipped with an incoming breaker and terminal arrangement to accept connection to a trailer-mounted 4160 V engine-generator set if a “black-start” situation is encountered.

The 4160 V switchgear has vacuum breakers for the main feeds and vacuum breakers or fused contactors for power distribution. The 4160 V system is low resistance grounded to limit the maximum fault current to 400 Amps. The 480 V system is solidly grounded. Power for the 208/120 VAC system is provided by the Low Voltage MCCs through 480-208 V dry type transformers.

3.4.6.4 DC Power Supply

Each CT will have its own 125 V DC power supply consisting of one 125 V battery, one battery charger, and one 125 VDC panel board. Three station DC power systems will serve switch gear controls and STG emergency lube oil pumps. Each station DC power system will include one battery, two chargers, and one DC switchboard.

The 230 kV switchyard will have its own 125 VDC system to feed the 230 kV breaker controls, the step-up transformer controls, and the switchyard metering and relay circuits. The switchyard DC system will consist of one battery, one charger, and one DC panelboard.

The battery chargers each receive 480 V, 3-phase power from one of the MCCs. They supply power to the DC loads while continuously charging the batteries. The 125 VDC system is ungrounded and includes a ground detector to detect ground faults.

3.4.6.5 Uninterruptible Power Supply (UPS) System

DCS and other critical, 120 VAC, single-phase loads are supplied via an uninterruptible power supply (UPS) system. In a static solid state system, the UPS uses two DC/AC

inverters, with maintenance bypass switches, and one 120 VAC distribution panel. The DC/AC inverters are supplied via a dedicated 125 VDC battery system.

3.4.6.6 Emergency Power System

Critical loads requiring operation during and following a loss of power or plant shutdown shall be fed from an emergency bus. The emergency bus shall have a normal power source and an emergency power source. The emergency power shall be provided by a dedicated stand-by generator, which shall be connected to the emergency bus by a synchronizing circuit breaker. The stand-by natural gas fueled engine generator shall be rated 600 kW, 480 V, 0.8 PF lag. Loads that are typically powered from the emergency service bus are:

- UPS Main Supply
- Battery Chargers
- Activated Obstruction Lighting
- Emergency Lighting
- Instrument Power
- Turbine.

3.4.7 Natural Gas Fuel Supply

The PEF combustion turbines will be single-fueled, natural gas fired. Natural gas will be supplied from the 42-inch diameter Kern River/Mojave Pipeline, which crosses Tejon Ranch property approximately 13.6 miles directly north (18.5 mile linear Route 3B) of the PEF site and has its closest approach approximately 6.5 miles directly north (11.65 mile linear Route 3) of the project site.

The natural gas fuel will be delivered to the facility through a 16- to 20-inch diameter underground pipeline. The proposed connection to the transmission pipeline, shown as Route 3 on Map 3.2-1, travels approximately 11.65 miles from the tie-in point, which is located approximately 6.5 miles north of the project site. The pipeline will be carbon steel with a shop applied epoxy coating used to prevent corrosion. The proposed pipeline route and construction are described in more detail in Section 3.7.1.

As the pipeline enters the site, the fuel gas will pass through one of three 50 percent filter separators before passing through a metering and pressure/flow control station.

The “F Class” CTGs require approximately 450 psig fuel gas pressure. The Kern River/Mojave pipeline normally operates between 700 and 900 psig. It is expected to reliably supply the required inlet pressure without need of supplemental compression. A turbo-expander may be installed to recover energy from the gas as its pressure is reduced from the

normal pipeline pressure to the required CT inlet pressure. The turbo expander will be used to drive an electric generator and will be capable of producing one to two MW of electric power. Heat exchangers, using hot cooling water, may be used to preheat the incoming gas and to reheat the gas between turbo expander stages and downstream of the turbo expander. This will have the combined benefits of increasing turbo expander output, reducing cooling tower water consumption by up to 5 million gallons per year, and reducing steam requirements for fuel preheating.

3.4.8 Water Supply and Treatment

3.4.8.1 Water Balance and Supply Requirements

The PEF will require an average of approximately 5,100 acre-feet of water per year at full plant load. Key plant functions requiring water are boiler feedwater for the HRSG, cooling water for heat rejection from the steam turbine exhaust, evaporative cooling of the combustion turbine inlet air, utility water for washdown and other purposes, and domestic water for plant personnel.

3.4.8.1.1 Water Balance. Water supply requirements are summarized in Table 3.4.8-1 for a 24-hour period. The table provides both the expected maximum water usage rate as well as an average usage rate. The facility water balance is illustrated in Figure B-1.

3.4.8.1.2 Water Supply Sources. PEF is located is located within the Wheeler Ridge-Maricopa Water Storage District (WRMWSD). WRMWSD has indicated that it would be able to provide PEF with its necessary water demand while also meeting the demand of its current customers as WRMWSD is planning to increase its storage facilities (see Appendix T, WRMWSD Letter). PEF will receive water under a long term contract as a customer in a new rate class that WRMWSD is creating for customers with high reliability requirements.

WRMWSD is a public agency that serves the southern portion of Kern County, managing the delivery and distribution of water from the California Aqueduct and underground storage facilities to local users. WRMWSD currently has approximately 197,000 acre-feet of entitlements to receive water from the State Water Project and delivers 190,000 acre-feet in a normal year. In order to better serve their users, and to provide a larger, more reliable supply of water, the District has at least 743,000 acre-feet of water stored underground within WRMWSD boundaries and approximately 243,000 acre-feet stored underground outside of its boundaries. WRMWSD is also developing additional water storage capacity in the White Wolf basin that would add up to 50,000 acre-feet/year of extraction capacity to WRMWSD's current supplies.

The project will be supplied from a 20-to 30-inch water line that would connect to a 54-inch water line proposed by WRMWSD. The proposed 54-inch line will run approximately 250

feet west of the project site and is intended to transport water supplies out of the California Aqueduct (see Table 3.4.8-6 for a listing of the types of water supply available to WRMWSD from the aqueduct) for delivery to the project, to other users, and to the White Wolf Water Bank. When water supplies from the aqueduct are inadequate, water will be drawn out of WRMWSD's storage facilities to supply the project and other WRMWSD users.

PEF will have on-site storage to meet 5 hours of peak cooling water requirements, up to 24 hours of demineralized water requirements, and 7 days of potable water consumption. The makeup water tank will contain a reserve, accessible only to the firewater pumps, equal to approximately 3 hours of fire system flow.

3.4.8.2 Water Quality

Table 3.4.8-2 provides a representative analysis of the raw water supply from the California Aqueduct. Table 3.4.8-3 provides a representative analysis of the raw water supply from the White Wolf Water Bank. This analysis will vary seasonally and with changes in usage patterns in the area.

3.4.8.3 Water Treatment Requirements

Facility water uses can be divided into four categories based on the quality of water required. Treatment requirements are described in the following paragraphs. Cooling water treatment and demineralized water production are described in the sections following.

- The raw water from the California Aqueduct will require clarification and/or filtration before being introduced to the cooling tower. A minimal amount of chemical treatment will be required to prevent scaling, corrosion, and biofouling in the cooling water system.

- The facility requires service water near potable water quality. Potable water is required for personnel consumption and sanitary needs. On-site treatment equipment will be installed to provide this water.

- The combustion turbine air inlet evaporative coolers require water with reasonably low dissolved and suspended solids. This prevents ingestion of compounds that could foul or damage the turbine and/or increase particulate emissions. Chlorine levels in potable water are damaging to the turbine alloys while demineralized water, as used in the HRSG, is damaging to the cooler pad material. Potable water will be treated to remove chlorine before being supplied to the evaporative coolers.

- An alternative inlet air cooling system, using a fogging system with demineralized water, will be evaluated during detail design as will inlet cooling options using absorption chillers or mechanical chillers.

Demineralized water will be produced on-site for makeup to the HRSGs. Raw water will be filtered and may be treated with a biocide before being supplied to the demineralizer system.

3.4.8.4 Water Treatment Systems

3.4.8.4.1 Makeup Water for HRSG and Steam Turbine System. Demineralized water is added to the HRSGs as boiler feedwater makeup. This water is recycled through the system, as steam and condensate, with small amounts lost in the process or discharged as blowdown to prevent excessive build-up of dissolved and suspended solids.

3.4.8.4.2 Demineralized Water System. Demineralized water is produced using clarified raw water. Raw makeup water is filtered to remove most suspended solids, and then forced through a reverse osmosis membrane to remove the dissolved solids along with the finest suspended solids. Demineralized water will be stored on-site in a 150,000-gallon storage tank. This capacity provides approximately 24 hours of supply in the event the demineralizer treatment process in interrupted.

3.4.8.4.3 Condensate/Feedwater Treatment. As water and steam circulate through the HRSG, steam condenser, and turbine, additional conditioning is provided by the cycle chemical feed system. This system supplies conditioning chemicals to minimize corrosion and scale formation. For pH control and corrosion prevention, the system automatically feeds an oxygen scavenger in proportion to condensate flow returning to the HRSG from the condenser. The system includes an oxygen scavenger solution feed tank and two full capacity chemical feed pumps.

The cycle chemical feed system also feeds sodium phosphate to the HRSG boiler water to control pH and minimize scale formation. For congruent phosphate treatment, a dilute solution of a disodium phosphate and trisodium phosphate mixture is manually prepared, in a dedicated phosphate solution tank for each HRSG steam drum pressure level. Feed is manually initiated based on boiler water phosphate residual and pH. One full capacity phosphate feed pump is provided for each HRSG steam drum. One common spare pump serves each drum pressure level. The system will be designed for ABMA/ASME makeup water boiler guidelines using the low solids, congruent phosphate method of boiler water treatment.

3.4.8.4.4 Circulating Cooling Water Treatment. The raw water supplied for cooling tower makeup will require removal of turbidity and larger solids before it is introduced to the system. Alum and polymers will be introduced into clarifying basins to flocculate and settle smaller solid matter. A filter press will remove the solids from the clarifier underflow and

return clear water to the clarifier discharge. Solids from the clarifier filter press will be shipped to an offsite composting facility for recovery as soil amendment.

A chemical feed system supplies water-conditioning chemicals to the circulating cooling water to minimize corrosion and to control the formation of mineral scale and biofouling.

Sulfuric acid will be added to reduce scaling. The sulfuric acid system will consist of a small above ground storage tank and two full capacity metering pumps.

Sodium hypochlorite, a chlorine substitute, will be shock fed to the system to minimize biofouling. The chemical feed equipment will consist of several storage drums and two full capacity chemical metering pumps.

An organic phosphate, corrosion-inhibitor solution will be fed into the cooling tower system. The corrosion inhibitor feed equipment will consist of several chemical storage drums and two full-capacity inhibitor metering pumps.

Table 3.4.10-1 Summary of Water Treatment Chemical Usage and Storage lists the chemicals to be used. The system will be designed for continuous monitoring of control parameters and specified quantities for optimum operations. Definitive equipment selection will be based on laboratory water quality analyses provided by DWR and the WRMWSD.

3.4.8.5 Wastewater Treatment and Discharge

A wastewater management system ensures that wastewater produced by PEF is properly collected, treated if necessary, and discharged from the facility. Solid wastes are also generated in several parts of these systems.

The plant's wastewater will consist primarily of cooling tower blowdown and water treatment system discharge. To the extent that it is practical, wastewater will be injected into existing and newly constructed wells located approximately 1.7 miles north-northwest of the site. All of the wells to be used for injection are located on Tejon Ranch property.

If adequate injection well capacity is not available, a zero discharge system will treat the remaining wastewater. Recovered water will be reused as demineralizer feedwater or cooling tower makeup while recovered salts will be shipped offsite for sale as product or disposal in a landfill.

3.4.8.5.1 Treatment and Disposition of Liquid Process Wastes. The facility will generate wastewater from a number of systems. These include cooling tower blowdown,

demineralizer system backwash, HRSG blowdown, inlet evaporative cooler blowdown and domestic waste.

The Water Balance Diagram, Figure B-1, shows the expected wastewater streams and flow rates for the facility's wastewater collection systems. The flow rates shown are based on annual average conditions with combined cycle plant operations at 100 percent load and gas turbine inlet air temperature of 60°F. The expected quality of the wastewater stream is provided in Tables 3.4.8-4 and 3.4.8-5.

Wastewater Disposal Wells. PEF will consider both ground well injection and zero discharge methods for disposal of wastewater. Using the ground well injection method, wastewater will be discharged to both existing and newly constructed injection wells located approximately 1.7 miles north-northwest of the site. Existing well log data will support the analysis of the subsurface geology and hydrology and its ability to accept the PEF wastewater stream. If this analysis indicates that the local formation is both capable and suitable for the injection program, a field test program will confirm the integrity of the existing well casings and the ability of the formation to accept the wastewater discharge. Well integrity and performance testing will be performed periodically throughout the life of the wells.

A 10- to 12- inch diameter wastewater pipeline will be installed from the site to the injection wells. A filtration system will prevent suspended solids in the blowdown from plugging the well perforations and the aquifer. Periodic sampling of the wastewater discharge will be performed to confirm that its composition is within permit limits.

Zero Discharge Wastewater Treatment System. A second method proposed by PEF for the control of wastewater is zero discharge. A proposed location for the equipment required to support zero discharge is shown in Figure 3.1-1.

The zero discharge (ZD) system will process wastewater streams from the plant with the exception of sanitary and storm water streams. The sanitary stream would continue to be discharged to the sanitary leach field. The stormwater stream would continue to be discharged to the onsite detention basins and then to Pastoria Creek.

The ZD enables a large portion of wastewater to be recycled to the plant's cooling water system. This will act to reduce the plant's water consumption by approximately five to ten percent.

The ZD system will generally include filtration, an evaporator/condenser, a brine crystallizer, and associated ancillary equipment such as mixing tanks and forwarding pumps. Membranes may be used to provide intermediate concentration of the blowdown and waste streams if they result in a more efficient and cost effective installation.

The ZD system will concentrate the dissolved and suspended constituents in the wastewater through a combination of evaporation and crystallization, resulting in the production of 2 to 4 cubic yards per day on non-hazardous salt cake. The solid salt cake will be collected in enclosed containers for off-site disposal or sale.

Cooling Tower Blowdown. Evaporative cooling towers, by their nature, concentrate suspended and dissolved solids in the water. Continuous makeup and blowdown are used to prevent solids from reaching a level that would foul cooling tower media and the steam turbine condenser. After 5 cycles, and to an expected maximum of 10 cycles of concentration, the blowdown will be discharged and treated as wastewater.

Demineralizer Backwash. The plant uses filtration, reverse osmosis, and ion exchange to create demineralized feedwater for the HRSG. Clarified raw water, produced by the cooling water treatment system, is the source for the demineralization system. Continuous bypass flow and cyclic backwash remove suspended and dissolved solids from the system. The concentrated backwash is returned to the cooling water and discharged with the cooling tower blowdown. Acid used to regenerate the ion exchange media passes through a neutralization tank before being discharged to the cooling tower basin.

HRSG Blowdown. The deaeration process and other factors concentrate the small amount of dissolved solids introduced to the HRSG with the demineralized feedwater. Blowdown is needed to prevent these from accumulating to the point that scale forms in the HRSG, steam turbine, or condenser. This blowdown is returned to the cooling water basin and discharged with the cooling tower blowdown after additional cycles of concentration.

Evaporative Cooler Blowdown. Evaporative cooler blowdown will consist of water which was circulated in the combustion turbine inlet air evaporative cooler system for approximately 5 cycles of concentration or as dictated by water supply quality. Blowdown will be as required to maintain the level of dissolved solids within acceptable ranges and will be routed to the cooling tower basin for disposal with the cooling water blowdown after additional cycles of concentration. Final determination of evaporative cooler cycles of concentration will be based on actual water supply characteristics. Evaporative cooler blowdown will not be created if an alternate inlet air cooling system (fogging, mechanical chiller, or absorption chiller) is used.

3.4.8.5.2 Plant Drains and Washdown. A system is provided to collect wastewater from equipment washdown and leakage, sample drains, and miscellaneous plant drains. Water from areas that may accumulate miscible chemicals will be collected in a system of floor drains, sumps, and piping and routed through an oil-water separator. After passing through the oil-water separator, water from the clear well of the oil-water separator will be discharged directly into the pipeline to wastewater disposal injection wells or ZD system.

This oil-water separator will be a small, skid mounted, enclosed unit. Oil from the oil-water separator will be collected and sent off-site for recycling. Clear water will be discharged with the cooling water blowdown.

3.4.8.5.3 Domestic/Sanitary Wastewater. The domestic waste system will collect discharge from sinks, toilets and other sanitary facilities and will discharge to the plant's septic sanitary sewer collection system. The sanitary system will include gravity drainage piping, manholes and lift stations as required. The system will discharge to an underground septic tank and a parallel series of perforated pipes in an on-site leaching field. An authorized hauler will periodically remove solids from the septic tank for transport and suitable disposal.

3.4.8.5.4 Stormwater Drainage. Rainfall from the project site will be predominantly drained by sheet flow and will maintain the integrity of the existing drainage patterns wherever possible. Based on the final site-grading plan, some isolated areas may require underground stormwater collection and drainage piping. Stormwater will be collected on-site using above ground and underground drainage and collection systems. Storm water will be discharged to an on-site Storm Water Quality Control Pond storm. Storm water that does not infiltrate into the soils or evaporate will be discharged to Pastoria Creek. Storm water drainage will be monitored in accordance with an established best management practices program.

Oil leakage from equipment is expected to be minimal. Composition will be similar to standard parking lot impacts. Nonetheless, all equipment that has potential for significant leakage of oil or hazardous chemicals, such as glycol coolants, will be located within spill containment basins.

Storm water from basins which could collect only non-miscible oil will be directed to an oil-water separator which consists of a basin with a clearwell and oil absorbent pillows. Water from the clearwell of this separator will be discharged to the Storm Water Quality Control Pond. The oil absorbent pillows will be replaced as needed and shipped offsite for disposal or recycling.

Basins that collect miscible chemicals or volatile liquids will be directed to another separator as described in Section 3.4.8.5.3 Plant Drains and Washdown.

Sizing of the ponds and separators will be in conformance with the standards of the California Water Quality Control Board, the National Clean Water Act, and Kern County.

3.4.8.5.5 Wastewater Treatment System Solid Wastes. The cooling tower accumulates dirt, sand and biological solids from the air and recycled wastewater makeup. One or more sidestreams, each with a small pump and self-cleaning strainer, will remove some of the

solids from the circulating cooling water. The concentrated discharge from these strainers will be the cooling tower blowdown. A filter press will collect the solids from the blowdown and produce an effluent of adequate quality to discharge to the disposal wells or zero discharge system.

The cooling tower basin will periodically have solids removed through suction or by draining and manual removal. Solids will occasionally be removed from cleanouts in other parts of the cooling water circulating system.

The demineralizer system's pre-filters and reverse osmosis membrane filters will periodically plug with solids and need replacement.

These solids are non-hazardous and will be collected and disposed of offsite at an approved facility (see Section 5.14.1.1).

3.4.9 Waste Management

The PEF will generate a variety of non-hazardous and hazardous wastes during construction and operation (see Tables 3.4.9-1 and 3.4.9-2). These include liquids and solids from the wastewater system (discussed in Section 3.4.8.5.1), kitchen and restroom wastes, waste filters, replaceable parts, rags, and other waste materials and chemicals produced from maintenance activities, equipment fluids and skimmed oil.

Handling of hazardous wastes is discussed in Section 3.4.10.

3.4.9.1 Solid Wastes – Non-Hazardous

3.4.9.1.1 Construction Wastes. Inert solid wastes resulting from construction activities may include lumber, excess concrete, metal and scrap, and empty non-hazardous containers. Management of these wastes will be the responsibility of the construction contractor(s). Typical management practices required for contractor waste include recycling, when possible, proper storage of waste and debris to prevent wind dispersion, and weekly pickup of wastes and disposal to local Class III landfills. The total amount of solid waste generated by construction activities has been estimated to be similar to that for normal commercial construction. It is not expected to result in a significant impact on public health or to cause adverse effects on local landfill capacity. Table 3.4.9-1 (Summary of Construction Waste Streams and Management Methods) provides an overview of the waste streams anticipated for the construction phase of the project.

3.4.9.1.2 Operations Wastes. Inert solid wastes generated at the facility during operation are predominantly office wastes and routine maintenance wastes such as scrap metal, wood and plastic from surplus and deactivated equipment and parts. Scrap materials such as paper,

packing materials, glass, metal, and plastic will be segregated and managed for recycling. Non-recyclable inert wastes will be stored in covered trash bins in accordance with local ordinances and picked-up by an authorized local trash hauler on a regular basis for transport and disposal in a suitable landfill in the area. Table 3.4.9-2 (Summary of Operations Waste Streams and Management Methods) provides an overview of the waste streams anticipated for the construction phase of the project.

3.4.9.2 Liquid Wastes – Non-Hazardous

Non-hazardous liquid wastes produced in the facility consist of wastewater system wastes. Handling and disposal of these wastes is discussed in Section 3.4.7.5.

Skim oil collected from equipment drains and other liquids drained from equipment will generally be treated as hazardous due to possible heavy metals content.

3.4.10 Management and Disposal of Hazardous Material and Hazardous Waste

Prior to operation, PEF will develop and implement a Hazardous Materials Management Program (HMMP) which will include, at a minimum, procedures for:

- Hazardous materials handling, use and storage
- Emergency response
- Spill control and prevention
- Employee training
- Reporting and record keeping.

3.4.10.1 Chemical Management

Tables 3.4.10-1 (Summary of Water Treatment Chemical Usage) and 3.4.10-2 (Summary of Non-Water Treatment Chemical Usage) list the chemicals to be used, handled, or stored at the project site during operation. Sulfuric acid is listed in 40 CFR 355 as an extremely hazardous substance and will require special handling (see Section 5.16, Public Health).

The storage, use, and handling of these hazardous materials will be in accordance with applicable laws, ordinances, regulations, and standards and will include:

- A facility hazardous materials management plan will be developed and implemented prior to turn-over of site management from the construction contractor to the operating company.

- Facility personnel will be trained in hazardous materials and hazardous waste awareness, handling and management as required for their level of responsibility.

- Bulk chemicals will be stored in aboveground storage tanks while all other chemicals will be stored in the original shipping container.

- Chemical storage areas and feed/transfer areas will be equipped with secondary containment sufficient in size to contain the volume of the largest storage container or tank including an allowance for rainwater.

- Small quantity chemicals used for maintenance tasks will be kept in appropriate flammable material or corrosive material storage lockers.

- Periodic inspections will ensure that all containers are secure and properly marked.

3.4.10.2 Hazardous Wastes

Table 3.4.9-1 Summary of Operation Waste Streams and Management lists the types of wastes to be generated during operation of the project. These wastes will be managed in accordance with applicable laws, ordinances, regulations, and standards and PEF's HMMP, including:

- Pastoria Energy Facility, LLC will secure an EPA Hazardous Waste Generator ID number prior to turn-over of site management from the construction contractor to the operating company.

- All hazardous wastes will be stored in appropriate bulk storage containers or in labeled 55-gallon drums equipped with secondary containment and closed-tops with bungs for liquid wastes or in secured open-top drums for solid wastes.

- All waste drums will be stored in accordance with good practice and applicable regulations and will be protected from environmental conditions (rain, wind, direct heat) and physical hazards such as vehicle traffic and sources of heat and impact.

- Storage of hazardous waste will at no time exceeds 90 days from the date of initial accumulation with a total of 55 gallons of hazardous waste or more on site.

- All used or skimmed oils will be managed for recycling.

- California-authorized hazardous waste haulers will transport hazardous wastes to registered waste treatment, storage, disposal and recycling facilities.

- Hazardous waste generation, handling and storage areas will be inspected and monitored on a regular basis.

- Emergency response and reporting will be performed per written procedures that follow government and industry requirements and standards.

3.4.11 Emissions Control and Monitoring Equipment

Best Available Control Technology (BACT) will be incorporated in the design of emissions control and monitoring facilities for PEF. Continuous emission monitoring system (CEMS) equipment will record NO_x and CO emissions and alert operators of deviations from design levels. The following subsections describe the emissions control. Emissions data, emissions impacts, and applicable regulations are addressed in Section 5.2 and Appendix I.

3.4.11.1 NO_x Production and Control Mechanisms

XONON™ technology will be used to control both NO_x and CO emissions. Integrated directly into the combustion zone of the gas turbine, the XONON™ Module controls CTG exhaust gas emissions at or below permitted stack levels. By combusting the fuel gas without a flame, XONON™ extends the combustion duration thereby reducing the peak temperatures which form NO_x while avoiding increases in CO and UHC.

As a back up alternative to the XONON™ catalytic technology, Dry Low NO_x combustors combined with post emission controls will be used. The Dry Low NO_x (DLN) combustor system may be used to control the concentration of oxides of nitrogen (NO_x) exiting the CTG. Post combustion NO_x control, using a selective catalytic reduction (SCR) system installed in the HRSG, will further reduce NO_x concentration to permitted levels.

The design of the SCR for PEF will reduce NO_x emissions to 2.5 ppmvd or less at 15 percent O_2 at the stack as measured on a one hour rolling average. The air modeling analysis for this project is based on stack NO_x emission rates of 2.5 ppmvd at 15 percent O_2.

The air modeling analysis for this project is based on stack NO_x emission rates of 2.5 ppmvd at 15 percent O_2.

3.4.11.2 NO_x Formation

NO_x is produced when oxygen and nitrogen come together under high temperature. In the typical combustion process, temperature distribution is erratic. NO_x production is greatest where the highest temperatures exist.

3.4.11.3 XONON™ Control Technology

Located within the CTG's combustor, the XONON™ Module combusts a portion of the fuel within the proprietary catalyst in a flameless reaction. The combustion process is completed in the burnout zone where essentially all remaining CO and hydrocarbons are combusted. The staged combustion sequence provided by the XONON™ Module effectively reduces peak NO_x forming combustion temperatures while achieving the high combustion temperature required for efficient CTG operation and performance.

As an emission control device which is integral to the CTG, the XONON™ Module will control the CTG's exhaust gas NO_x levels to 2.5 ppmvd at 15 percent O_2 on an 1-hour rolling average and CO levels to 6 ppmvd at 15 percent O_2 on a 3-hour rolling average. Since no ammonia is used with the XONON™ technology, the ammonium sulfate contribution to PM_{10} is avoided.

3.4.11.4 Dry Low NO_x Combustors

DLN combustors reduce NO_x by thoroughly mixing air and fuel to create an even temperature spread, thereby reducing temperature peaks. For a given heat input, the peak temperature, and therefore peak NO_x production, is lower. For a given NO_x level, a gas turbine using DLN technology can operate at a higher temperature where its thermodynamic efficiency is higher.

The exhaust gases of F-Class CTGs using DLN technology contain between 9 and 25 ppmvd NO_x at 15 percent O_2 when operating at full load. As the CTG operating load decreases, the ability of the DLN combustors to control NO_x production also decreases. To maintain control of stack NO_x emissions, the CTGs will not be operated below the effective DLN control level which is approximately 50 percent load with General Electric Frame 7FA, and approximately 60 percent load with Westinghouse W501F turbines. The use of DLN technology requires the use of an SCR and CO catalyst.

3.4.11.5 SCR System

The SCR system consists of the reduction catalyst and an aqueous ammonia vaporization and injection system. The catalyst and ammonia injection grid is arranged within the HRSG so that ammonia vapor, injected into the CTG exhaust gas stream, will be well mixed with the

exhaust gas when it reaches the catalyst. As this gas stream passes over the catalyst bed, the ammonia (NH_3) combines with NO_x, in a reduction reaction, to produce nitrogen gas (N_2) and water vapor (H_2O). A small amount of ammonia slip results from the SCR operation.

The SCR system will use a 25 percent-by-weight aqueous ammonia solution. At base load, the aqueous ammonia injection rate will be approximately 450 pounds per hour. Onsite storage of aqueous ammonia, for each CTG, will provide approximately 15, 24-hour days of base load operation. The required storage capacity will be provided by three 20,000 gallon, double-walled storage tanks. The injection system, tanks and transfer piping will be provided with control and monitoring equipment as needed to ensure safe and effective operation of the system.

3.4.11.6 CO and VOC Emissions

Carbon monoxide (CO) forms when hydrocarbons are burned in an oxygen deficient or low temperature atmosphere.

Lean-burn operation, DLN technology, and other good combustion technology will ensure that carbon monoxide (CO) produced by the CTG is minimized. Post combustion control of CO will be accomplished by passing the exhaust gases over a CO oxidizing catalyst installed in the HRSG. The CO catalyst facilitates an oxidizing reaction at a temperature lower than normal combustion. 80 to 90 percent of the CO in the exhaust combines with exhaust oxygen to form CO_2.

Volatile organic compounds (VOC) include all unburned hydrocarbons except methane and ethane. They remain in the exhaust when part of the incoming fuel does not have sufficient contact with oxygen to support full combustion. For these CTGs, VOC emissions are low due to proper CTG combustion controls and the use of natural gas as the single fuel. The CO oxidizing catalyst, installed in the HRSG, further reduces VOC levels by facilitating “low” temperature oxidation of approximately 30 percent of the VOCs in the exhaust to form CO_2 and water.

3.4.11.7 Particulates

Particulate emissions are minimized through selection of natural gas as the exclusive fuel. Combustion of natural gas produces minimal particulate emissions compared to other fuels.

A significant fraction of the particulate matter in stack emissions consists of compounds of ammonium and sulfate. Sulfur compounds, contained in small quantities in natural gas, are oxidized in the gas turbine combustors to form CO_2, H_2O, SO_2 and SO_3. While most of the fuel sulfur is converted to SO_2, approximately 1.5 percent is converted to SO_3. When the exhaust gasses pass through the CO oxidizing catalyst, approximately 3 percent to 11 percent

of the SO_2 is converted to SO_3, which then combines with water in the exhaust to form H_2SO_4 which is defined as a condensable particulate. Passing through the SCR, some of the ammonia injected for NO_x control combines with H_2SO_4 to form ammonium sulfate and ammonia bisulfate which form very fine solids which meet the air quality definition of noncondensable PM_{10}. The remaining SO_2 is emitted as a gas.

Inlet air filtration removes particulate matter present in the air, thus preventing it from entering and being exhausted by the turbine.

Particulate emission associated with cooling tower drift will be minimized through the use of high efficiency drift eliminators.

3.4.11.8 Emission Monitoring

A continuous emissions monitoring system (CEMS) will be installed at the stack of each HRSG. The system will sample, analyze and record the concentrations of carbon monoxide, oxides of nitrogen, oxygen and carbon dioxide in the flue gas. The system provides a record of emissions data and transmits alarm signals to the control room when the emissions level exceeds pre-selected limits. The CEMS will comply with 40 CFR 60 and 40 CFR 75 requirements.

3.4.12 Fire Protection and Safety Systems

The plant fire protection and safety systems will be designed to limit personnel injury, property loss, and plant downtime caused by a fire or other event. The systems will be designed in accordance with:

- Federal, State and Local fire codes, occupational health and safety regulations, and other jurisdictional requirements.
- California Building Code (CBC)
- National Fire Protection Association (NFPA) standard practices.

Table 3.4.12-1 provides a summary of PEF fire protection systems design conditions. The subsections below provide a detailed description of the fire protection and safety systems for the PEF.

3.4.12.1 Firewater System

The fire water supply and pumping system will provide an adequate quantity of fire-fighting water to yard hydrants, hose stations, and water spray and sprinkler systems. The system will

be capable of supplying maximum water demand for any automatic sprinkler system plus water for fire hydrants and hose stations.

The primary source of firewater is the Makeup Water Storage Tank, which includes 500,000 gallons reserved for fire protection. A plant firewater loop will reach all parts of the facility and will have dual check-valves to prevent back flow to the tank. As system back-up, the firewater pump skid will also be able to supply the plants firewater loop from the raw water supply pipeline or the cooling tower basins.

The fire water system will have sectionalizing valves to allow a failure in any part of the system to be isolated. The remainder of the system will then be able to function properly. Hydrants and hose houses will be placed at appropriate spacing around the plant. The hydrants will be located and the hose houses equipped in accordance with NFPA 24 and local fire codes. Firewater monitors will be placed where they can reach equipment that may need cooling during a fire event. Valves requiring periodic testing will be accessible.

Three pumps will supply the plant fire water system. A small, electric driven, jockey pump will ensure that the firewater loop remains pressurized. A 400-horsepower, electric driven pump will start automatically if the pressure in the firewater loop drops below a specified set point. A 400-horsepower diesel engine driven pump will start automatically if the pressure in the firewater loop drops below a lower set point. Automatic valves will open, in order, to draw water from the raw water supply pipeline if pressure falls below a lower set-point. The fire pump(s) will run until manually stopped. Fire pump installation will be in accordance with NFPA 20. The design capacity of the plant's firewater system will be approximately 3000 gpm.

3.4.12.2 Fixed Fire Protection Systems

Fixed fire protection systems will be provided for the steam turbine bearings, lube oil equipment, cooling towers, and station transformers. The cooling tower fire protection system will be designed and constructed in accordance with NFPA 214. Sprinkler and fixed spray systems will be designed and installed in accordance with NFPA 13 and NFPA 15, respectively. Temporary fire protection will be provided for the cooling towers during the period between the completion of construction and start-up.

Automatic fire protection systems will be provided in the plant control room and electrical equipment rooms.

3.4.12.3 Fire Alarm and Detection

The main fire control panel, located in the station Control Room, will annunciate activation of a fire protection/detection system by location zones. The panel will be designed to operate

on 120 VAC power through the UPS system. The alarm and detection system will be designed to comply with NFPA 70 and 72.

Local building fire pull boxes and audible alarms will be provided. Flashing lights will be used in addition to audible alarms in high noise areas.

3.4.12.4 Portable Extinguishers

Portable CO_2 and dry chemical extinguishers will be located throughout the plant, including switchgear rooms, with size, rating, and spacing in accordance with NFPA 10. Handcart CO_2 extinguishers will be provided for the turbine area as needed for specific hazards.

3.4.12.5 Miscellaneous Fire Safety Items

All materials of construction used in the plant will be free of asbestos and will meet the required fire and smoke rating.

Plant management will coordinate with the local fire marshal and fire department to provide an appropriate orientation to the plant and its operating and emergency procedures for emergency personnel.

3.4.12.6 Safety Fixtures

Safety showers and emergency eyewash stations or bottles will be provided at all chemical treatment and storage areas, laboratories, Battery Room, Warehouse, and Maintenance areas.

Self-contained breathing apparatus sets will be available in the control room. First-aid kits will be located in work areas around the plant. Fire blankets and evacuation stretchers will be located in the Turbine Building and in the Administration and Control Building.

3.4.13 Plant Auxiliaries

3.4.13.1 Lighting

Lighting will be required for safe and efficient operation in a number of areas. These include:

- Building interior, office, control, and maintenance areas
- Building exterior entrances
- Outdoor equipment platforms and walkways
- Transformer areas
- Power island perimeter roads

- Parking areas
- Entrance gate
- Cooling tower.

To avoid intrusion on sensitive areas, outdoor lighting will be directed downwards and towards the interior of the plant.

Emergency lighting from DC battery packs will be provided in areas of normal personnel traffic to permit safe egress from the area in the event of failure of the normal lighting system. In major control equipment areas and electrical distribution equipment areas, emergency lighting will be sufficient to allow equipment operation and to facilitate reestablishment of auxiliary power.

Aviation obstruction lighting will be provided as required by the Federal Aviation Administration.

3.4.13.2 Grounding

The electrical system may experience unit ground potential rise due to ground fault, lightning strike, or switching surge. This constitutes a hazard to site personnel and electrical equipment. A grounding system will be installed to permit dissipation of ground fault currents and minimize ground potential rise.

The station grounding grid consists of bare conductors installed below grade in a grid pattern. Each junction of the grid is bonded together by an exothermal welding process or mechanical connectors.

The grounding grid is designed with adequate capacity to dissipate heat produced by ground current under the most severe fault conditions. Grid spacing is designed to maintain safe voltage gradients. Ground resistivity testing will be performed during detailed design to determine the number of ground rods and the grid spacing necessary to ensure safe step and touch potentials under fault conditions.

Grounding cables will connect building structural steel and non-energized metallic parts of electrical equipment to the grid. Isolated grounding conductors will connect sensitive control systems to the grid.

3.4.13.3 Cathodic Protection and Lightning Protection

Cathodic protection may be provided, using an impressed current or buried anode system, to prevent corrosion of buried carbon steel piping and structures. Protective coatings are applied as primary protection and to minimize cathodic protection current requirements. The

requirement for a cathodic protection system will be determined during detailed design.

Lightning protection will be furnished for buildings and structures. Lightning protection for the switchyard will be installed in accordance with industry practice.

3.4.13.4 Distributed Control System

A distributed control system (DCS) provides coordinated monitoring and control for the CTGs, HRSGs, STGs, and balance of plant equipment. Plant operation is controlled from the control console in the plant control room. Cathode ray tube (CRT) display and input stations provide indication and control for most DCS functions. Auxiliary control panels contain chart recorders, backup indicator and control devices, and non-critical auxiliary controls.

The DCS provides modulating control, digital control, and monitoring and indicating functions for operation of the plant systems and auxiliaries. The CTG and STG control systems interface with the DCS via a data link and/or hardwired I/O. CEMS inputs are hardwired to the DCS for monitoring and alarming of emissions concentrations in the exhaust gas. A sequence-of-events (SOE) function will be an integral part of the DCS.

Annunciation will be provided primarily through the DCS. Major packaged subsystems, such as water treatment, may have a local alarm system with a single trouble alarm in the control room. A more detailed description of the DCS is provided in Section 3.9.2.6.

3.4.13.5 Plant Service and Instrument Air System

The plant service and instrument air system will provide compressed, dry air for use in instruments and control devices and to hose connections for general plant service. The system will consist of two 100 percent capacity, electric driven air compressors, an oil separator, two air dryers with pre-filters and after-filters, an air receiver, service and instrument air headers, distribution piping and hose connections.

The compressors will be sized to provide the required instrument air plus a sufficient amount of 125 psig service air for hose stations. The system capacity will be based on the total quantity of air users, the capacity of each user, plus a margin to account for leakage and plant modifications. The air receiver will be sized to allow sufficient surge time during a compressor failure to allow the spare compressor to be brought on-line.

3.4.14 Heating, Ventilation and Air Conditioning

The heating, ventilation and air conditioning (HVAC) systems provide an acceptable environment for personnel comfort and electrical and electronic equipment operation within plant buildings. Air conditioning in the control and administrative areas maintain a suitable

environment for plant personnel. Humidity control is provided, as needed, for control room systems.

Outside air ventilation systems are provided for buildings where air conditioning is not required. Electric heaters will be used for cold weather heating.

Normally occupied plant areas, including toilet areas, will be supplied with fresh air in accordance with the Uniform Building Code, ASHRAE Standard 62, and the California Code of Regulations.

3.4.15 Plumbing

Plant plumbing systems will be constructed in accordance with the Uniform Plumbing Code and local and state regulations. Potable water will be produced with on-site treatment of raw water from the California Aqueduct. Potable water will be provided to restrooms, showers, and kitchen facilities in the Administration and Control Building and Warehouse and Shops Building. Work sinks and drinking water will be provided in the various areas throughout the plant. Safety showers, eyewash stations, and utility hose bibs will be provided at appropriate locations in the plant.

Restrooms, showers, sinks, water coolers, and floor drains will be taken to the on-site sanitary sewer system. Contact stormwater, wash water, and equipment drips collected in equipment sumps will be directed to one of two oil-water separators.

Spill containment areas and sumps subject to spills of miscible chemicals will be drained to a small enclosed oil-water separator. Oil from this oil-water separator will be collected in a waste oil tank for offsite recycling. Clean water from the oil-water separator clear well will be discharged into the wastewater disposal line and discharged with the other plant wastewater.

Spill containment areas and sumps subject only to non-miscible oil spills will be drained to a pillow type oil-water separator. Oil absorbent pillows will be replaced and recycled as needed. Water from the clear water sump will be drained to the Storm Water Quality Control Pond.

TABLE 3.4.1-1
PASTORIA ENERGY FACILITY

MAJOR EQUIPMENT LIST

Quantity	Description	Size/Capacity [1]	Remarks
3	Combustion Turbine	168 MW	Dry Low NO_x combustion control & starter package; Gross Output
2	Steam Turbine	185/90 MW	Single Shaft HPT, IPT, & LPT (2x1 configuration/1x1 configuration)
5	Generators		Included with CT & ST
3	CT Inlet Air Filter	3,600,000 lb/hr	
3	Inlet Air Cooling		Evaporative/Refrigeration/Fogging
3	Fuel Gas Filter – Separator	150,000 lb/hr	
1	Turbo Expander	230,000 lb/hr	
3	Heat Recovery Steam Generator (HRSG)	550,000 lb/hr	HP, IP, LP with Reheat
3	HRSG Stack		18'-0" dia. x 213' High
3	Catalytica – CO Emission Control		Achieve BACT/LAER
3	Catalytica – NO_x Emission Control		Achieve BACT/LAER
(3)	Ammonia Injection Skid		(Two blowers per HRSG – Alternate)
(3)	Aqueous Ammonia Storage Tank	20,000 gal.	(Double walled tanks – Alternate)
6	HP/IP HRSG Feedwater Pumps	1,700 gpm	HP with interstage bleed
1	Make-up Water Clarifier	5,600 gpm	Gravity Flow
1	Make-up Water Storage Tank	2,300,000 gal	Includes firewater storage
3	Demineralized Water Pumps	170 gpm	
1	Demineralized Water Treatment Package	350 gpm	
1	Demineralized Water Storage Tank	150,000 gal	
5	Condensate Pumps	1300 gpm	1 spare per condenser
6	Circulating Water Pumps	60,000 gpm/30,000 gpm	2x1 Configuration/1x1 Configuration
2	Wet Cooling Tower Banks	1,100mm BTU/hr / 600mm BTU/hr	2x1 Configuration/ 1x1 Configuration
1	Fire Water Pump Skid	3,000 gpm	
3	Auxiliary Cooling Water Pumps	750 gpm	
2	Plant Air Compressors & Dryers	750 cfm	
4	Step-up Transformers	18/230 kV	To Electrical Grid
1	Emergency Backup Standby Generator	66 kW	Natural Gas Fired

(1) Approximate Size/Capacity for each piece of equipment. Final sizing and configuration will be determined during detailed design.

( ) Applicable to SCR alternative only.

TABLE 3.4.1-2
PASTORIA ENERGY FACILITY
SIGNIFICANT STRUCTURES AND EQUIPMENT[(1)]

Quantity	Description	Dimensions		
		Length [Ft]	Width [Ft]	Height [Ft]
3	Combustion Gas Turbine/Generator/Starter Package (CT)	100'	40'	20'
3	CT Air Inlet Filter with Air Cooling	70'	30'	45'
1	Turboexpander Building	20'	20'	15'
3	Heat Recovery Steam Generator (HRSG)	160'	40'	70'
3	HRSG Stack		18' dia.	200'
1	Water Treatment Building	160'	60'	20'
1	Demineralized Water Storage Tank		30' dia.	30'
1	Make-up Water Storage Tank		150' dia.	20'
2	Steam Turbine Pedestal w/ Turbine, Generator & Condenser	100'	50'	40'
2	Wet Cooling Tower Banks	430'	100'	64'(2)
		230'	100'	64'(2)
1	Administration Bldg./Control Room	120'	60'	20'
1	Warehouse and Shops	120'	120'	35'
1	Switchyard, Busses & Towers	450'	225'	40'
2	Electrical Control Buildings (Plant Area)	80'	20'	15'
1	New Transmission Tower	< 20'	< 20'	110'
1	Firewater Pump House	30'	15'	10'

Note:
(1) All structure dimensions shown are approximate. Structures greater than 50' high are identified to support air modeling considerations. Actual Dimensions will be determined during detailed design.
(2) Fan Deck Height--50'

TABLE: 3.4.8-1

PASTORIA ENERGY FACILITY WATER USAGE RATES

Water Use	Maximum Summer (gpm) (1)	Average Annual (gpm) (4)
PLANT MAKE-UP WATER USE:		
Make-up Water for cooling tower make-up	4,800	2,925
Make-up Water for HRSG water treatment and make-up	100	100
Make-up Water for water treatment system discharge	50	50
Make-up Water for Evaporative Cooler	65	40
TOTAL PLANT MAKEUP WATER USAGE(3)	**5,015**	**3,115**
PLANT WASTEWATER:		
Cooling tower blowdown	960	585
Water from plant drains	15	15
HRSG blowdown to cooling tower	100	100
Evaporative cooler blowdown to cooling tower	15	10
Water treatment system backflush and drains to cooling tower	50	50
TOTAL WASTEWATER	**1,140**	**760**
POTABLE WATER USE:		
For drinking and sanitary water requirements	5	5
For safety showers and utility stations	15	15
TOTAL POTABLE WATER USAGE	**20**	**20**
PLANT WASTEWATER DISCHARGE:		
To Injection Wells (Includes OWS Clear Well Discharge)	1,140	760
Discharge to oily-water separator (OWS)	15*	15*
Sanitary wastewater discharge(5)	5	5
TOTAL PLANT WASTEWATER DISCHARGE	**1,145**	**765**
PLANT WATER LOSS TO ATMOSPHERE:		
Evaporative cooler evaporation loss	50	30
Cooling tower evaporation loss	3,840	2,340
Cooling tower drift loss(6,7)	<1	<1
TOTAL PLANT WATER DISCHARGE TO ATMOSPHERE	**3,891**	**2,371**

(1) "Maximum Summer" is based on ambient temperatures $\geq$ 110°F, 71°F, wet bulb.
(2) Evaporative cooler is 80 percent effective, at five cycles of concentration.
(3) Total plant water use is based on operation of the CTG's at 100 percent base load with natural gas.
(4) Average annual is averaged over 24-hour period at 60 °F, 50% RH.
(5) Sanitary wastewater to leaching field.
(6) Cooling tower recirculation rate of 175,000 gpm.
(7) Cooling tower drift loss is less than 1 gallon/min based on use of cellular type drift eliminator.
* Included in line above

Table 3.4.8-2
Pastoria Energy Facility
California Aqueduct Water Analysis

COMPONENTS	Units	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Mean
ALKALINITY	mg/l	41	66	65	61	63	66	102	109	51	69	79	80	71
ARSENIC	mg/l	0.002	0.003	0.003	0.002	0.002	0.002	0.003	0.003	0.001	0.002	0.002	0.002	0.002
BORON	mg/l	0.104	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
BROMIDE	mg/l	0.07	0.19	0.11	0.06	0.06	0.08	0.17	0.13	0.13	0.15	0.17	0.18	0.13
CALCIUM	mg/l	12	19	17	15	14	16	26	27	15	19	18	20	18
CARBON- TOTAL ORGANIC	mg/l	4.4	3.4	3	3	2.5	2.5	9	3	3.4	3.2	3.2	3.3	3.7
CHLORIDE	mg/l	22	57	37	21	20	25	48	42	26	49	58	62	39
CHROMIUM	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	0.005	0.007	<0.005
COPPER	mg/l	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
FLUORIDE	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
HARDNESS	mg/l	52	93	80	66	64	69	114	121	66	89	90	99	84
IRON	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005
LEAD	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MAGNESIUM	mg/l	5	11	9	7	7	7	12	13	7	10	11	12	9
MANGANESE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NITRATE +NITRITE	mg/l	NR	0.65	0.5	0.64	0.66	0.79	0.54	0.36	0.76	0.76	0.44	0.48	0.55
PHOSPHORUS-ORTHO	mg/l	0.08	0.11	0.1	0.07	0.07	0.06	<0.01	<0.01	0.07	0.05	0.07	0.08	0.06
PHOSPHORUS- TOTAL	mg/l	0.2	0.2	0.13	0.12	0.1	0.08	0.07	0.04	0.23	0.08	0.15	0.1	0.13
SELENIUM	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SODIUM	mg/l	19	41	30	21	20	26	43	41	26	45	45	52	34
SPECIFIC CONDUCTANCE	µS/cm	205	398	313	239	235	272	426	433	277	416	414	436	339
SULFATE	mg/l	20	34	27	22	21	22	44	47	36	55	24	38	33
TOTAL DISSOLVED SOLIDS	mg/l	114	219	198	139	137	152	234	223	143	230	249	230	189
TRIHALOMETHANE FORMATION POTENTIAL	µg/l	485	412	420	357	322	324	386	335	380	394	345	303	372
TURBIDITY	NTU	140	70	48	15	6.8	3.7	4	3	47	16	30	24	34
Zinc	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
pH														
TEMPERATURE														
TSS														

mg/l milligrams per liter
µg/l micrograms per liter
µS/cm microSiemens per centimeter
NTU nephelometric turbidity unit
NR - Not Reported

Note: Samples taken by CDWR at Tehachapi Afterbay (Check 41) on the California Aqueduct

TABLE 3.4.8-3

PASTORIA ENERGY FACILITY
WATER QUALITY ANALYSIS, WHITE WOLF WATER BANK
WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT[1]

Constituent	Units[(2)(3)]	Quality
Electrical Conductivity	mμms/cm	635
Nitrate	mg/L	18
Sodium	mg/L	38
Chloride	mg/L	36
Boron	mg/L	0.3
Dominant		
cation		Calcium
anion		Bicarbonate

[1] Data from Wheeler Ridge-Maricopa Study; samples taken in 1991.

[2] Unit = umhos = microsiemens per centimeter.

[3] Unit = mg/L = milligrams per litre.

TABLE 3.4.8-4

PASTORIA ENERGY FACILITY
SUMMARY OF WASTEWATER STREAMS AND ESTIMATED QUALITY

Stream Description	TDS, mg/l	pH
Oily/Water separator discharge water	500	6.0-9.0
Sanitary wastewater to leaching field	300	6.0-9.0
Cycle backwash discharge	800	6.0-9.0
CT Inlet Evaporative coolers blowdown water	750	6.0-9.0
Cooling tower blowdown water @ 5-10 cycles of concentration	1,500 – 2,500	6.0-9.0
HRSG blowdown water	150	9.0-11.0

TABLE 3.4.8-5

PASTORIA ENERGY FACILITY
SUMMARY ESTIMATED WASTEWATER QUALITY

Analysis	as	Combined Stream[1] 5 cycles	Combined Stream[2] 10 cycles
Ca	$CaCO_3$	76.1	138.2
Mg	$CaCO_3$	39.2	71.1
Na	$CaCO_3$	161.5	278.6
K	$CaCO_3$	0.0	0.0
Al	$CaCO_3$	0.0	0.0
Ba	$CaCO_3$	0.0	0.0
Fe+3	$CaCO_3$	0.1	0.1
Mn+2	$CaCO_3$	0.0	0.0
Se	$CaCO_3$	0.0	0.0
Br	$CaCO_3$	0.4	0.8
Sus Iron	$CaCO_3$	0.0	
HCO_3	CaCO3	321.1	584.4
CO_3	$CaCO_3$	23.6	23.5
OH	$CaCO_3$	22.9	22.9
SO_4	$CaCO_3$	134.9	245.1
CL	$CaCO_3$	183.6	318
NO_3 +NO_2	$CaCO_3$	2.5	4.3
F	$CaCO_3$	0.6	1.1
T-PO4	$CaCO_3$	0.6	1.0
O-PO4	$CaCO_3$	0.2	.5
B	$CaCO_3$	0.5	1.1
M Alk	$CaCO_3$	153.4	534.1
P Alk	$CaCO_3$	23.5	23.5
pH	pH	7.2	
SiO_2	SiO_2	46.4	84.0
Al		.04	0.5
Conductivity	µmhos	1442.7	2803.4
Turbidity	NTU	1.7	3.4
TSS	ppm	3.4	6.8
Ammonia	N	0.0	0.0
Res-Cl_2	ppm	0.0	0.0
Res-Br_2	ppm	0.0	0.0
BOD	ppm	NT	NT
Temp	Deg. F	69	96

(1) Based on 5 cycles of concentration from the cooling tower.
(2) Based on 10 cycles of concentration from the cooling tower.

TABLE 3.4.8-6

WHEELER RIDGE MARICOPA WATER STORAGE DISTRICT WATER SUPPLIES FROM THE CALIFORNIA AQUEDUCT

SWP Entitlement Water	WRMWSD has a contractual supply of 197,088 acre-feet/year of State Water Project (SWP) surface water entitlement through the Kern County Water Agency. It is felt that the minimum allocation to WRMWSD under the worst case hydrological conditions would be approximately 60,000 acre-feet.
SWP Interruptible Water	This supply is essentially the flood flows available from the SWP in January through March of many years. This supply is expected to be available to WRMWSD even in some years when the full SWP entitlement supply is not available.
WRMWSD Pool Water	In years in which demand in WRMWSD is less than the allocated SWP supply, WRMWSD water users can place their excess supplies in WRMWSD pools. WRMWSD is then obligated to dispose of this water if there is a market for it. This market can include banking of these supplies.
Kern County Water Agency Pool Water	In years in which demand within some Kern County water districts are less than the allocated supply, member districts of the Kern County Water Agency can release their excess supplies to the Agency. The Agency attempts to use this supply within the County for irrigation deliveries or banking, including availability to WRMWSD, and then subsequently to others outside the County.
State Turnback Pool Water	In most years, the demands of some SWP Contractors are less than their allocated SWP supplies. Such excess water can be made available for purchase by other SWP Contractors through the State Turnback Pool.
Exchange Water	In some years, WRMWSD may provide a portion of its water supply to other districts under the condition that the water be returned at a later date.

TABLE 3.4.9-1

SUMMARY OF CONSTRUCTION WASTE STREAMS AND MANAGEMENT METHODS

Waste Stream and Classification	Origin and Composition	Estimated Amount	Estimated Frequency of Generation	On-site Treatment	Waste Management Method
Construction Waste Nonhazardous	Scrap wood, steel, glass plastic, paper	40 cu yd/wk	Intermittent	None	Dispose to landfill
Construction Waste Hazardous	Empty hazardous material containers	1 cu yd/wk	Intermittent	Store for < 90 days	Dispose to hazardous waste disposal facility
Construction Waste Hazardous	Solvents, used oils, paint, oily rags, adhesives	165 gallons	Every 90 days	Store for < 90 days	Dispose to hazardous waste disposal facility or recycle
HRSG and preboiler piping cleaning waste Hazardous	Chelant type solution	100,000 gallons	One time event	None	Dispose to hazardous waste disposal facility or recycle
Spent batteries Hazardous	Lead acid, alkaline type	20 in 2 years	Intermittent	Store for < 90 days	Dispose to recycling facility
Stormwater from construction area Nonhazardous	Surface runoff (Water, inert material, dirt and concrete particles)	1500 gpd	Intermittent	None	Dischage to the existing evaporation pond
Residual solids from evaporation pond Nonhazardous	Dirt and concrete particles	50 cu yd	One time at end of construction	None	Excavate at end of construction and spread on site
Sanitary waste Nonhazardous	Portable Chemical Toilets Sanitary waste	200 gpd	Periodically pumped to tanker truck by licensed contractors	None	Ship to sanitary water treatment plant

TABLE 3.4.9-2

PASTORIA ENERGY FACILITY
SUMMARY OF OPERATION WASTE STREAMS AND MANAGEMENT METHODS

Waste Stream	Classification and Status	Origin and Composition	Estimated Amount	Estimated Frequency of Generation	Waste Management Method	
					On-Site	Off-Site
Used Hydraulic Fluid, Oils and Grease, and Oily Filters	Hazardous Recyclable	CTG, STG and other users of hydraulic actuators and lubricants	< 5 gpd	Intermittent	Store for < 90 days	Recycle
Used Air Filters	Nonhazardous	CTG	2000 Filters	Every 5 Years	None	Recycle
Spent batteries	Hazardous Recyclable	Lead Acid, Alkaline	5 per year	Intermittent	Store for< 90 days	Recycle
Spent SCR and CO Catalyst	Hazardous Recyclable	HRSG, Heavy metals	16,000 cu ft	Intermittent Once every 3 to 5 years	None	Recycle
Cooling Tower Basin Sludge	Nonhazardous	Cooling Tower	2 tons per year	Annually	None	Recycle to Compost or Dispose to nonhazardous waste disposal facility
Oily Rags	Nonhazardous	CTG, STG and other users of hydraulic actuators and lubricants	55 gallons per mouth	Intermittent	Store for < 90 days	Laundry at authorized facility
Oily Absorbent	Hazardous Recyclable	CTG, STG and other users of hydraulic actuators and lubricants	55 gallons per mouth	Intermittent	Store for < 90 days	Dispose to authorized waste disposal facility
Sanitary Wastewater	Nonhazardous	Rest Rooms, Waste Rooms, Sanitary Waste	1400 gpd	Continuous	Liquids disposed to on-site leaching field	Sludge disposed to sanitary waste disposal facility
Make-up water solids (filter cake)	Nonhazardous	Dirt, sand and Biological Solids	2 to 3 cu yds/day	Continuous	Media Filters	Recycle to Compost or Dispose to nonhazardous waste disposal facility
Salt Cake Zero Discharge Option	Nonhazardous	Naturally occurring salt compounds	2 to 4 cu yds/day	Continuous	None	Commercial sale or dispose to nonhazardous waste disposal facility

TABLE 3.4.10-1
PASTORIA ENERGY FACILITY

SUMMARY OF WATER TREATMENT CHEMICAL USAGE AND STORAGE

CHEMICAL	APPLICATION	EXPECTED STORAGE QUANTITY (GALLONS)
		AVERAGE
Sulfuric Acid 93%[1] (H_2SO_4)	pH control of cooling towers neutralize excess alkalinity	3500
Sodium hydroxide[2] 32% (NaOH)	pH control of cooling towers	3500
Oxygen scavenger 30% concentration	Boiler chemical	100
Neutralizing amine 20% concentration	Boiler chemical	150
Phosphate 20% concentration	Removal of dissolved hardness ions (scale deposit control)	100
Sodium hypochlorite 12.5% solution (Bleach)	Biocide for cooling water	1500
Bromine Biocide and Biodispersant	Fed with Bleach	1500
Dehalogenation agent – NaIco1316 or equal	Neutralize oxidant from chlorine & Bromine	1500
Disodium phosphate	Boiler pH and scale control	750 lbs
Trisodium phosphate	Boiler pH and scale control	750 lbs
Scale inhibitors	Scale reduction in cooling water	200
Polymer	Water treatment coagulant	800
Aluminum sulfate	Water treatment coagulant	500

[1] California Toxic chemical.
[2] California air toxic “hot spots” chemical.

TABLE 3.4.10-2

PASTORIA ENERGY FACILITY
SUMMARY OF NON-WATER TREATMENT CHEMICALS USAGE AND STORAGE

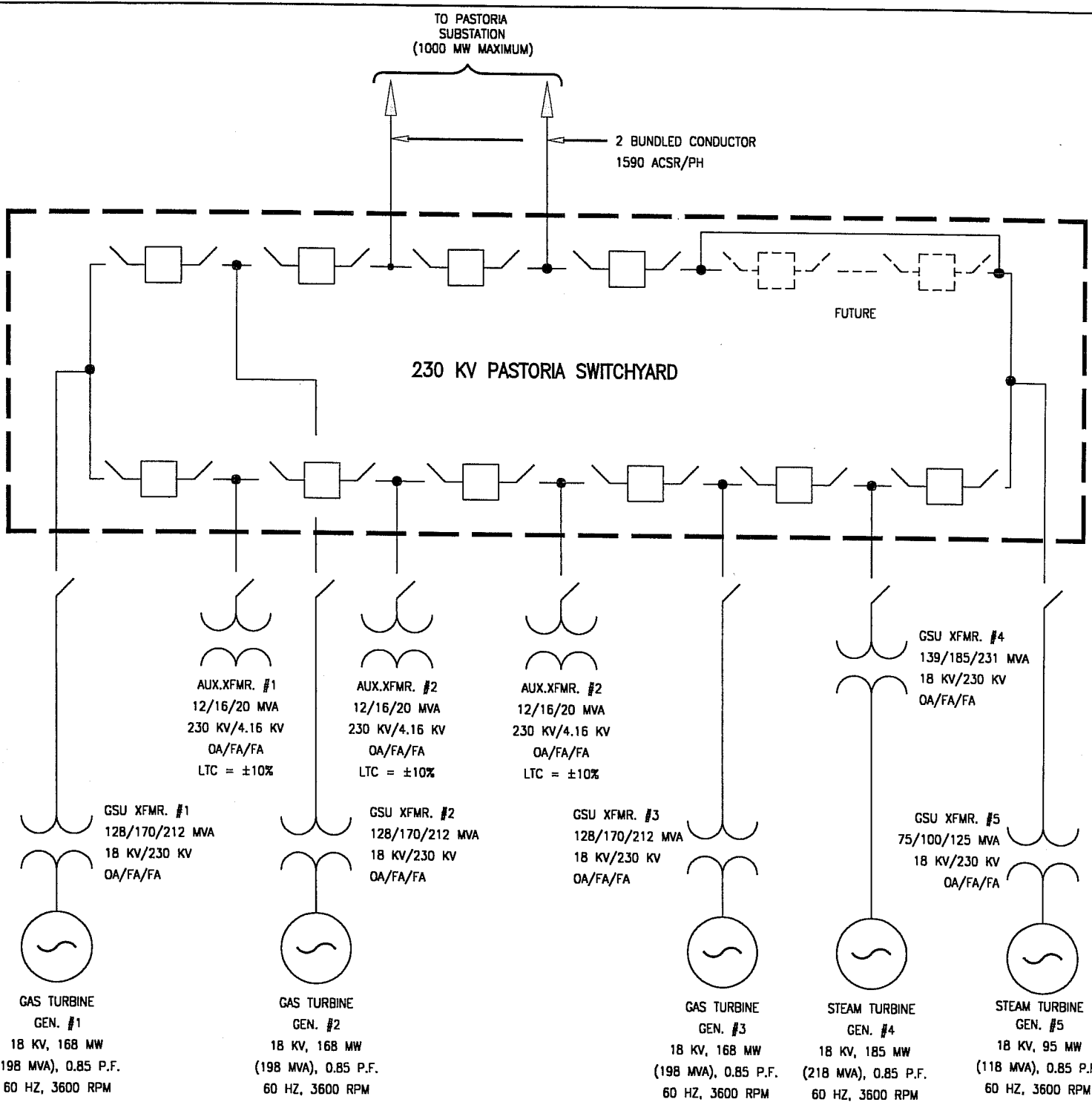
CHEMICAL	APPLICATION	STORAGE LOCATION	STORAGE OR USAGE QUANTITY	
			AVERAGE	MAXIMUM
Natural gas	Fuel for power plant	Piped into plant on as-needed basis	NA	NA
Aqueous Ammonia[(1)] (25% solution-Alt.)	Air pollution control system for nitrogen oxides	SCR System - Alternate	30,000 Gallons - Alternate	60,000 Gallons[(2)] - Alternate
Insulating oil (heat transfer)	Electric equipment	--	60,000 gal, Initial fill	Not stored on-site. Initial fill quantity is brought to site at the time of replacement
Lubricating oil	Rotating equipment	Throughout plant	7000 gal, Initial fill	Not stored on-site. Initial fill quantity is brought to site at the time of replacement
Carbon dioxide	Fire protection, generator purging	--	12,000 lbs Initial fill	NA
Hydrogen	Generator cooling	--	Initial fill	Initial fill
Hydrochloric acid	HRSG cleaning	--	Prior to startup 10,000 lbs	Not required
Propylene - Glycol	Inlet air cooling	--	250 Gallons	250 Gallons
Ammonium bifluoride	Inlet air cooling	--	Prior to startup 200 lbs	Not required
Various Detergents	Combustion turbine cleaning	--	Prior to startup 1000 lbs	Periodic short term storage 500 lbs
Diesel Fuel	Firewater Pump	Firewater Skid	100 gal for initial fill	Maintain full diesel tank

[1]California extremely hazardous material.
[2]Material would be transported to the site using 8,000-gallon tanker trucks (Alternate).

TABLE 3.4.12-1

PASTORIA ENERGY FACILITY
FIRE PROTECTION SYSTEMS DESIGN CONDITIONS

Location	Type of System
Buildings	Automatic Clean Agent System per NFPA 2001 for Control Room, wet/dry/pre-action sprinkler system for Administrative areas, Warehouse, and offices. Firewater supply shall be from an on-site water storage tank. NOTE: The fixed fire systems in the buildings will be provided as required by local jurisdiction or Uniform Building Code (UBC). Hose stations and portable extinguishers shall be provided throughout buildings as required by Code. Detection system and fire alarm pull stations shall be provided for the Control Room, combustion turbine inlet filter area and the switchgear room. Pull stations shall be located in buildings as required by Code.
Combustion Turbine	A Carbon Dioxide (CO_2) System or Clean Agent System as defined per NFPA 2001 will be provided for the combustion turbines.
Water Treatment Area	An automatic wet pipe sprinkler system (Refer to note in Building Section), portable “BC” rated fire extinguishers in all areas and hose reel stations with 100-foot hose in the area.
Outside Areas	Dry barrel type fire hydrants shall be designed, installed and located as per NFPA 24 and as required per local jurisdiction. The location of hydrants is not more than 300 feet apart in all outside areas as required by Code.
Cooling Towers	Fire protection requirements for the cooling tower will be determined based on a prudent review of local fire codes and insurance underwriter policy.



REV. NO.	DATE	DESCRIPTION	DR'N BY	CK'D	ENG'R	PROJ ENG'R	APPR.
C	11/17/99	STEAM TURBINE REVISION	JRM	AK	AK		
B	10/21/99	ADD GAS TURBINE	JRM	AK	AK		
A	5/20/99	PRELIMINARY	ND	AK	AK		

FIGURE 3.4–1

PASTORIA ENERGY
FACILITY, LLC

ELECTRICAL

SINGLE LINE DIAGRAM – 750 MW

* ENGINEERING *
1261 TRAVIS BOULEVARD
SUITE 105
FAIRFIELD, CA 94533

* CONSTRUCTION *
PHONE: (707) 435–9994
FAX: (707) 435–9991
EMAIL: PATCH@PATCHINC.COM

SCALE: NONE	DRAWING NO.	REV.
JOB NO: 9880	9880–5001	C

3.5 FACILITY CIVIL/STRUCTURAL FEATURES

3.5.1 Power Island Complex

The power island complex for the Pastoria Energy Facility will consist of five power blocks and associated auxiliary equipment. Three power blocks will each consist of one combustion turbine and generator (CTG), one heat recovery steam generator (HRSG) and exhaust stack, and one generator step-up transformer. The two remaining power blocks will consist of one steam turbine and generator, with surface condenser, and one generator step up transformer. Corresponding balance-of-plant (BOP) mechanical and electrical equipment will be located adjacent to each power block.

The CTGs and HRSGs will be supported on reinforced concrete foundations at grade. The stand-alone STGs will be supported on a reinforced concrete pedestal mounted on a base mat. The condenser will be located below this STG pedestal and supported on the base mats.

Individual reinforced concrete pads at grade will be used to support the BOP mechanical and electrical equipment. Foundation pilings will be used for major equipment and building foundations if required. All equipment will have seismic anchoring that meets or exceeds requirements for CBC Seismic Zone 4.

3.5.2 Stacks

Each HRSG will be provided with a self-supporting steel stack. The stacks will be 213 feet tall or less and will include associated appurtenances, such as sampling ports, exterior ladders and side step platforms. A lighting system will be installed on each stack as required by FAA regulations.

3.5.3 Buildings

The plant buildings will include an Administration and Control Building, Water Treatment Complex, Electrical Control Buildings, Warehouse and Shop Building, Switchyard Control Building, Turboexpander Building, and a Firewater Pump Building. All buildings will be constructed in accordance with the appropriate edition of the CBC and other laws, ordinances, regulations and standards (LORS).

3.5.3.1 <u>Administration and Control Building</u>

The Administration and Control Building will be a one-story building, located in the center of the site and measuring approximately 60 feet wide by 120 feet long by 20 feet high. This building will house the plant control room, offices, change rooms, a kitchenette and break room, an electrical control room, and a battery room.

3.5.3.2 Warehouse and Shop Building

The Warehouse and Shop Building will be a pre-engineered building measuring approximately 120 feet long by 120 feet wide by 35 feet high. This building will be located in the south center area of the site. It will house a meeting and training room, a maintenance office, workshops, and storage space for spare parts and maintenance supplies.

3.5.3.3 Water Treatment Building

The Water Treatment Building will contain equipment for processing and treating water to provide those water properties required for condenser cooling, HRSG make-up, and combustion turbine inlet evaporative cooling. The process area of this building will be power-ventilated and will contain a fire protection system. The building will contain an analytical lab and an attached office with separate ventilation and air-conditioning. Storage of some bulk chemicals will occur in this building.

The Water Treatment Building will be a pre-engineered building, measuring approximately 160 feet long by 60 feet wide by 20 feet high and constructed with metal exterior walls and roof. All equipment will be floor mounted and raised slightly above the finished floor on housekeeping pads. Curbs will be installed for spill containment where needed. Corrosion resistant coatings will be applied, as necessary, on floors and structural members.

3.5.3.4 Electrical Control Buildings

Two Electrical Control Buildings**,** located south of the power island, will house station auxiliary power controls, motor control centers and data acquisition and distributed control system hubs for balance of plant equipment in the power island, condensate pumps, water treatment equipment, and other site facilities. These will be pre-engineered metal buildings, measuring approximately 60 feet long by 20 feet wide by 15 feet high, and will be provided with a positive pressure air conditioning system and in-plant telephone.

3.5.3.5 Aqueous Ammonia Unloading Station

The Aqueous Ammonia Unloading Station will be a pre-engineered metal building measuring approximately 70 feet long by 20 feet wide by 15 feet high. The two end walls will consist of draped plastic sheets to contain vapors while allowing direct access by tanker trucks. Sidewalls will be cast-in-place concrete, to a height of 4 feet, with metal siding above. A finished concrete floor will slope to a center drain. A containment vault, adequate to hold a full truckload of aqueous ammonia and an equal quantity of wash-down water, will be located adjacent to or below the concrete floor and drain. This structure will not be required with the use of XONON™ emission control technology.

3.5.3.6 Switchyard Control Building

The Switchyard Control Building will contain a local operating station and control equipment for the switchyard breakers. This building will be pre-engineered, with metal siding and roof. It will measure approximately 60 feet long by 20 feet wide by 10 feet high and be provided with air conditioning and in-plant telephone service.

3.5.4 Yard Tanks

Yard storage tanks will include the following:

- One 2,300,000 gallon cooling water make-up and firewater storage tank;
- One 150,000 gallon demineralized water storage tank;
- Three 20,000-gallon double-walled aqueous ammonia storage tanks (not required for XONON™ emissions control);
- One 100 gallon Diesel Tank;
- One 1,000 gallon Potable Water Tank; and,
- Small tanks and drums for storage of water treatment chemicals.

The water storage tanks will be vertical, cylindrical, field-erected steel tanks. Each will be supported on a suitable foundation consisting of either a reinforced concrete ring wall with an interior bearing layer of compacted sand for the tank bottom, or a reinforced concrete mat. These tanks will be protected from corrosion with internal and external coatings as required.

The ammonia storage tanks, if required, will be double-walled steel tanks. All tanks will be securely anchored on a reinforced concrete foundation.

Chemical storage tanks will be shop fabricated of thermoplastic, reinforced thermoset plastic, or steel, as appropriate for their contents and size. These tanks, and portable drums, will be provided with appropriate anchors or cradles and placed within spill containment basins.

Tanks, foundations, and piping connections will be designed to appropriate standards for the contents and seismic zone. Pilings and anchor bolts will be used as required.

3.5.5 Roads

The internal plant road network serving the facility is shown on the Site Access Plan and the Site General Arrangement (see Figures 3.1-6 and 3.1-7). The main plant roads and maintenance equipment staging areas in the Pastoria Energy Facility will be asphalt paved. The Administration and Control Building parking lot, parking areas at other buildings, and the roads circling the power blocks and plant perimeter will also be asphalt paved. Remaining plant roads and open areas will be surfaced with gravel or crushed stone. Preparation of base material prior to paving will ensure that paved areas are suitable for the use of heavy lift equipment.

Access to the project will be available from interstate Highway 5 via the Edmonston Pump Plant Road. The plant access road from Edmonston Pump Plant Road to the site will be constructed to Kern County Standards. The plant access road is approximately one mile long. The Edmonston Pump Plant Road was originally constructed to Kern County and Caltrans standards. It has sufficient width and strength to provide adequate access to the project site.

3.5.6 Site Security

An onsite security system will be installed as part of the project. Controlled access will be maintained at entrances to plant secure areas. Entry through the facility's main gate will be remotely controlled from the Control Room. In the event of an "after-hours emergency", entry into the facility by Fire Department or emergency units will be handled on a manual override basis, per prior arrangement between facility management and appropriate local officials.

3.5.7 Site Grading and Drainage

Most offsite drainage will be diverted around the site. Rainfall from areas within unimproved areas of the site will be predominantly drained by sheet flow or piped conduit to the Storm Water Detention Ponds. Rainfall from paved areas and building roofs will be collected and directed to an oily water trap prior to discharge to the Storm Water Detention Ponds. To the extent possible, storm water "Best Management Practices" (grassy swales, check dams, etc.) will be incorporated to improve water quality and to enhance the efficiency of the site's storm water quality systems.

Storm water studies indicate that all significant surface pollution from vehicles and other sources are washed into the drainage system during the first half inch of rainfall from the early winter storms. The pond will be sized to retain the first half-inch of storm water runoff for settlement and/or for biological uptake of potential pollutants. The outlet structure of the pond will be sized to release the retained storm water in 72 hours. Storm water in excess of the first half inch has been generally determined to be free of pollutants and will be

discharged to Pastoria Creek. The policies outlined above are in conformance with the requirements of the NPDES permits that will be issued for the project.

The project drainage system will also include an oil-water separator that will receive all water from areas that are subject to oil contamination, primarily parking lots and equipment maintenance areas. The separator will be an underground vault with baffles to collect oils and solids. The inlet pipelines into the separator will be sized to collect the "first flush" and to bypass the later larger storms. Storm Water will be retained so as to allow oils to rise to the surface and solids to settle to the bottom. The underground vault will be pumped out each fall prior to the start of the winter season using the same equipment as is used on the sanitary septic tank to remove accumulated solids. Oils will be removed using oil absorbent pillows or other acceptable methods for eventual recycling.

3.5.8 Site Flood Issues

The Federal Emergency Management Agency has prepared a Flood Insurance Study (dated September 6, 1995) for Kern County. The purpose of the study is to provide local and regional planners with the information necessary to promote sound land use and floodplain development. The study did not include any specific technical analysis of Pastoria Creek. However, in general terms the study indicated that the project site is within an area that has the potential for shallow flooding. The project proponent, recognizing the limitations of the Flood Insurance Study, has developed a detailed report focusing on Pastoria Creek and the project site. A copy of the report is included in Appendix M.

Pastoria Creek drains approximately 51 square miles of the Tehachapi Mountains. The creek flows through a gap in the California Aqueduct, which effectively limits the ability of the creek to leave the existing channel. The hydrology study prepared for the project indicates that Pastoria Creek will have a peak flow of 3,600 cubic feet per second (cfs) at the California Aqueduct. An independent study by the California Department of Water Resources has collaborated these calculated flows.

The project's hydrology study has prepared a U.S. Army Corps of Engineers HEC-1 analysis of Pastoria Creek (beginning at the California Aqueduct) and has developed a more detailed flood and defined limit. As can be seen on the "Flood Inundation Map," in Appendix M, the site is located outside the flooded area. For added protection, a small three-foot high berm is shown along the westerly boundary of the project site to provide additional control. The berm will be constructed as a wide structure with varying side slopes and protected with native vegetation in order to enhance its stability and effectiveness.

Within the actual project site, buildings and equipment will be constructed on foundations set at elevations above potential surface waters, and the overall site-grading scheme will include overland release mechanisms for storm waters. The storm water drainage system will be

sized to accommodate a 10-year storm event. Buildings and equipment will be constructed in a manner that will provide protection from a 100-year storm event.

3.5.9 Sanitary Sewer System

The plant's sanitary wastes will be conveyed, via an underground sewer system, to an onsite septic tank and leaching field. This system shall be constructed in conformance with State of California and Kern County regulations.

3.5.10 Earthwork

Earthwork is required to establish the grade for the project site. The grading plan will provide a general balance between cuts and fill. Consideration for drainage and flood constraints will be incorporated into the design of the grading plan. The site is expected to be terraced in order to achieve beneficial use of, and better match, the natural topography.

The site is virtually free of vegetation, being limited to grasses and a few low-lying shrubs along Pastoria Creek. Site clearing will primarily involve removal of vegetative material to allow for proper compaction. Vegetative material will be disposed of onsite at a location where compaction is not critical. Construction water from the Wheeler Ridge-Maricopa Water Storage District will be used to develop optimum moisture for compaction. Fills will be placed in lifts and fully compacted.

The site slopes to the north and west between 4 and 5 percent. Therefore, it will be necessary to construct level pads on which the equipment and buildings can be placed. This grading will require the movement of approximately 120,000 yards of material. Pads will be placed at varying elevations to reduce grading requirements and to better match the existing topography. The berms shown on the preliminary plans are low (less than four feet high) and will be constructed with varying side slopes so as to 'naturalize' their appearance. The berms are expected to be constructed with less than 10,000 yards of material, which is included in the above earthwork total. All fills will be engineered in conformance with an approved geotechnical report and constructed under the supervision of an approved geotechnical engineer to ensure long term stability (see Figure 3.1-6).

The only imported material expected to be used onsite is base rock for roads and structures. Such material will be clean, placed in lifts and fully compacted. As shown by the neighboring gravel quarry operation, onsite excavation may provide a source of base fill which will be used as practical.

3.6 TRANSMISSION FACILITIES

3.6.1 Electrical Interconnection Points

The 230 kV double-circuit line for this project is a direct intertie between the Pastoria project switchyard and SCE's Pastoria Substation. The line connecting the plant to SCE's system is approximately 1.3 miles long. The 230 kV switchyard at SCE's Pastoria Substation is the point of interconnection for the project.

3.6.2 Transmission Line Specifications

The 230 kV double-circuit line will be designed and constructed in accordance with General Order 95 (GO-95), "Rules for Overhead Electric Line Construction", and other applicable state and local codes.

3.6.2.1 Conductor

The transmission line structures will be designed to carry a double-circuit feed between the plant and the Pastoria Substation. The double circuit will use ACSR conductor. This is an aluminum conductor with steel reinforcement. ACSR conductors combine low electrical resistance of 1350 alloy aluminum strands with the high strength of the steel strands. Each circuit will use two bundled 1590 ACSR conductor and is rated for 2760 A at 75º C. This is equivalent to 1100 MVA at 230 kV.

Under normal conditions with both circuits in service, each circuit will carry 50 percent of the plant output. Each circuit is designed to carry a maximum plant output of 1000 MW or approximately 1100 MVA at 0.9 pf. The line can be operated in the emergency condition, where one circuit is out of service, on a long-term basis to a substantially higher ampacity without damage to the conductor or violation of the code requirement. The emergency rating will be determined in the detailed design phase.

3.6.2.2 Transmission Route Description

The proposed transmission line will originate from the plant switchyard. The switchyard is located on the southern side of the site. The line will proceed in a southerly direction for approximately 1.3 miles and will terminate at SCE's Pastoria substation (see Map 3.2-1).

3.6.2.3 Pastoria Substation Interconnection

To terminate the project's 230 kV double-circuit transmission line at SCE's Pastoria Substation, spare # 2 bay position will be used.

3.6.3 Transmission Structures

The new 230 kV double-circuit line from the project switchyard to the SCE's Pastoria Substation will utilize lattice steel towers. Lattice towers will also be used as take-off structures at the project switchyard and at the SCE's Pastoria Substation.

3.6.3.1 Structure Types

Lattice type structures are proposed for the transmission line for the double circuit lines. All towers will range in height from 100 feet to 120 feet and will be designed to provide at least 30 feet of conductor-to-ground clearance at any point along the span.

3.6.3.1.1 Double Circuit 230kV Structure. Figure 3.6-3 shows a typical double-circuit, lattice steel structure designed for an average span length of 650 feet. The actual tower heights and span lengths will be determined during the detailed design. These structures will be used throughout the transmission line route from the PEF switchyard to the existing SCE's Pastoria Substation.

3.6.3.2 Foundations

All lattice towers will have concrete foundations designed to support the imposed loads. The type of foundation used will be determined during detailed design.

3.6.3.3 Access to Structures

Access to the transmission line and support structures will be available from existing roadways to established or newly dedicated combined easement corridors.

3.6.4 Pastoria Project Transmission System Evaluation

The existing transmission system in the project area consists of 230 kV, and 66 kV facilities owned by SCE. The 230 kV and 66 kV systems are not significantly affected by the proposed 230 kV interconnection at SCE's Pastoria Substation. The transmission system evaluation is ongoing. SCE performed a Preliminary System Impact Study in 1994 examining the impact of a new generation siting in the Pastoria region. A completed Application has been filed with SCE to perform a System Impact Study under SCE's Transmission Owner's Tariff. The System Impact Study would determine the impact on the SCE system based on power flows on the existing transmission lines and transformers, short circuit duties of the existing transmission facilities and stability of the interconnected system considering various contingencies and fault conditions. The System Impact Study is expected to be completed in late December 1999. Following the completion of the System Impact Study, SCE will perform a Facility Study. The Facility Study will outline mitigation measures for

transmission facility overloads and the cost associated with the upgrading of the transmission facilities, should this be necessary.

3.6.4.1 Transmission System Reliability Criteria

The North American Electric Reliability Council (NERC) and the Western System Coordinating Council (WSCC) Reliability Criteria for Transmission System Planning, the Independent System Operator (ISO) and the SCE Reliability Criteria, will be used in the evaluation of the transmission system. Additionally, SCE has special operating criteria for the southern California Area. These criteria will also be utilized in the analysis to insure minimum criteria requirements are adhered to and project objectives are met. The ISO processes will be monitored throughout the transmission system evaluation to insure that any changes to the criteria are considered.

3.6.4.2 Transmission System Interconnection Study

Preliminary analysis indicates that the proposed project can be interconnected to the SCE Pastoria 230 kV Substation. This interconnection proposal will provide enhanced reliability to SCE grid for the southern California Area.

The Tariff Application for SCE to perform the System Impact Study for the Pastoria Energy Facility project is included as Appendix O.

3.6.4.3 Electric and Magnetic Fields

3.6.4.3.1 Generation of Electric and Magnetic Fields. Power lines, electrical wiring, electrical machinery and appliances all produce electric and magnetic fields, commonly referred to as EMF. The electric and magnetic fields produced by PEF power system have a frequency of 60 Hertz (Hz), meaning that the intensity and orientation of the field changes 60 times per second. This section addresses the estimates of the maximum possible electric and magnetic field strengths that will be produced by the PEF transmission facilities. These estimates are computed for a height of 1 meter above the ground and include the canceling effects of other electrical transmission lines existing along the proposed transmission line right of way.

When a conductor is energized, an electric field is formed around the conductor that is proportionate to the energization voltage. The strength of the electric field is independent of the current flowing in the conductor. When alternating current (AC) flows through a conductor, an alternating magnetic field is created around the conductor. Overhead AC transmission lines carry power over three conductors with currents and voltages that are 120 degrees out of phase with each other. The fields from these conductors tend to cancel out because of the phase difference. However, when a person stands on the right of way under a

transmission line, one conductor is always significantly closer and will contribute a net uncanceled field at the person's location. The strength of the magnetic field depends on the current in the conductor, the geometry of the structures, the degree of cancellation from other conductors, and the distance from the conductors.

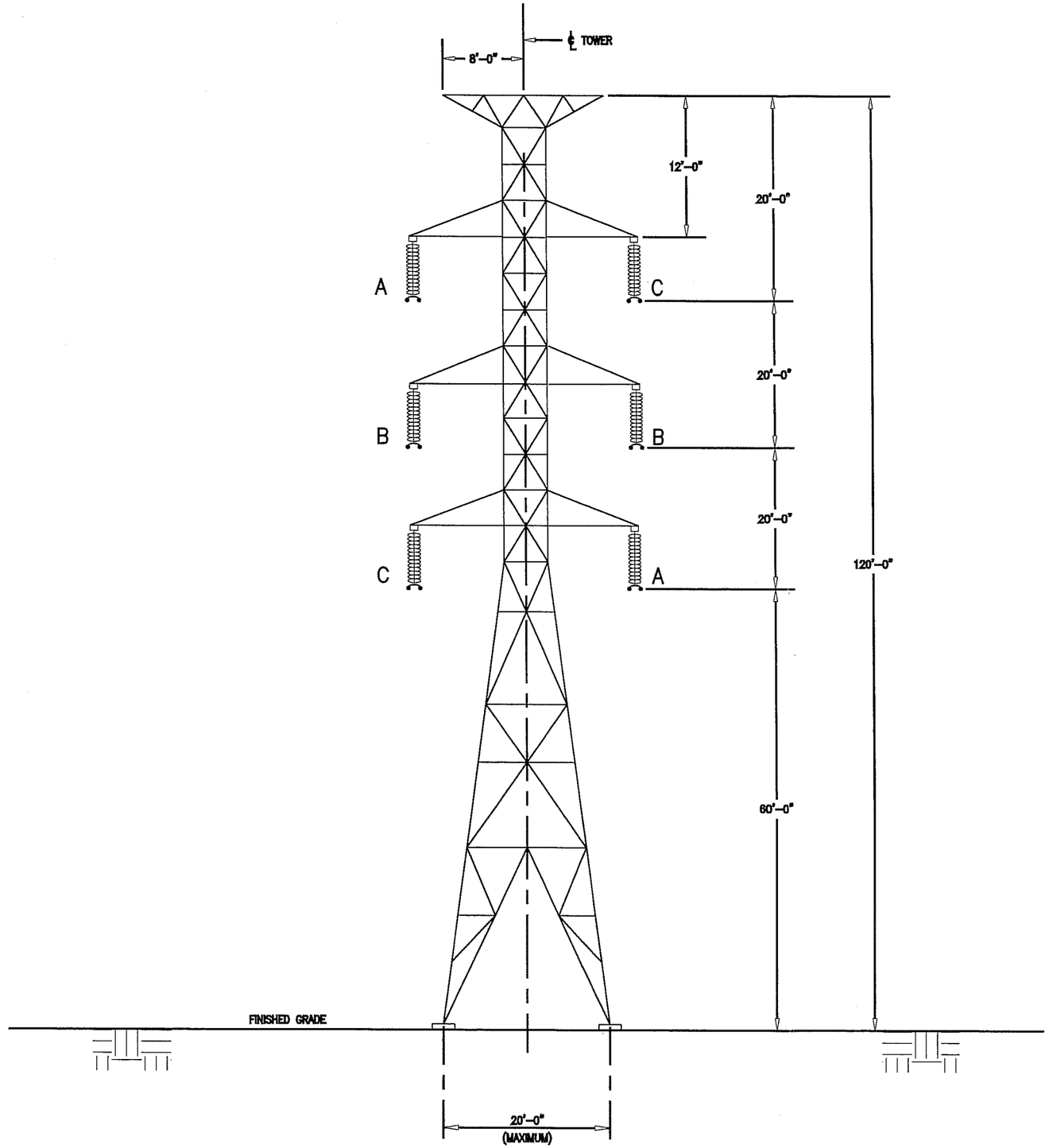
3.6.4.3.2 Line Loads for EMF Calculation. Maximum magnetic fields are produced at the maximum conductor currents**.** For the purposes of the EMF analyses, the maximum line loading was assumed to be 1000 MW at a power factor of 90 percent. This loading converts to approximately 2790 amps per phase at 230 kV.

3.6.4.3.3 Calculation Methods. To estimate the maximum fields, calculations are performed at mid-span where the conductor is positioned at its lowest point between structures (the estimated maximum sag point). The magnetic fields are computed at 1 meter above ground. The BPA Corona and Fields Effects program was used to calculate the magnetic field strengths for the line. This program and others like it has been used to predict electric and magnetic field levels that have been confirmed by field measurements by numerous utilities.

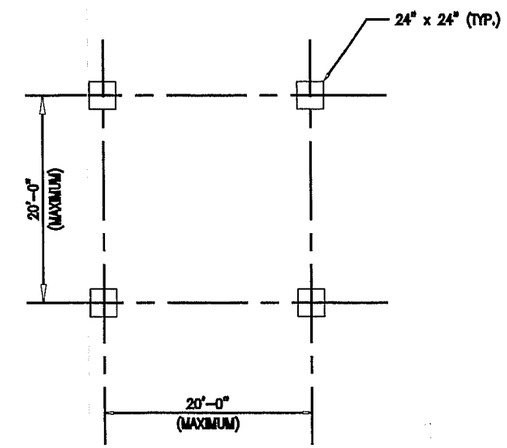
All loads on all circuits on the same tower are assumed to be maximum and taken at normal plant operating conditions. The dimensions of the existing power lines were based on preliminary information received from SCE.

3.6.4.3.4 Electric Fields Along the Rights of Way. Calculated electric field strengths at the left and right edges of the proposed right of way, as derived from the structure configuration sketches and corresponding field strength graphs are included in Appendix P. Note that at the edge of 80 feet right of way from the centerline on the east side, the electric field level is approximately 0.06 kV/meter.

3.6.4.3.5 Magnetic Fields Along the Rights of Way. Calculated magnetic field values at the left and right edges of the proposed right of way, as derived from the structure configuration sketches and corresponding field strength graphs are included in Appendix P. Note that for maximum current flow, the magnetic field at the edge of 80 feet right of way from the centerline on the east side is approximately 15 mG.



LOOKING NORTH



FOOT PRINT
TRANSMISSION TOWER

FIGURE 3.6-3

PASTORIA ENERGY FACILITY,LLC

STEEL TRANSMISSION TOWER
LATTICE – DOUBLE CIRCUIT

• ENGINEERING •
1281 TRAVIS BLVD.
SUITE 105
FAIRFIELD, CALIFORNIA 94533

• CONSTRUCTION •
PHONE: (707)435-9994
FAX: (707)435-9991
EMAIL: PATCH@PATCHINC.COM

SCALE: NONE	DRAWING NO.	REV.
JOB NO: 9880	9880-5304	C

3.7 PIPELINES

3.7.1 Natural Gas Supply Line

3.7.1.1 Description

A 16- to 24-inch diameter natural gas fuel transmission pipeline will connect PEF to the 42-inch diameter Kern River-Mojave transmission pipeline. Operating pressure of the line will be approximately 700 to 900 psig. Three routes for the proposed connection from the transmission pipeline to the site, as shown on Map 3.2-1, are included so as to allow flexibility in acquisition of the required rights of way.

3.7.1.2 Route

Three possible tie-in points on the Kern River-Mojave transmission pipeline have been identified.

The first alternative, Route 3, follows a route of approximately 11.7 miles and ties in to the transmission pipeline just north of Sebastian Road. Approximately 8.3 miles of this line will be installed on Tejon Ranch property.

From the proposed tie-in point on the Kern River-Mojave pipeline, a straight line distance of approximately 6.5 miles north of the PEF, the interconnecting pipeline will travel south, approximately 0.4 mile, then travel due east approximately 2.5 miles along Sebastian Road. After crossing onto Tejon Ranch property, the pipeline will turn to the southeast and follow farm and fire roads for approximately 1.5 miles. The route then travels approximately 1.2 miles due south on an orchard road and turns southwest for approximately 1.5 miles along a fire road. From this point, the pipeline will follow an existing underground aqueduct, in a southwest and south-southwest direction, for approximately 3 miles before turning due west and traveling approximately 0.7 mile to the PEF site.

The second alternative, marked as Route 3A on Map 3.2-1, follows a route measuring approximately 13.8 miles and ties in to the transmission pipeline on David Road. Beginning at the transmission pipeline on David Road, the interconnecting pipeline will extend east approximately 1.9 miles to just across the Tejon Ranch boundary, and then south, approximately 3.6 miles, on the east side of that boundary, to Sebastian Road. The pipeline will then extend to the project site along the same alignment as described in the first alternative, discussed above.

The third alternative, marked as Route 3B on Map 3.2-1, follows a route measuring approximately 18.5 miles and ties in to the transmission pipeline near the northwest boundary of the Tejon Ranch property. Beginning at the transmission pipeline, the interconnecting

pipeline will extend south, east of the Tejon Ranch boundary, approximately 6.6 miles to David Road. The pipeline will then follow the same alignment as described in the above alternatives to the project site.

The pipeline will enter the northeast corner of the site and connect to the plant's fuel gas filter/separator and metering facilities located north of the power blocks.

3.7.1.3 Buried Pipe

The natural gas supply pipeline will be buried approximately 4 feet underground. This steel pipeline will be provided with a corrosion resistant covering. The line will be cathodically protected if required.

3.7.2 Make-up Water Supply Pipeline

Make-up water will be obtained from the Wheeler Ridge-Maricopa Water Storage District. Water will be transported to the site by a 24-inch diameter pipeline connected to a proposed water main to be constructed by the District approximately 250 feet west of the site. The line will be routed directly to the site and will be dedicated to the District. It will be buried approximately 4 feet underground and shall be constructed in conformance with Wheeler Ridge Water District requirements as well as other applicable standards.

3.7.3 Wastewater Discharge Line

3.7.3.1 Description

Process wastewater will be piped approximately 8,000 feet north of the site where it will be discharged by injecting it into the operating Tejon Ranch Oil Field. Wastewater will be injected using existing wells and/or newly constructed wells. The hydrology surrounding the existing well field will accommodate anticipated wastewater discharge flows as well as support oil recovery operations.

This line and the injection wells may be deleted if the zero discharge of wastewater system is included as part of the project.

3.7.3.2 Buried Pipe

Wastewater will be transported to the injection wells via a buried 12-inch diameter pipeline. The pipeline will be buried approximately 4 feet underground and will be constructed in conformance with applicable specifications.

3.7.3.3 Wastewater Injection Wells

Existing and/or newly constructed wells will be used for wastewater injection, if hydrology studies indicate adequate long-term performance. Wastewater will be filtered prior to injection, as necessary, to protect the formation. Wastewater will be tested on a regular basis to insure compliance with permitted requirements.

3.8 PROJECT CONSTRUCTION

The engineering, procurement, and construction activities on this project will be accomplished on a “fast track” schedule. This method of performance is defined by requiring construction work to start before all construction plans are completed during the engineering phase. The need to place the project on a fast track schedule is necessary to gain benefits of an earlier plant completion without resorting to the expensive, marginally efficient use of overtime. Simply put, “fast-track” allows the project to begin sooner, promotes efficiencies by staging project engineering decision making and permits an earlier start of plant operating revenue. In addition, fast tracking allows the design and construction of the main plant to progress without requiring final commitment to the details associated with construction of the plant’s linears. Typically, separate contractors will perform off-site work.

By placing the project on a fast track basis, both engineering and construction are allowed to proceed in parallel. With a minimal amount of lead-time, engineering will define major systems and processes, purchase long lead equipment, and begin issuing drawings to the field for construction. The work of engineering and the issuing of construction drawings will continue well into the physical construction of the plant. This closely coupled integration of engineering and construction is well proven and is the standard approach used in highly competitive industries.

The fast track approach also requires that the plans, procedures and protocols required by the CEC’s Conditions of Certification will be submitted prior to the beginning of incremental construction work and not before construction as a whole begins. An example of the phasing of plans would be the plans required for mitigation of noise. Plans, procedures and protocols for the minimization of construction equipment noise would be presented before site preparation activities begin. However the plans for handling noise associated with HRSG steam blows would not be submitted in the same document, but would submitted later in the engineering process.

A set of proposed Preliminary Condition of Certification Schedule for this project is presented in Appendix S. This appendix illustrates the sequence and approximate timing for Condition of Certification submittals. It illustrates that there will be multiple plans for similar work, all necessitated by the need to start project activities in a certain sequence.

The engineering, procurement and construction (EPC) schedule for the Pastoria Energy Facility (Project) is expected to be thirty (30) months in duration. The Construction Phase of this project will require approximately twenty-four (24) months. The schedule begins when the Owner issues a Notice to Proceed to the EPC Contractor and is completed when the facility is commercially operational.

Construction activities include all work on the main site, installation and connection of offsite utilities, pipelines and transmission lines, switchyard, substations, and plant start-up. Interim sequential activities for both on-site and off-site work will include site preparation, foundation construction, erection of major equipment and structures, installation of piping, electrical systems and control systems, and start-up/testing. Offsite utilities are often constructed on a separate schedule since the trades involved are different from the bulk of the on-site activities. Fast track advantages can be realized if on-site and off-site approval processes are segregated. Commencement of commercial operations activities will then occur upon completion of construction.

The EPC Schedule, which includes Project Milestone Schedule Engineering and Construction activities, Construction Manpower loading; Construction Equipment requirements, Construction Deliveries and Land Disturbed through Construction, is described in the following sections and illustrated in Tables 3.8-1, 3.8-2, 3.8-3, 3.8-4, 3.8-5 and 3.8-6.

3.8.1 Power Plant Facility

3.8.1.1 Project Schedule and Workforce

The Work for this 750 MW merchant class electrical generating facility will fast track Engineering and Design, Procurement of Equipment and Materials, and Construction (EPC) of the project. The Work will be executed under one or several agreements entered into by the Owner. The number and type of agreements and the structure of those agreements will be based on economic analyses and market status at the time of award. Off site utility engineering and construction will typically be performed by contractors not involved in the construction of the main plant. The Owner will issue Requests for EPC Proposals (RFP) to qualified firms. The RFP's will be structured to optimize the Owner's control of the cost and performance of the contracts. The list of qualified firms to whom RFP's will be issued will include major EPC firms, engineering companies, construction contractors and/or suppliers of major equipment. Bids will be evaluated and contracts awarded to achieve timely and cost effective construction of a reliable and efficient generating facility. The form of the EPC agreements will be determined after bid proposals are received.

The selected EPC contractor will prepare detailed work plans after the Owner has received the California Energy Commission's Final Decision. Early work will include preparation of logistical studies, development of project specific procedures, schedules and administrative control systems that are required to perform, monitor, and control the scope of work and its implementation. These will all be in accordance with the CEC's Conditions of Certification and other LORS. Occupational, Construction and Environmental Safety Programs, and Project Quality Programs will be prepared and implemented during this phase. Interface with the State and Local Agencies, and the public will be prominent during this period.

The general sequence of Work will proceed as follows:

- Receipt of the Facility's Final Decision from the CEC by the Owner and issuance of a Notice to Proceed to the EPC Contractor by the Owner.

- Development of the Project with preparation of the schedule incorporating items required by the CEC's Conditions of Certification.

- Commencement of engineering and procurement activities. All engineering and design is scheduled to be completed approximately eighteen (18) months after beginning.

- Construction Mobilization, commencing approximately six (6) months after the start of engineering or when sufficient design has been completed and plan approvals received.

- Construction of access roads to the site and necessary improvements to other nearby roads, as required, to facilitate construction activities.

- Site preparation and construction of temporary facilities, including construction of the laydown area and parking lots, office complex and stormwater ponds to collect site runoff.

- Installation of underground piping and electrical systems.

- Construction of concrete foundations.

- Installation of power and steam-generating equipment.

- Installation, interconnection, and testing of aboveground piping and electrical systems.

- Installation, interconnection, and testing of instrumentation and control devices and distributed control system.

Construction will conclude with start-up and testing activities, which will continue until the entire facility is capable of reliable operation within permit requirements and good operating practice. All of the systems and subsystems in each unit will be tested and adjusted, first individually and then combined with others, before the Facility is deemed ready for startup.

The Pastoria Energy Facility will be declared commercially operational after successful completion of plant start-up activities, and after appropriate testing has been completed. Facility optimization activities may continue after commencement of commercial operation.

3.8.1.2 Execution Plans - Engineering and Construction Phases

3.8.1.2.1 Engineering and Pre-Construction Mobilization. At the beginning of the project, the EPC Contractor(s) will prepare written Plans for execution of the project. A detailed Project Execution Plan will be prepared early in the project and will contain the Project Master Schedule, describe implementation of the "fast-track" approach to the project, and describe the interface between engineering, procurement and construction activities. The detailed operating plans to be included in the Project Execution Plan are discussed below. Detailed engineering plans will be developed as required, and by the Conditions of Certifications (COC), in stages, but well in advance of installations covered by the individual plan.

A project specific Occupational Safety and Health Plan will be developed to specify worker safety procedures and owner and contractor responsibilities in order to prevent incidents involving personnel on the project site. This Safety Plan will address actions, including documentation, required during the design, procurement, and construction phases of the Work.

An Environmental Safety Plan will similarly address actions necessary to minimize the impact of the work on the surrounding environment.

The project specific Quality Assurance/Control Plan will be developed by the EPC Contractor's QA/QC Department with input from appropriate representatives of the Contractor's Project Team, the Owner, and major equipment suppliers.

The Project Administration Plan will include a detailed responsibility matrix, specifications, equipment lists and expediting schedules, procurement plans, and project control systems, logistics plans and the Project Execution Programs. It is anticipated that the EPC Contractor and the Owner's Engineer will work closely together during the project to maximize constructability and efficiency, accelerate approvals, and ensure that the project conforms with all permit requirements.

3.8.1.2.2 Construction Facilities. Office space, required for the Owner, Owner's Engineer, EPC contractor and major subcontractor supervisory personnel, shall be located on the site of the Work and will have adequate parking space for appropriate personnel. A small number of mobile trailers will be used for inspectors and craft supervisors and will be located throughout the main site and offsite utility construction areas. It is probable that at least one satellite office will be established away from the construction site to handle personnel recruiting and hiring. Trailers will be used to accommodate on-site training of the Facility operators and administrative personnel during the test and startup phases of construction. This activity will move to the facility meeting room and control room when they are available.

3.8.1.2.3 <u>Construction Parking</u>. Craft parking, during construction at the main site, will be located within the laydown area. This parking area will be approximately one (1) acre. The parking area will be fenced and controlled by security personnel during normal work hours.

Parking for craft personnel during construction of the offsite pipelines and transmission line will be at central points along the rights-of-way. Craftsmen will be transported from the parking sites to their work sites, if necessary.

3.8.1.2.4 <u>Laydown and Storage</u>. An area of approximately 25 acres, located adjacent to the plant site, will be devoted to equipment and materials laydown, storage, parking of construction equipment, small fabrication areas and office trailers. The construction laydown area has been outlined on Map 3.2-1.

The construction laydown area will include a storage area for equipment and material storage, and shakeout of approximately 18 acres. Layout of access roads and loading areas will be important in the development of the Laydown Yard. Space will be required for HRSG parts, large turbine parts, structural steel, piping spools, electrical components, switchyard apparatus, and building parts. Sufficient space will be provided to accommodate equipment preventive and in-storage maintenance activities such as moving, shaft rotation, connecting, lubricating and heating. Power and other utilities as required, will be available in this area. The components of the Laydown Yard are as follows:

- Parking and maintenance of construction equipment (cranes, cherry pickers, loaders, etc) will require an area of approximately three (3) acres.

- An area totaling one to two acres, at several locations in the laydown area, will be required for fabrication of piping and miscellaneous structural items.

- Enclosed warehouse space will be required. The contractor and subcontractors can use this area for storage of small tools, electrical panels, instruments, turbine crates and other items that require inside storage. Loading/unloading docks and parking for approximately 20 to 25 vehicles will be required.

3.8.1.2.5 <u>Emergency Facilities</u>. Emergency services will be coordinated with a nearby fire department and hospital. A medical clinic will be contracted to set up non-emergency physician referrals. First-aid kits and fire extinguishers will be provided around the site and in offices and regularly inspected and maintained. Safety personnel, all trained in first-aid, will be part of the construction staff. As this is a remote site, an EMT or other highly trained medical professional will be assigned to the site to provide advanced injury care. In addition, selected supervisors will be given first-aid training.

3.8.1.2.6 <u>Construction Utilities</u>. During construction, temporary utilities will be provided for the project site and for laydown and storage areas.

Temporary construction power will be supplied initially by generator and, when available, by a temporary connection to the local distribution system. Area lighting will be provided and strategically located for safety and security.

Water for construction will be provided by Wheeler Ridge-Maricopa Water Storage District. Drinking water will be distributed daily. During hydrotest of the piping systems and HRSG's, water usage will increase. Used hydrotest water will be reused when possible with final disposal to the oily-water separator. Portable toilets will be provided throughout the site for sanitation purposes.

3.8.1.2.7 Site Services.

Site services to be provided will include the following:

- Environmental Health and Safety Training.
- Site Security.
- Site first-aid.
- Transportation to and from remote sites as necessary.
- Construction testing including NDE, Hydrostatic testing of pipe systems, instrument testing and calibration, electrical testing of both low voltage and high voltage equipment, and testing of concrete and soil.
- Site fire protection in concert with the local authorities.
- Furnishing and servicing of sanitary facilities.
- Trash collection and disposal.
- Disposal of hazardous materials and waste in accordance with local, state, and federal regulations.

3.8.1.2.8 <u>Construction Equipment and Materials Delivery.</u> Table 3.8-4 provides an approximate tabulation of construction equipment to be used for the project.

Truck deliveries, of equipment and materials, will normally occur only during daylight hours. There could be need for offloading and/or transporting to the site on the weekend, but not as a general rule. Estimated average daily frequency of truck deliveries is shown in Table 3.8-5. Materials such as pipe, wire and cable, fuels, reinforcing steel, and small tools and consumables will be delivered to the site laydown area or the warehouse by truck. Most of the heavy equipment items will be transported by rail to the rail terminal nearest the site. Equipment and material will be off-loaded at the rail terminal and transported to the site by truck.

Site access will be controlled for personnel and vehicles. A security fence will be installed around the plant site boundary, including the laydown area.

3.8.2 Transmission Lines

3.8.2.2 Construction Schedule and Workforce

The project will construct a transmission line approximately 1.38 miles in length. The line will run from the Pastoria Energy Facility switchyard to SCE's Pastoria Substation. Construction of the line will require approximately four (4) months. Transmission line construction will occur concurrent with construction activities at the plant site but will use different personnel. Transmission line work activities will be sequenced as follows:

- Survey of the right-of-way (ROW) and property lines adjacent to the ROW
- Survey of the line and grade for the transmission line structures
- Installation of foundations for new transmission line lattice steel towers.)
- Erection of towers including the upper and lower halves, crossarms and insulators.
- Stringing of cables
- Testing and tie-in at the Pastoria Substation and the Pastoria Energy Facility switchyard.

3.8.2.2 Construction Planning

3.8.2.2.1 Land Surveying and Engineering. Surveying for construction of a transmission line segment includes engineering and property line surveys. The engineering survey collects topographic and feature detail for use in the design of the transmission structures. Land surveys are performed to develop legal descriptions of the rights-of-way easements. Particular care will be taken to locate pipelines and transmission lines due to the rolling and variable terrain in the area.

3.8.2.2.2 Right-of-Way Acquisition. The purchase agreement between the applicant and the property owner, Tejon Ranch, provides for the purchase of the needed right-of-way for the off site pipelines and transmission lines. Options for the purchase of right-of-way

easements will be negotiated with the property owners along the transmission rights-of-way as required.

3.8.2.2.3 **Transmission Line Access.** Access to all structures will be from existing roadways into an existing right-of-way or into newly dedicated transmission line right-of-way.

3.8.2.2.4 **Clearing.** Because of the minor amount of vegetation on the transmission and pipeline routes, the clearing operations will be minimal. A general clean up of the area will precede transmission and pipeline installation.

3.8.2.2.5 **Structure Installation.** Construction of the transmission structures will involve:

- Excavation for foundations
- Installation of reinforcing steel for the concrete foundations
- Placement of foundation concrete
- Installation of structure anchoring equipment
- Installation of the structures.

Steel lattice structures will be shop fabricated, to the maximum extent possible, and erected at the site.

The cross-arms, insulators and other hardware will be installed on the towers, to the maximum extent possible, before erection.

3.8.2.2.6 **Conductor Installation.** Once the structures are erected, the conductor and overhead static wire will be installed. This involves:

- Installation of stringing hardware, such as pulleys on the insulator bells

- Stringing of a rope used for pulling of the conductor through these pulleys

- Pulling and tensioning the conductor

- Installation of clamps and other devices to hold the conductor in place at the end of the insulators and to minimize vibration

The length of conductor pulled at any one time is dependent on the size of the conductor, amount of conductor provided on each reel, conductor bundling, and the location of appropriate sites for locating the pulling and stringing equipment. It is expected that multiple setups may be required along the length of the line.

3.8.2.2.7 <u>Right-of-Way Clean-up.</u> During cleanup, all temporary structures are removed and any remaining foundation excavations are backfilled. Packing crates, shipping materials and other debris is to be cleaned-up and removed for recycling or disposal. Roads built during transmission line installation and required for access during operation will continue to be maintained.

3.8.2.2.8 Material and Equipment Laydown Areas. An area for storage of material before installation, assembly of structures and marshalling of personnel and equipment will be provided to accommodate installation of the transmission line segments. This area will be approximately five acre site around the middle of the two segments.

3.8.2.2.9 <u>Transmission Line Construction Safety Practices.</u> Safety related measures incorporated as part of construction activities include:

- Utilizing proper signs and traffic control measures
- Installing crossing structures to avoid obstructing other access ways
- Coordinating construction activities, including road crossings, with the appropriate governmental agencies when closures of roads is necessary during construction and cable stringing activities
- Limiting vehicular traffic to approved access roads, construction yards, and construction sites
- Obtaining proper clearances before proceeding with work that could affect any existing pipeline, telephone, electric line or structure
- Complying fully with applicable fire laws and regulations
- Maintaining construction related areas in a neat, clean, and sanitary condition at all times
- Conforming construction methods to the California Administrative Code, Title 8, Chapter 4 (Division of Industrial Safety), Subchapter 5 (Electric Safety Orders), and Subchapter 7 (General Industrial Safety Orders).
- Construction activities will be in accordance with California Public Utility Commission General Order 95 regulations.

3.8.3 Pipeline Construction

The project will involve construction of the following pipelines:

- Natural Gas Supply Line
- Make-up Water Supply Line - for domestic and service water, cooling water, demineralizer feedwater and firewater.
- Wastewater Discharge Line

3.8.3.1 Construction Schedule and Workforce.

Construction of the offsite pipelines is expected to take approximately nine (9) months and will occur concurrent with construction of the power plant facility. The exact sequence and duration of pipeline construction will vary based on final design.

3.8.3.2 Construction Plans and Activities

Almost all of the offsite utility pipelines will be installed underground. The elements of construction include right-of-way clearing, excavation and/or trenching, shoring, bedding and laying of pipe, testing, backfill and compaction, and restoration. The logistics involved in installing the lines are similar to those for construction of the main facility. The storage and laydown areas, parking areas and areas for construction offices, will be kept to a minimum, but will be strategically placed along the rights-of-way for appropriate access, particularly along the Fuel Gas Pipeline route. The main construction laydown areas will be utilized, to the maximum extent possible.

Plans for each of the installation components and logistical items will be prepared early in the design of the pipeline. Particular care in both the engineering and construction phases will be taken to handle stream crossings and other crossings of depressed areas.

3.8.3.3 Pipeline Construction Equipment

Table 3.8-3 includes a list of construction equipment to be used during construction of the offsite pipelines and transmission structures.

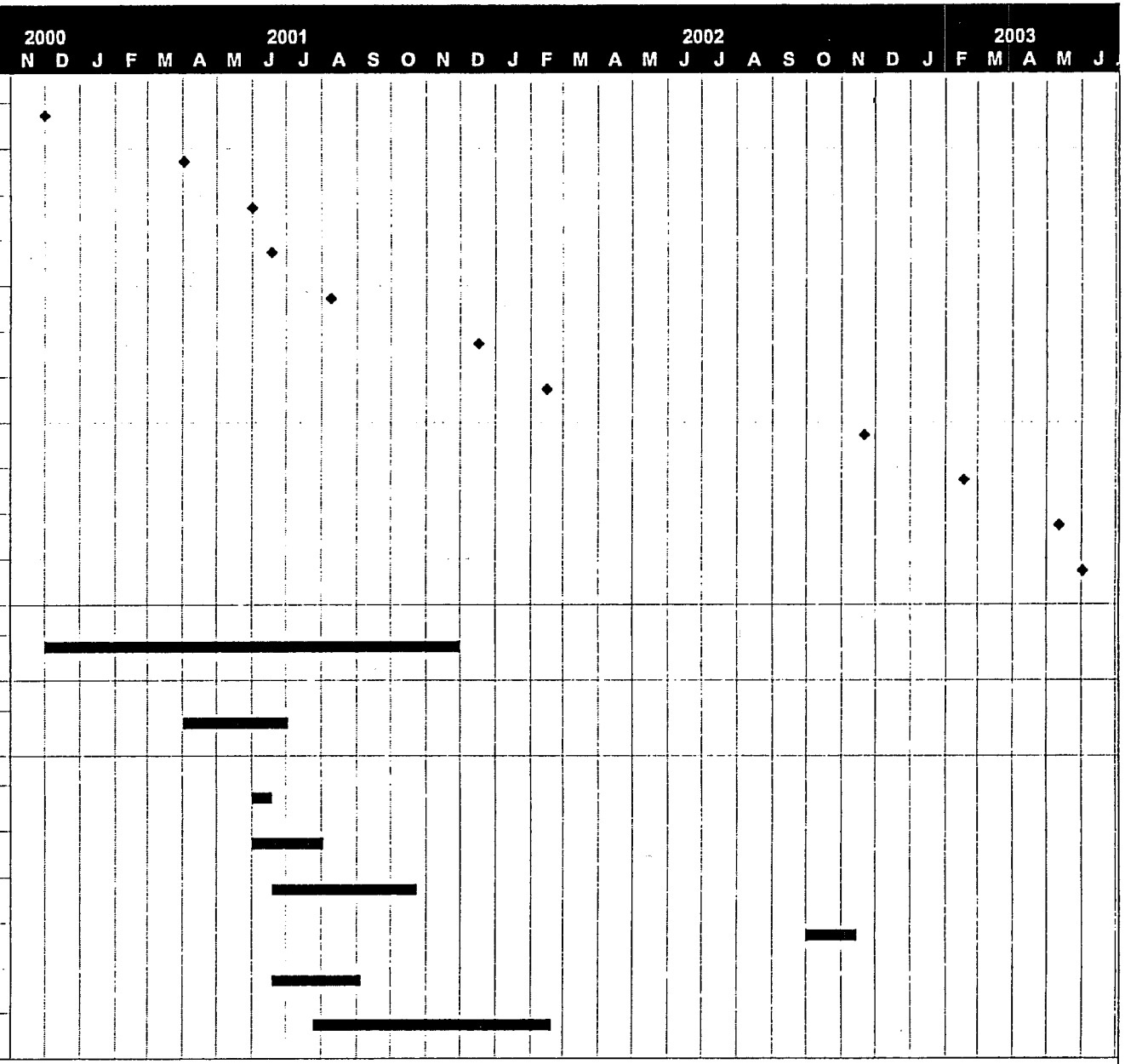
3.8.4 Total Land Disturbance during Construction

Table 3.8-6 contains a summary of the estimated acreage that will be disturbed during construction of the main facility, installation of the transmission lines, and installation of each of the offsite pipelines. The table also includes a listing of estimated land disturbance at

the various laydown and storage areas, craft parking areas, and construction equipment parking and maintenance areas and new roads.

Land disturbance for pipeline and transmission line construction will be kept to a minimum through selection of appropriate construction techniques and equipment.

Act ID	Description
MILESTONES	
9000	NTP/Financial Closure/Begin Engineering
9050	Start Access Road Construction
10000	Construction Mobilization Start
10010	Site Prep Start
10020	Foundations Start
10025	Deliver Steam Turbine
10030	Deliver Gas Turbines
10040	Mechanical Completion
10050	Systems Completion Complete
10060	Start-Up & Commissioning Complete
10070	Commercial Operation
ENGINEERING AND PROCUREMENT	
1007	Engineering and Procurement
ACCESS ROAD	
10075	Construct Tie In to Edmonston Pmpng Plnt Rd
SITE PREP-U/G-FOUNDATIONS	
10080	Mobilization Inside Battery Limits
10090	Temporary Power
10100	Site Prep./Storm Water Drainage/Laydown Area
10105	Leaching Field
10110	Storm Water Retention Basin
10200	U/G Piping & Electrical



Project name	PASTORIA
Finish date	30MAY03
Data date	01DEC00
Page number	1A
Page count	3A

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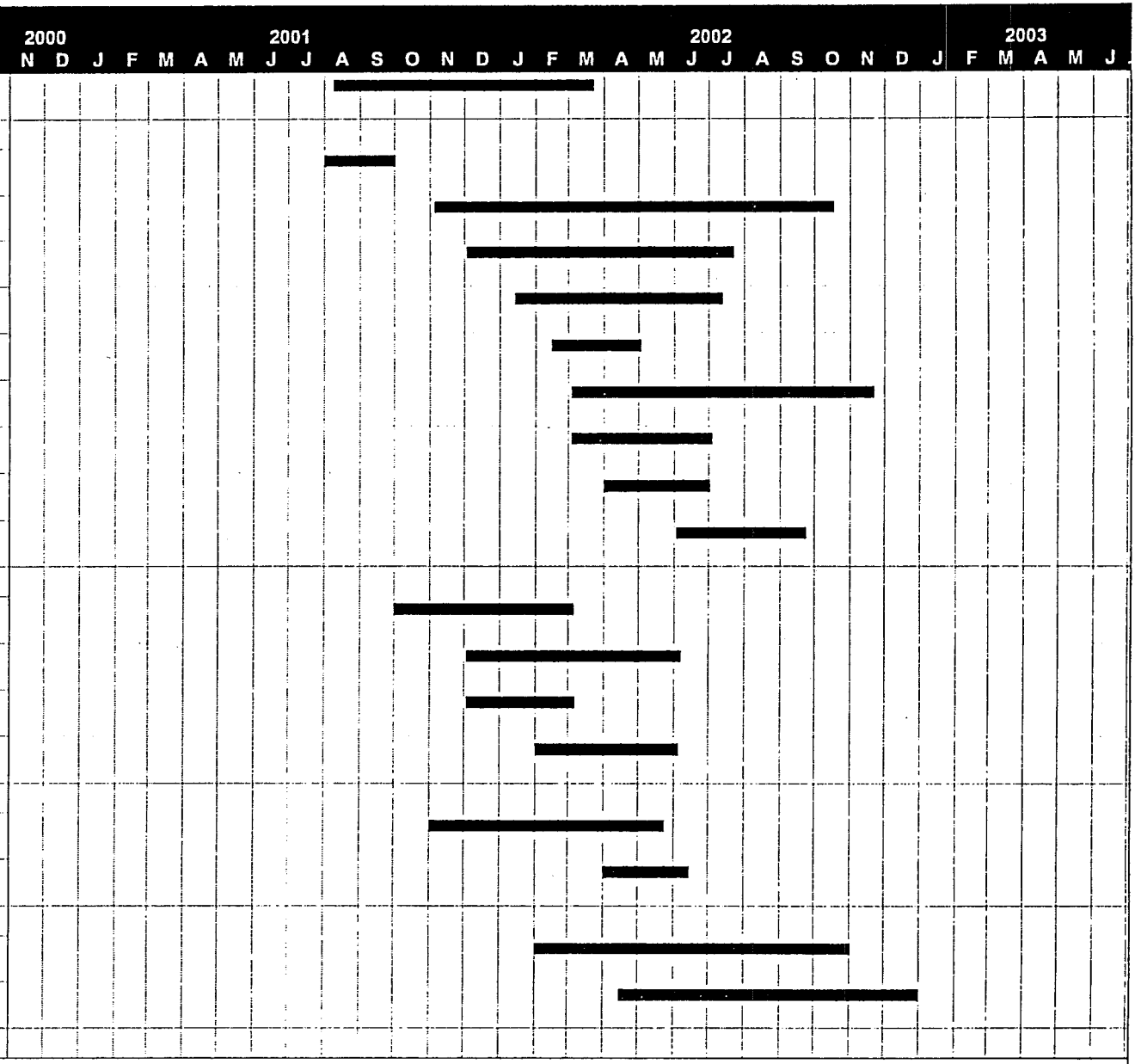
Table 3.8-1

PASTORIA ENERGY FACILITY

PROJECT MILESTONE SCHEDULE

Date	Revision	Checked	Approved
17AUG99	Prelim for Rvw		
21OCT99	Added Table No.		
21OCT99			

Act ID	Description
10300	Foundations (Plantwide)
INSTALL EQUIPMENT	
10304	Erect Siphon Station at Aquaduct
10306	Erect HRSGs(3)
10307	Erect Steam Turbine, Generator & Condenser(1)
10309	Pumps/Skids/Fuel Gas Metering
10310	Fuel Gas Equipment
10311	Assemble Gas Turbines & Generators(3)
10312	Erect Cooling Towers(2) on Basins
10316	Erect Storage Tanks on Foundations
10320	Erect Inlet Air Filters & Coolers(3)
BUILDINGS/ENCLOSURES	
10640	Warehouse/Shops
10660	Administrative/Control Building
10670	Electrical Control Building
10680	Water Treatment System
230 kV SWITCHYARD AREA	
11350	Erect Switchyard Equipment
11360	Install Auxilliary Transformers
PIPE	
11500	Rack & Above Ground Pipe
11600	Interconnecting Piping
ELECTRICAL AND INSTRUMENTATION	



Project name	PASTORIA
Finish date	30MAY03
Data date	01DEC00
Page number	2A
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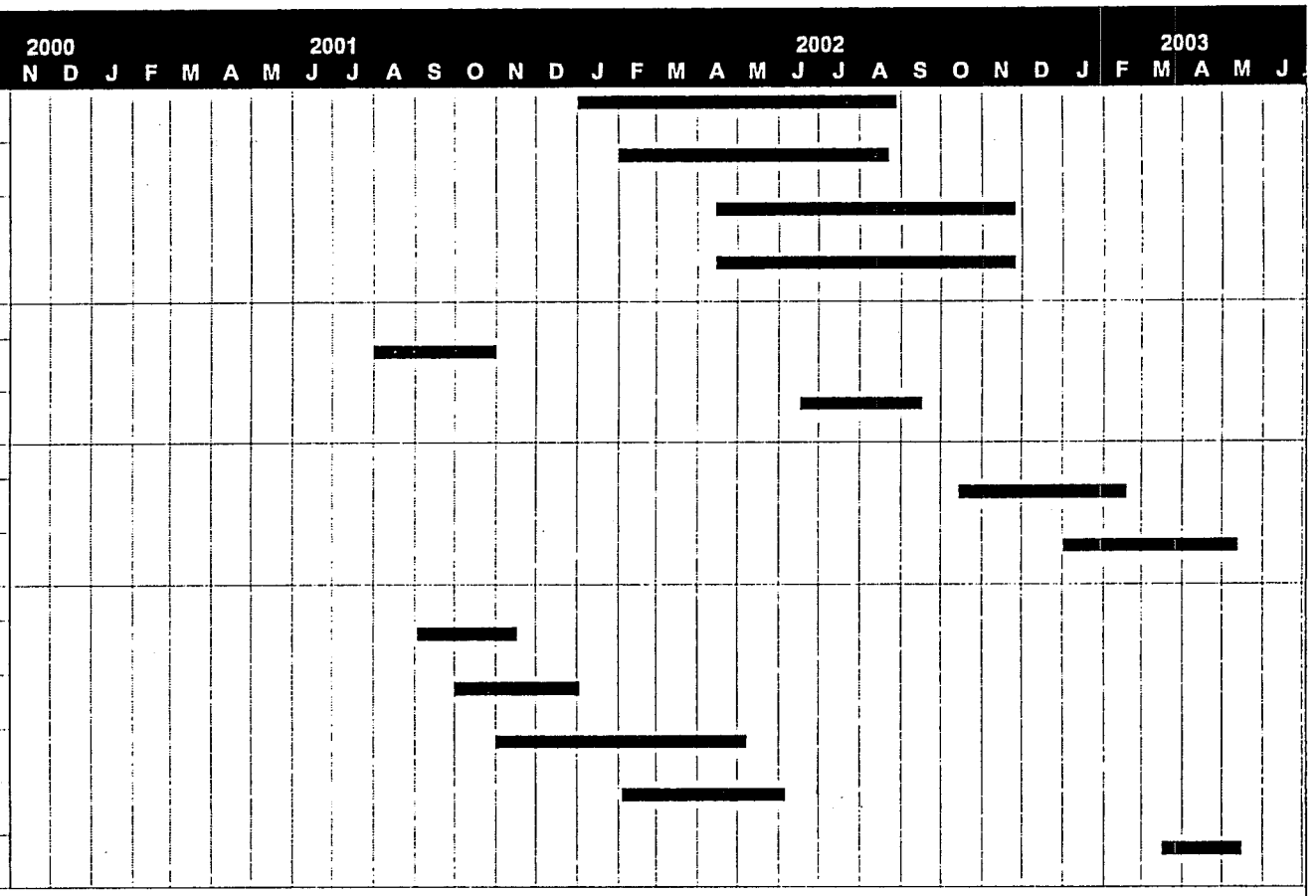
Table 3.8-1

PASTORIA ENERGY FACILITY

PROJECT MILESTONE SCHEDULE

Date	Revision	Checked	Approved
17AUG99	Prelim for Rvw		
21OCT99	Added Table No.		
21OCT99			

Act ID	Description
10700	Main Control Room
10750	Electrical Equipment
10760	Instrumentation
10775	Electrical Bulks
ENVIRONMENTAL/SAFETY SYSTEMS	
10900	Fire Water System
10950	Continuous Emissions Monitoring System
STARTUP/ACCEPTANCE	
11700	System Completion
11900	Start-Up & Commissioning
OFFSITE UTILITIES/ACCESS ROADS	
12604	Wastewater Discharge
12610	Cooling Water Supply
12620	Fuel Gas Supply Line
13110	New 230kV Double Circuit A/G Transmission Line
13120	Complete Access Road



Project name	PASTORIA
Finish date	30MAY03
Data date	01DEC00
Page number	3A
Page count	3A

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Table 3.8-1

PASTORIA ENERGY FACILITY

PROJECT MILESTONE SCHEDULE

Date	Revision	Checked	Approved
17AUG99	Prelim for Rvw		
21OCT99	Added Table No.		
21OCT99			

TABLE 3.8-2

PASTORIA ENERGY FACILITY
PROJECT ENGINEERING AND CONSTRUCTION MANPOWER BY MONTH

RESOURCE DESCRIPTION	MONTHS AFTER NOTICE TO PROCEED																														Man Months
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
ENGINEERING	MANPOWER PER MONTH																														
ENGINEERING AND PROCUREMENT	10	30	75	75	75	75	75	75	50	50	25	20																			635
TOTAL ENGINEERING	**10**	**30**	**75**	**75**	**75**	**75**	**75**	**75**	**50**	**50**	**25**	**20**																			**635**
ONSITE CONSTRUCTION	MANPOWER PER MONTH																														
ACCESS ROAD					20	20	20																								60
SITE PREPARATION							30	40	40	40	40																				190
U/G PIPE AND ELECTRICAL								15	30	30	40	40	40	30	15																240
FOUNDATIONS								20	20	45	55	55	65	65	55	20															400
INSTALL EQUIPMENT									10	25	35	35	40	60	75	80	85	90	95	95	80	60	35	20							920
BUILDINGS AND ENCLOSURES											30	40	40	50	40	40	40	30													310
PIPING															20	60	70	70	80	80	80	60	40	20	20						600
ELECTRICAL AND INSTRUMENTATION														10	30	40	80	80	80	90	90	90	60	50							700
ENVIRONMENTAL AND SAFETY SYSTEM									10	10	10								10	10	10	10									70
SWITCHYARD												15	25	25	25	25	25	20	10												170
STARTUP AND ACCEPTANCE TESTING																							20	20	20	20	20	20	20	20	160
DIRECT CRAFT SUBTOTAL					**20**	**20**	**50**	**75**	**110**	**150**	**210**	**185**	**210**	**240**	**260**	**265**	**300**	**290**	**275**	**275**	**260**	**220**	**155**	**110**	**40**	**20**	**20**	**20**	**20**	**20**	**3820**
FIELD STAFF					5	5	5	10	10	15	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	15	10	10	10	380
ONSITE TOTAL					**25**	**25**	**55**	**85**	**120**	**165**	**225**	**200**	**225**	**255**	**275**	**280**	**315**	**310**	**295**	**295**	**280**	**240**	**175**	**130**	**60**	**40**	**35**	**30**	**30**	**30**	**4,200**
OFFSITE UTILITIES	MANPOWER PER MONTH																														
WASTE WATER DISCHARGE										15	15	15																			45
COOLING WATER SUPPLY											25	25	25																		75
FUEL GAS SUPPLY												20	20	20	20	20	20														120
230 KV DOUBLE CIRCUIT A/G TRANS LINE															30	30	30	30													120
COMPLETE ACCESS ROAD																												20	20	20	60
OFFSITE TOTAL										**15**	**40**	**60**	**45**	**20**	**50**	**50**	**50**	**30**										**20**	**20**	**20**	**420**
GRAND TOTAL	**10**	**30**	**75**	**75**	**100**	**100**	**130**	**160**	**170**	**230**	**290**	**280**	**270**	**275**	**325**	**330**	**365**	**340**	**295**	**295**	**280**	**240**	**175**	**130**	**60**	**40**			**50**	**50**	**5,170**

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TABLE 3.8-2

PASTORIA ENERGY FACILITY
PROJECT ENGINEERING AND CONSTRUCTION MANPOWER BY MONTH

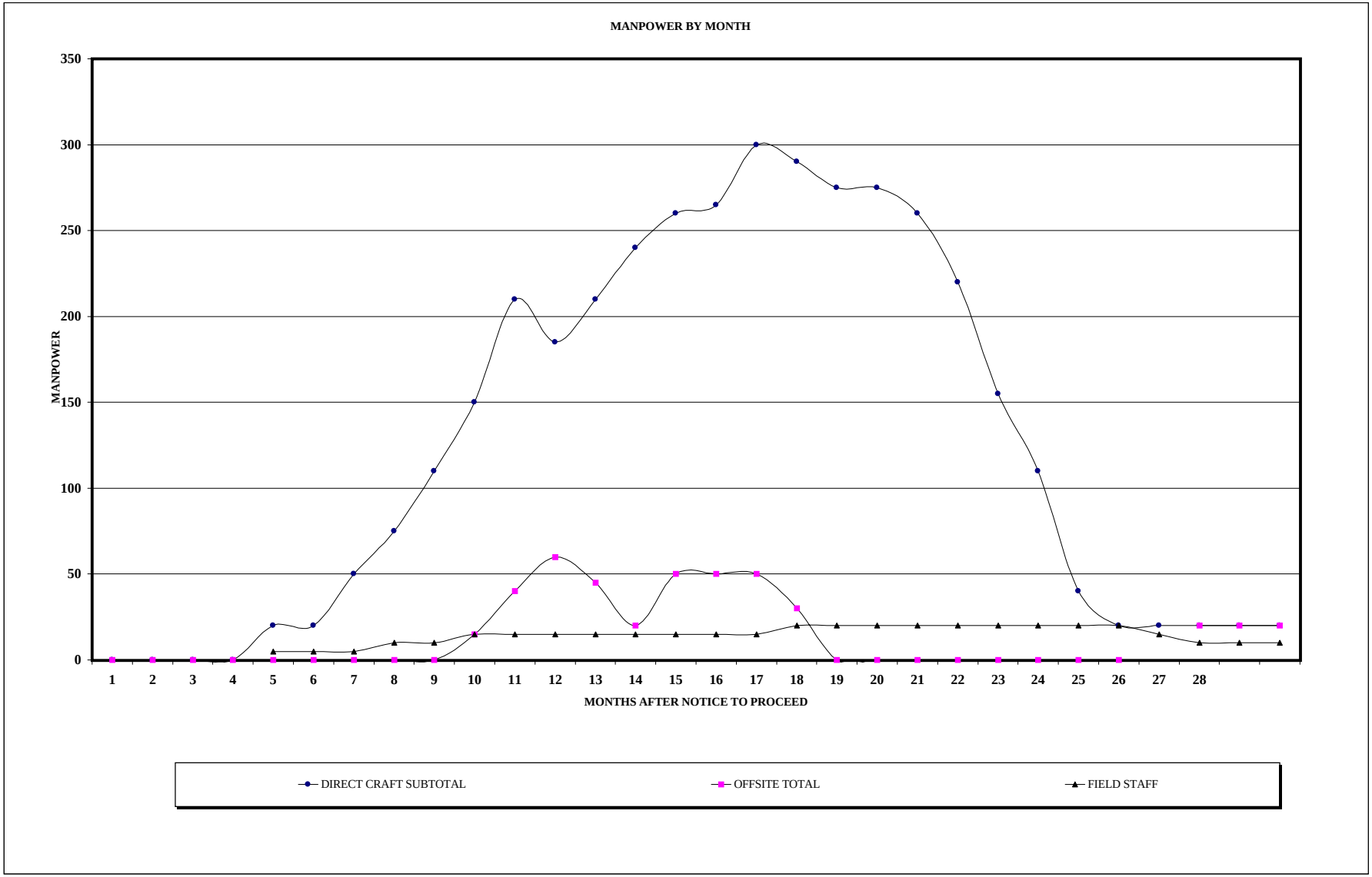


TABLE 3.8-3
PASTORIA ENERGY FACILITY
PROJECT MANPOWER BY CRAFT

RESOURCE DESCRIPTION	MONTHS AFTER NOTICE TO PROCEED																														Man Months
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
ENGINEERING	MANPOWER PER MONTH																														
ENGINEERING AND PROCUREMENT	10	30	75	75	75	75	75	75	50	50	25	20																			635
TOTAL ENGINEERING	10	30	75	75	75	75	75	75	50	50	25	20																			635
ONSITE CONSTRUCTION	MANPOWER PER MONTH																														
CARPENTERS					2	2	6	11	11	20	22	18	20	20	19	7															158
CEMENT MASONS								4	4	8	17	10	12	12	7	2															76
ELECTRICIANS								5	18	18	18	9	27	36	40	54	90	80	70	70	70	70	54	47	12	6	6	6	6	6	818
INSULATION WORKERS																		4	14	14	15	27	12	7	7						100
IRONWORKERS(Rebar/Structural)/BOILERMAKERS								5	13	28	53	62	66	93	92	94	94	94	79	79	69	49	33	20	6	2	2	2	2	2	1,039
LABORERS					8	8	20	23	28	32	44	29	31	30	24	4															281
MILLWRIGHTS									2	2	4	4	5	6	9	10	11	12	6	6	5	3	2	2	2	2	2	2	2	2	101
OPERATING ENGINEERS					6	6	14	15	17	22	26	31	28	25	30	30	35	35	35	35	32	32	28	10	4	2	2	2	2	2	506
PAINTERS															10	11	11	6	6	6	5	3	2	2							62
PIPEFITTERS								3	6	8	12	15	12	9	20	42	45	45	57	57	57	29	18	18	7	7	7	7	7	7	495
TEAMSTERS					4	4	10	9	11	12	14	7	9	9	9	11	14	14	8	8	7	7	6	4	2	1	1	1	1	1	184
DIRECT CRAFT SUBTOTAL					20	20	50	75	110	150	210	185	210	240	260	265	300	290	275	275	260	220	155	110	40	20	20	20	20	20	3820
FIELD STAFF					5	5	5	10	10	15	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	15	10	10	10	380
ONSITE TOTAL					25	25	55	85	120	165	225	200	225	255	275	280	315	310	295	295	280	240	175	130	60	40	35	30	30	30	4,200
OFFSITE UTILITIES	MANPOWER PER MONTH																														
CARPENTERS											2	2	2															2	2	2	12
CEMENT MASONS										2	4	6	4	2	2	2	2														24
ELECTRICIANS															10	10	10	10													40
IRONWORKERS										2	4	6	4	2	16	16	16	14													80
LABORERS										4	8	15	11	7	9	9	9	2										8	8	8	98
OPERATING ENGINEERS										2	4	6	4	2	5	5	5	3										6	6	6	54
PIPEFITTERS										5	18	24	19	6	6	6	6														90
TEAMSTERS												1	1	1	2	2	2	1										4	4	4	22
OFFSITE TOTAL										15	40	60	45	20	50	50	50	30										20	20	20	420
GRAND TOTAL	**10**	**30**	**75**	**75**	**100**	**100**	**130**	**160**	**170**	**230**	**290**	**280**	**270**	**275**	**325**	**330**	**365**	**340**	**295**	**295**	**280**	**240**	**175**	**130**	**60**	**40**			**50**	**50**	5,170

TABLE 3.8-4

PASTORIA ENERGY FACILITY
CONSTRUCTION EQUIPMENT UTILIZATION
(Number of Pieces of Equipment)

Construction Equipment Description	HP	Construction Period after Notice to Proceed /Equipment Pieces per Month for Linears																					Total Pieces Months	Machine Total Hrs With Util
		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
COOLING WATER SUPPLY PIPELINE																								
Excavator ***	195					1	1	1															3	248
Crane, 15 T ***	127					1	2	1															4	330
Plate Compactor **	5					5	5	5															15	619
Pickup Truck **	175					2	2	2															6	248
Dump Truck, 10CY ***	225					3	3	3															9	743
Generator, Portable **	10					2	2	2															6	248
Air Compressor, 300 CFM **	90					2	2	2															6	248
TOTAL						16	17	16															49	2681
WASTEWATER DISCHARGE LINE																								
Backhoe/Loader ***	225				1	1	1																3	248
Plate Compactor **	5				4	4	4																12	495
Crane, 15 T **	127				1	1	1																3	124
Pickup Truck **	175				1	1	1																3	124
Dump Truck, 10CY ***	225				2	2	2																6	495
TOTAL					9	9	9																27	1485
230 KV TRANSMISSION LINE																								
Backhoe ***	175									2	2	2	2										8	692
Generator, Portable **	10									2	2	2	2										8	692
Concrete Transit Mixer *	300									2	2	2	2										8	138
Truck Crane 50T **	700									2	2	2	2										8	346
Winch, 100T **	450									2	2	2	2										8	346
Pickup Truck ***	175									3	3	3	3										12	1038
TOTAL										13	13	13	13										52	3252

NOTES:

1. Construction Equipment Hours are based on 165 hours per month
2. Equipment Utilization is assigned as follows:

* = 10%
** = 25%
*** = 50%

TABLE 3.8-5
PASTORIA ENERGY FACILITY
CONSTRUCTION TRUCK DELIVERIES OF EQUIPMENT AND MATERIALS
(Number of Deliveries)
DELIVERY PROFILE

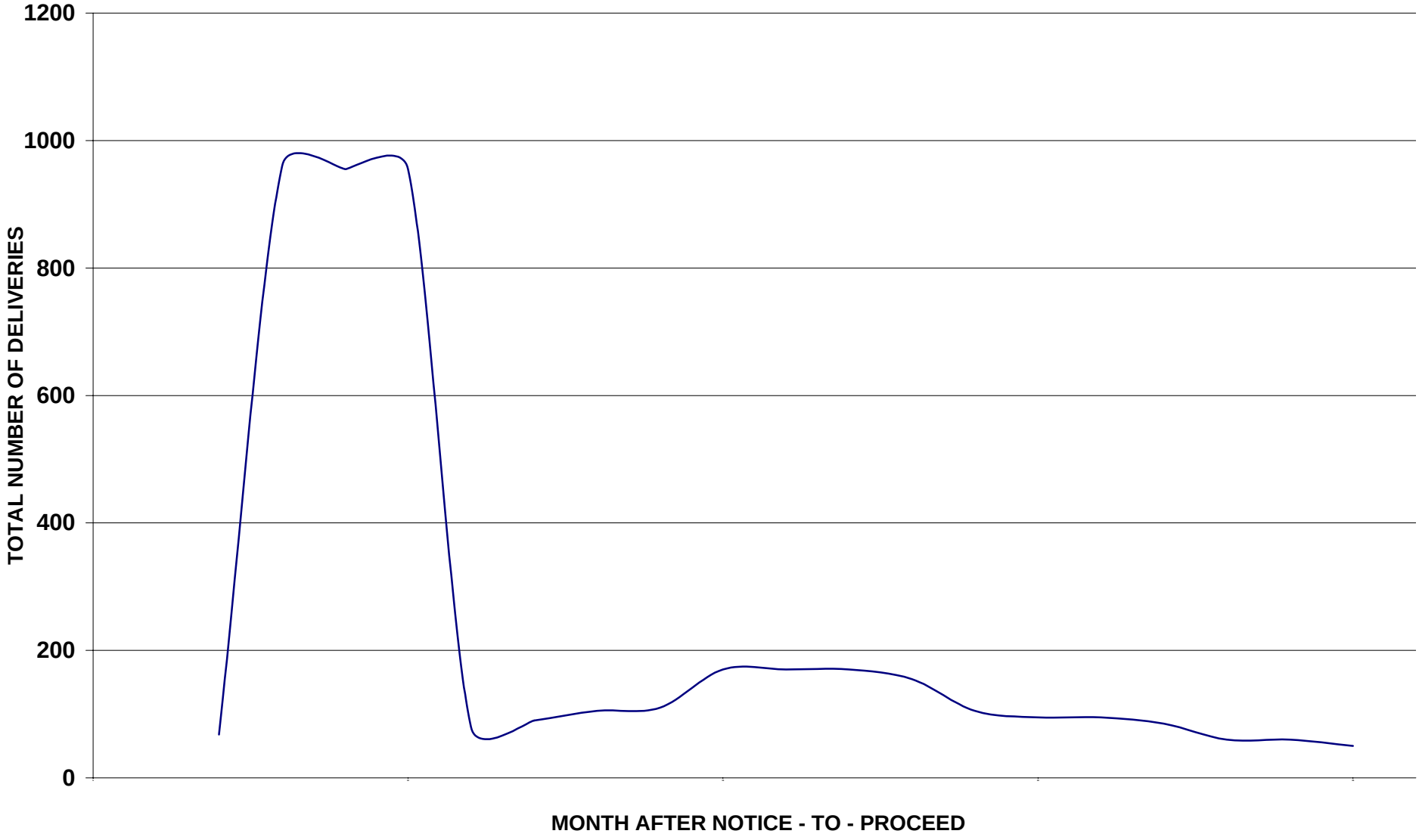


TABLE 3.8-6

PASTORIA ENERGY FACILITY
ESTIMATED DISTURBED AREA SUMMARY

Project Component Item	Unit Area Construction	Unit Area Operations	Proposed Length of Units	Construction Right of Way
PLANT SITE				
Site Boundary	30 acres	30 acres		N/A
Construction Laydown	25 acres	N/A	N/A	N/A
Proposed New Double Circuit 230 kV Transmission Line to the SCE Pastoria Substation				
Aboveground	23 acres	400 SF/Structure	1.38 miles	140 feet
Proposed Fuel Gas Supply Line				
Route 3 Underground	71 acres	35	10.65 miles	50 feet
Alternate Fuel Gas Supply Line				
Route 3A Underground	84 acres	42	13.8 miles	50 feet
Alternate Fuel Gas Supply Line				
Route 3B Underground	110 acres	55	18.2 miles	50 foot
Proposed Make-Up Water Supply Line				
Route 2 Underground	0.5 acres	0.15	0.05 miles	75 feet
Proposed Wastewater Discharge Line To Injection Wells				
Route 4 Underground	15 acres	5	1.7 miles	75 feet
Proposed Stormwater Discharge Line				
(onsite) Underground	N/A	N/A	N/A	N/A
Proposed Sanitary Sewer				
(onsite) Underground	N/A	N/A	N/A	N/A
Proposed Access Road				
Route 5 Roadway	8 acres	4 acres	0.85 mile	80 feet

[1] Refer to Map 3.2-1 for location for project components.

[2] Note: operational right of way widths for pipelines are assumed to be 25 feet; permanent access road width is planned to be 40 feet.

3.9 FACILITY OPERATIONS AND MAINTENANCE

3.9.1 Introduction

The Pastoria Energy Facility (PEF), and related offsite linear facilities, will be designed and operated to ensure safe, reliable, and environmentally acceptable operations per Title 20 CCR 1752 (c) for an operating life of 25 years. Reliability and availability projections are based on this projected operating life.

PEF is a combined cycle generating facility, designed for the restructured California energy market. The facility incorporates three F-Class combustion turbine generators in one two-on-one configuration and one one-on-one configuration. The plant design and operating philosophy will be based on operation as a merchant plant in the competitive California electricity market, with a high emphasis on efficiency and flexibility.

PEF is expected to be operated by a staff of approximately 25 full-time, on-site employees. The facility will operate seven days per week, 24 hours per day. Plant operations will be controlled from the operator's panel, which will be located in the control room. A distributed control and information system will provide control, monitoring, and indication for plant functions, including startup, shutdown, load holding and following, and emergency annunciation and override.

3.9.2 Power Plant Facility

3.9.2.1 Merchant Plant Operation

The California electricity market was deregulated on April 1, 1998. After that date, independent power producers, such as Pastoria Energy Facility, LLC, are free to sell their electricity into the California Power Exchange, and to all users, including electric utilities. The Pastoria Energy Facility may be able to sell all or part of its generation under contract. Generating capacity that has not been sold through contracts will be available for sale through the Power Exchange, which will work to match buyers and sellers of electricity in the spot market. Operation of the Pastoria Facility therefore depends on the quantity of electricity sold through contracts and the ability to sell into the spot market.

3.9.2.1.1 Operating Modes. Electricity demand and availability fluctuate greatly, depending on weather and other factors. In response to market conditions, the facility may operate in one or all of the following modes:

Base Load. The facility would operate at maximum continuous output for as many hours per year as were profitable. This mode would require that the sum of contractual load and spot market sales equate to the base load output of the facility.

Load Following. The facility would be operated to meet contractual load and whatever spot sales could be made. The output of the unit would be adjusted periodically to meet whatever load proved profitable to the facility.

Partial Shutdown. At certain times of the day, week and/or year, the sum of the contractual load and spot market sales could drop to a level where it would be economically favorable to shutdown one or two CTG/HRSG trains and operate the facility using the remaining one or two trains with the corresponding STG(s). This mode of operation could occur during late evening/early morning hours and weekends when contractual load could decrease and/or spot market sales would not be economically viable.

Full Shutdown. A full shutdown may occur if forced by equipment malfunction, fuel supply interruption, or transmission line disconnect. Full shutdown could also occur where the market price was less than the incremental cost of generation. Operation below maximum continuous output (base load) by economics and turbine operating characteristics. Gas turbine efficiency decreases sharply and emissions increase as output is decreased below 50 to 70 percent of CTG base load, depending on conditions and specific equipment characteristics.

3.9.2.1.2 Annual Operating Practices. The plant will generally be operated to provide maximum electrical output during the summer and winter peak periods when demand for electricity is the highest. Some or all units may be shut down or operated at partial load when reduced market demand makes full load operation uneconomical. When possible, planned maintenance outages will be scheduled during times of the year that typically experience the lowest electricity demand.

3.9.2.1.3 Operation with Daily and Seasonal Variation in Temperature and Demand. Peak electricity demand periods in California correspond with high air conditioning use on summer afternoons with high ambient temperatures. At the same time, available generating capacity is decreased because the high temperatures decrease airflow into combustion turbines and decrease cooling tower effectiveness for steam turbines. High temperatures also decrease transmission system capacity.

This combined cycle plant will provide a significant portion of the electricity that California needs to meet peak loads. By placing its electric output in the proposed location, the reliability of the SCE system would be enhanced.

To economically maximize output on hot days, an inlet air cooling system will be installed on each CTG. The inlet cooling system will increase power and efficiency in many conditions down to or below 60° F ambient temperature.

Depending on the market price, a combined cycle plant could effectively operate approximately 95 percent of the year, although permitted use will be 8,760 hours per year. While this facility will be designed for maximum flexibility, the equipment is better suited for lower cycling and longer periods of constant boiler temperature.

When responding to demand, the facility may start from zero baseline or may change incremental from some level of output above minimum load. Each gas turbine can respond concurrently (in parallel) or sequentially (by cascading units). The "ramp rate" (the rate at which the facility will respond to a change in demand) - is a function of the starting point and operating mode.

3.9.2.1.4 <u>Startup and Shutdown</u>. The time required for startup is dependent on the time elapsed since the unit was shutdown and on the CTG manufacturer's specifications. A "cold startup" follows any outage of 72 hours or more. The facility will be capable of reaching full load in approximately 3.5 hours after startup from cold shutdown. A "hot startup" occurs if the facility is restarted within 48 hours after shutdown. The facility will be capable of reaching full load in approximately 0.5 hour on a hot start.

Based on temperature cycle variations, it is anticipated that approximately 13 combustion turbine starts and stops per week (676 total starts/stops per year) will be made at the Pastoria Facility.

3.9.2.2 Control Philosophy

The control system will consist of a state-of-the-art, integrated microprocessor-based distributed digital control and monitoring system (DCS). The control system will provide for startup, shutdown, and control of plant operation limits, and shall provide protection for the equipment.

Interlock and logic systems will be provided via hardwired relays, the DCS, or programmable controllers. Process switches (i.e., pressure, temperature, level, etc.) used for protective functions will be connected directly to the DCS and the protective system.

3.9.2.3 Degree of Automation

The plant will be designed with a high degree of automation in order to reduce the number of procedures requiring intervention by operating personnel. Where it is not beneficial, systems will not be automated. Use of subsystem automation and a distributed control system will reduce the number of individual control switches and indicators and the complexity and size of the main control room consoles and panels that confront the operator. This modern, ergonomically based, control room design improves plant safety, reliability, and efficiency

by simplifying operator actions and reducing opportunities for confusion when rapid response is needed.

3.9.2.4 Centralized Control

The majority of control consoles and input devices required to support the operation of the plant shall be located in the control room. The control room contains the DCS control consoles and the auxiliary control panels. In addition, the control room contains the alarm, utility, and log printers. Local control panels or stations will be furnished only where required to set up a system for operation, or where the equipment requires infrequent and non-urgent attention during plant operation. Main control room indication and control will only be duplicated for those variables critical to plant availability.

3.9.2.5 Distributive Control and Monitoring System

The Distributive Control System (DCS) will provide modulating control, digital control, monitoring, and indicating functions for the plant power block systems. The following functions will be provided:

- Control of the combustion turbine generators (via data link to CTG furnished control system), and other systems in a coordinated manner

- Control of the balance-of-plant systems in response to plant demands

- Monitoring of controlled plant equipment and controlled process parameters and providing this information to the plant operators

- Control displays (printed logs, cathode ray tubes [CRT] for signals generated within the system or received from input/output (I/O) points

- Consolidated plant process status information through displays presented in a timely and meaningful manner

- Out-of-limit parameters or parameter trends will be automatically alarmed, displayed on the alarm CRT(s), and recorded on the alarm log printer

- Historical data storage and retrieval.

The DCS will be a redundant microprocessor-based system and will consist of the following major components:

- CRT-based operator consoles
- Engineer work station
- Distributed processing units
- Input / output cabinets
- Historical data unit
- Printers
- Data links to the combustion turbine generator.

The DCS will have functionally distributed architecture made up of a group of similar redundant processing units linked to a group of operator consoles and the engineer workstation by redundant data highways. Each processor will be programmed to perform specific dedicated tasks for control information, data acquisition, annunciation, and historical purposes. By being redundant, no single point failure can cause a unit trip.

The DCS will be data-linked to the control systems furnished by the combustion turbine supplier to provide remote control capabilities, as well as data acquisition, annunciation, and historical storage of turbine and generator operating information.

The system will be designed with sufficient redundancy to preclude a single device failure from significantly impacting overall plant control and operations. This also allows critical control and safety systems to have redundancy of controls, as well as an interruptible power source.

3.9.2.6 Reliability and Availability

Pastoria Energy Facility is expected to have an annual availability of approximately 95 percent. It will be possible for the plant availability to exceed 98 percent for a given 12-month period. Plant design, operation, and maintenance will work together to provide this high plant reliability and availability.

3.9.2.6.1 Equipment Reliability and Redundancy. Where possible, control systems and auxiliary equipment serving the power generating and transmission equipment will be selected for high reliability. Where cost effective or necessary for safety, redundant equipment and systems will be installed to allow the plant to continue operating in the case of an auxiliary equipment failure. Table 3.4.1-1 lists the plant's main generating components and major auxiliary equipment. Equipment redundancy is discussed further in Section 4.3.2 and illustrated in Table 4.3-1.

Reliability will be further ensured through a regular inspection and maintenance program. Planned outages will normally be scheduled in sequence so that only one CTG is out of

service at any time. Outages will normally occur during times when regional electric demand was low and surplus generating capacity was readily available.

CTG inspections and overhauls will dictate the length and frequency of major scheduled outages. Under expected operating conditions, the CTG combustors and rotating sections will require a scheduled outage of 1 to 2 weeks each. Every 3 to 5 years, major CTG overhauls will require scheduled outages which will last from 3 to 12 weeks for each CTG. Major hot section overhauls will be required at about 25,000 equivalent fired hours and major overhauls of the complete turbine and compressor will be required at about 50,000 hours. Equivalent fired hours includes actual operating hours plus a factor for the number of starts. Experience with similar large frame-type CTG's indicates that the first major overhaul will be required during the third year of operation.

3.9.2.6.2 Personnel and Administration. Along with the plant hardware, plant administrative and operational procedures will be designed to enhance reliability. Plant operations and maintenance activities will be carried out in accordance with documented procedures and by personnel trained in accordance with a documented training program. The training program will include classroom and hands-on training. Plant operations and maintenance personnel will also participate in the commissioning, startup and test activities during the plant construction period.

Selected spare parts for plant equipment and machinery will be maintained on-site.

3.9.2.6.3 Natural Gas Supply. Although the PEF has identified the Kern-Mojave Pipeline to provide fuel gas transmission, natural gas is available from existing pipelines that serve the region around the project location. Pipeline companies serving California include PG&E Gas Transmission – Northwest, El Paso Natural Gas Company, Transwestern, Kern River Gas Transmission Company and Mojave Pipeline Company. These have traditionally been highly reliable sources.

As stated in the CEC's 1995 natural gas market outlook, California has a total natural gas resource base of 1,056 trillion cubic feet (TCF) for surrounding basins. This resource base is expected to satisfy current production levels for the next 60 years. Therefore, sufficient supplies of natural gas are projected to be available throughout the life of the project. Further, new pipelines have increased the supply diversity into the region through new access routes to multiple supply basins. These activities have largely eliminated the risk of supply curtailment in the region and have allowed access to more competitively priced supplies.

Pastoria Energy Facility, LLC will negotiate short and long term natural gas supply and transportation contracts in order to best enhance the reliability and economic viability of the plant.

3.9.2.6.4 Water Availability. Raw water will be used, with appropriate treatment, for all power cycle requirements and other plant needs. This includes makeup to the cooling towers and the demineralized water system for the HRSG, firewater, domestic water for drinking water, safety showers and sanitary facilities, and service water for various uses around the plant.

Water will be provided to PEF through long term contracts with Wheeler Ridge-Maricopa Water Storage District (WRMWSD). PEF will become a customer in a new rate class WRMWSD is creating for water users with high reliability requirements. The District obtains most of its water from the California Aqueduct. It also has significant quantities of water stored underground to provide backup water to supply the District's customers, including PEF, when water supplies from the aqueduct are inadequate. WRMWSD will serve PEF from the aqueduct when supplies are available (see Table 3.4.8-6 for list of the types of water supply available to WRMWSD from the aqueduct). During periods when those supplies are unavailable, WRMWSD will draw water from its storage facilities to serve the project.

3.9.3 Transmission System Operation and Maintenance

3.9.3.1 Introduction

Operation of the transmission system will be controlled using facilities at the PEF as well as the substation tie-in point at SCE's Pastoria Substation. Maintenance activities for the transmission system are described in the following sections.

3.9.3.2 Access Maintenance

Access ways to poles and structures will be provided as required. All access ways will be maintained to minimize erosion and to allow access by maintenance crews.

3.9.3.3 Right of Way Management

Land use activities within and adjacent to the transmission line right of way will be permitted within the terms of the easement. Incompatible uses of the right of way include buildings and tall trees that interfere with required line clearances, as well as storage of flammable materials, or other activities that compromise the safe operation of the transmission line.

3.9.3.4 Inspections

Transmission line structures, access ways, and right of way will be inspected on a routine, periodic basis.

3.9.3.5 Emergency/Safety Repairs

Emergency repairs will be made if the transmission line is damaged and requires immediate attention. Maintenance crews will use tools and other such equipment, as necessary, for repairing and maintaining insulators, conductors, structures, and access ways.

3.9.3.6 Insulator Washing

The buildup of particulate matter on the ceramic insulators supporting the conductors on electric transmission lines increases the potential for "flashovers", which affects the safe and reliable operation of the line. Structures with buildup of particulate matter are identified for washing during routine inspections of the lines. Washing operations consist of spraying insulators with deionized water through high-pressure equipment mounted on a truck

3.9.4 Pipelines

Operation of the gas pipeline will be in accordance with applicable FERC and DOT regulations (as applicable). The pipeline will receive periodic inspections as part of PEF's routine pipeline maintenance program.

3.10 FACILITY CLOSURE

Facility closure can be either temporary or permanent. Facility closure can result from two circumstances: 1) the facility is closed suddenly and/or unexpectedly due to unplanned circumstances, such as a natural disaster or other unexpected event (e.g., a temporary shortage of facility fuel); or 2) the facility is closed in a planned, orderly manner, such as at the end of its useful economic or mechanical life or due to gradual obsolescence. The two types of closure are discussed in the following sections.

3.10.1 Temporary Closure

Temporary or unplanned closure can result from a number of unforeseen circumstances, ranging from natural disaster to economic forces. For a short term unplanned closure, where there is no facility damage resulting in a hazardous substance release, the facility would be kept "as is", ready to re-start operating when the unplanned closure event is rectified or ceases to restrict operations.

In the event that there is a possibility of a hazardous substances release, Applicant will notify the CEC compliance unit and follow emergency plans that are appropriate to the emergency (RMP). Depending upon the expected duration of the shutdown, chemicals may be drained from the storage tanks and other equipment. All wastes (hazardous and non-hazardous) will be disposed of according to LORS in effect at the time of the closure. Facility security will be retained so that the facility is secure from trespassers.

3.10.2 Permanent Closure

The planned life of the generation facility is 25 years. However, if the facility were economically viable at the end of the 25-year operating period, it could continue to operate for a much longer period of time. As power plant operators continuously upgrade their generation equipment, and maintain the equipment up to industry standards, there is every expectation that the generation facility will have value beyond its planned life.

3.10.3 Closure Mitigation

At the time of facility closure, decommissioning will be completed in a manner that: 1) protects the health and safety of the public; and, 2) is environmentally acceptable. One year prior to a planned closure, the Owner will submit a specific decommissioning plan that will include the following:

- Identification, discussion, and scheduling of the proposed decommissioning activities to include the power plant, applicable transmission lines, and other pertinent facilities constructed as part of the project.

- Description of the measures to be taken that will ensure the safe shutdown and decommissioning of all equipment, including the draining and cleaning of all tankage, and the removal of any hazardous waste.

- Identification of all applicable laws, ordinances, regulations, and standards (LORS) in effect at the time, and how the specific decommissioning will be accomplished in accordance with the LORS.

- Specify notification of State and Local Agencies, including the CEC.

- Once land is used for industrial or commercial purposes, it rarely reverts back to its natural state. Reuse of the land will be encouraged in this case, as opposed to taking additional land for future industrial or commercial purposes. If the plant site is to return to its natural state, the specific decommissioning plan will include discussion covering the removal of all aboveground and underground objects and material, and an erosion control plan that is consistent with sound land management practices.

In the event of an unplanned closure, due to earthquake damage or other circumstances, the owner will meet with the CEC and local agencies and submit a detailed decommissioning closure plan in a timely manner.

No decommissioning plan will be submitted for a temporary shutdown.

3.11 ALTERNATIVES

3.11.1 Introduction

Many interests must be balanced when selecting the project site, technology, fuel and water supplies, and operating plans for a large power plant in California's competitive power market. In developing the plan for this generating facility, Pastoria Energy Facility, LLC representatives worked to balance the following general goals along with many items of interest to specific constituencies:

- The plant must be economical to build and to operate. It must be able to sell electric power at a price that provides a clear benefit to customers while returning a profit that justifies the time and money that the owners have invested and the tremendous risks that are incurred.

- The plant must make optimum use of resources. Efficient use of fuel, water and land makes the plant more economical and decreases environmental impacts.

- The plant must have minimal environmental impact. It must be able to deliver the electric power that California residents require in the manner that either benefits or is at least benign to the natural environment that they treasure.

- The plant must be compatible with landowner and local citizen interests.

- The plant must operate safely.

- The plant must be reliable. To be profitable and to be able to sell power at an economical price, the plant must be available to deliver power when it is required. High reliability in a power plant of this size also makes a significant contribution to the stability of California's electric transmission grid.

3.11.2 Alternate Site Locations

Pastoria Energy Facility, LLC representatives made an extensive search of locations that might be suitable for a merchant class power plant. The Pastoria Creek location was preferred for several reasons:

- A supportive landowner for the plant site with available land with proper zoning in a supportive community

- A minimal number of involved landowners for project linears

- Access to natural gas fuel at competitive pricing
- Access to an adequate water supply
- Access to an electric transmission connection to the southern California market
- Minimal impact on visual resources
- Access to a potential baseload customer.

Three candidate sites were identified and evaluated by the Applicant as shown on Figure 3.11-1. All three sites met the siting criteria listed above. However, sites A and B were removed from further consideration due to their proximity to elevated terrain in the Tehachapi Mountains and associated air quality concerns. Site C (the proposed site) was selected as the preferred site based on its ability to meet the siting criteria listed above, air quality consideration, and landowner preference. Additionally, the Applicant is exploring the possibility of selling electricity to the Edmonston Pumping Plant (operated by the State Department of Water Resources) which adds to the desirability of the project site area for siting a power plant.

3.11.3 Alternate Technologies and Equipment

3.11.3.1 Alternate Generating Technology

PEF is intended to be a merchant class generating facility, which is able to respond to daily fluctuations in the competitive power market. The facility will use the latest combined cycle generating technology using natural gas fueled combustion turbines. This proven reliable technology is currently the most efficient and environmentally benign technology available for large-scale power generation using fossil fuel.

Other generating technologies, which could conceivably serve as alternatives to the proposed project, include geothermal, solar, hydroelectric, wind, fluidized bed or fired boilers using coal, oil, or biomass as fuel, and gas turbine combined cycle using oil as fuel. These technologies have inherent disadvantages, which make them less suitable than natural-gas-fired combined cycle for the intended service for this plant. These include need for large land area, inadequate supply in the target area, inadequate flexibility in responding to demand, lower efficiency, and or higher air emissions.

3.11.3.2 Alternate Emissions Control Technology

It is the intent of PEF to use or to advance the current state-of-the-art, or Best Available Control Technology (BACT), for emissions control in large, natural-gas-fired, combustion

turbines. Currently this employs Dry Low NO_x (DLN) combustors to limit emissions formation during combustion, oxidizing catalysts for post combustion control of CO emissions and selective catalytic reduction with ammonia injection for post combustion control of NOx emissions.

Catalytica Inc.'s innovative XONON™ emissions control technology has been proven to limit production of NO_x and CO in small CT's. NO_x control performance is comparable to SCR without the side effects of using ammonia injection. Stack CO levels are controlled to those levels typically associated with use of a CO catalyst. It is expected that XONON™ technology will be ready for use at the higher combustion temperatures in F-Class turbines on a schedule compatible with the PEF project schedule.

The project also considered SCONOX™ as an alternate NO_x and CO emissions control technology. Like XONON™, this technology, discussed in more detail in Section 5.2, is not yet proven for F-Class turbines. Unlike XONON™, the SCONOX™ technology requires a special installation, with many moving parts and control systems, which carries significant reliability risk. SCONOX™ purchase and operating costs are also expected to be higher than XONON™ or SCR.

Section 5.2 provides additional discussion of emission control technologies and operating strategies.

3.11.3.3 Alternate Plant Configuration

A plant configuration is desired that will most economically and reliably meet operating conditions. As a merchant plant, selling on competitive basis into the California Power Exchange, a high degree of flexibility is required to optimally meet highly varying demand. In operating modes with either two CTGs running or one CTG running, the chosen two-on-one plus one-on-one combined cycle configuration offers the highest efficiency and flexibility available with F-Class turbines.

A three-on-one configuration would provide higher efficiency under 100 percent load conditions. Efficiency of this configuration drops rapidly as power output decreases below 67 percent of full plant power. This configuration was rejected based on its lower efficiency during part load operation and the plant's dependence on a single ST.

The planned facility will have flexibility to add another one-on-one power block at some time in the future.

3.11.3.4 Alternate Inlet Air Cooling

At cooler inlet temperatures, air is denser a greater mass quantity can be drawn into a combustion turbine's compressor. Various forms of inlet air cooling are used to increase peak power output on hot days. Inlet air cooling methods examined for this project include:

- Inlet Evaporative Cooling (IEC) accomplished by passing the air through a wetted pad.
- Inlet Air Fogging (IAF), an evaporative cooling technique which sprays a fine mist into the incoming air.
- Inlet Absorption Chilling (IAC), which passes the inlet air stream over coils containing an absorption-cooled heat transfer fluid.
- Inlet Mechanical Chilling (IMC) which passes the inlet air stream over coils containing a refrigerant cooled by a mechanical compression/evaporation process.

Each of these techniques has significant advantages and disadvantages relevant to its application for PEF. Final selection of a technique will occur during the detail design phase of the project.

IEC is a proven technology that is used widely to achieve modest gains in turbine peak output. For most applications, it requires a modest increase in plant water consumption and additional water treatment equipment.

IAF can achieve lower temperatures than IEC but requires more expensive demineralized water and has enough risk of damage to the turbine, if not controlled adequately, to discourage turbine manufacturers from endorsing its use.

IMC and IAC can achieve much greater temperature reduction and peak power than the evaporative processes. Their advantages are not as great in the dry climate at PEF. Both methods have high capital cost and consume a large part of the increased CT output as electricity (IMC) or steam (IAC) to drive the chiller process. Both also require added cooling tower capacity to reject the heat removed from the inlet air and added by the chiller process.

3.11.3.5 Alternate Heat Rejection Systems

Surface condensers using wet-dry (or plume abatement) cooling towers were considered as the heat rejection system best able to meet the objectives of this project. The electric transmission grid experiences its highest power demand on the highest temperature days. A water-cooled surface condenser with the coldest water possible provides the best steam

turbine output and efficiency. With adequate water available, a wet cooling tower is best able to provide this at this site.

To achieve maximum efficiency, the lowest possible steam turbine exhaust pressure is required. This is achieved by condensing the saturated steam exhaust at the lowest possible temperature. A heat rejection system includes a condenser, where the heat of vaporization is extracted from the steam to allow it to condense, and a heat rejection mechanism, which discharges the heat to atmosphere or to an available water body.

Heat rejection systems considered for this plant included:

- Air cooled condenser (ACC)
- Surface condenser with wet cooling tower or wet/dry cooling tower
- Parallel-path cooling, using both a surface condenser, with a wet cooling tower, and an ACC
- Once-through cooling using water from the California Aqueduct.

Air-cooled condensers were rejected for use for this project because they significantly compromise the ability of the power plant to meet peak demand. At the hottest ambient temperatures experienced at this site, an air-cooled condenser can at best provide marginally acceptable backpressure with greatly reduced ST output and efficiency. The reduction in peak power output on peak demand days is on the order of 5 to 10 percent. Net heat rate increases more than 5 percent. At worst, excessive backpressure may prevent all turbines from running at the time they are needed the most.

In a dry climate such as at PEF, a wet cooling tower is able to deliver cooling water to the surface condenser at 10° F to 15° F above wet bulb temperature. Wet bulb temperature can be more than 45° F below dry bulb temperature. Even a very large ACC can only place ambient dry bulb temperature on the outside of the condenser tubes while internal temperature is significantly higher.

Peak power is also limited by the ACC on the coldest days. Current technology limits the ACC internal pressure, and LPT backpressure, to a minimum of 1.5 to 2 in Hg. Surface condensers with cold cooling water can reach 1 in Hg and below to draw maximum power from the steam turbine.

The air cooled condenser requires significantly more land area and capital cost to achieve heat rejection equal to that of a wet cooling tower or wet/dry cooling tower. To achieve noise

levels comparable to a wet/dry cooling tower, the size and cost of the ACC are further increased to allow reduced fan speed.

Air cooled condenser advantages over wet and wet/dry cooling towers include avoidance of cooling water consumption and the associated water supply, water treatment, and wastewater disposal infrastructure. The fan power required by the ACC is significantly less than the combined fan and pumping power required for wet cooling. An ACC also does not have issues with drift and visible plume, which are inherent with wet cooling.

ACC hot weather performance degradation can be lessened somewhat if water is sprayed on the ACC tubes or into the air before it enters the ACC. However, the spray system requires a large quantity of water, which must be very clean to avoid excessive PM10 emissions.

The cost and efficiency advantages of a wet cooling tower are lessened if plume abatement is required. The addition of water to air coils, to make a wet/dry plume abatement cooling tower, adds additional pumping power as well as significant cost to a wet cooling tower. It was judged that the advantage did not warrant the cost and performance penalty for this site.

The parallel path cooling system balances the benefits of wet and dry cooling. As the ambient air temperature decreases, the condensing temperature and pressure in the ACC increase. A higher proportion of LPT exhaust steam flows to the ACC and condenses there. As ambient temperature increases, the effectiveness of the ACC decreases and cooling load automatically swings back to the surface condenser. This operation can significantly reduce cooling water consumption and pumping power. At the same time, the lower turbine backpressure of a wet surface condenser is available to meet peak power demand on hot summer days. With full cooling load transferred to the ACC on cold days, expensive plume abatement coils are not needed in the wet tower.

Depending on how it is implemented, the cost of a parallel path system can approach that of a full ACC. On the hottest and coldest days, unless the wet condenser and tower are full-sized, and bypass valves are installed, the parallel path system will still not perform as well as a wet condenser and cooling tower system.

Once through cooling was rejected as incompatible with operating scenarios for the California Aqueduct. The aqueduct pumps are primarily operated during off-peak electric demand conditions while PEF will be most needed during on-peak conditions. Cooling water recirculation would result in excessive temperature in the aqueduct and poor performance for the power plant.

3.11.4 Alternate Water Supply and Treatment

3.11.4.1 Water Supply

This site was selected because of its convenient access to a reliable water supply from the Wheeler Ridge-Maricopa Water Storage District (WRMWSD) based on the district's contracted supply from the California Aqueduct and the district's significant quantities of water stored underground. WRMWSD will supply water to PEF from a 20- to 30-inch pipeline connected to WRMWSD's proposed supply and withdraw pipeline for the White Wolf Water Bank.

If PEF were unable to contract with WRMWSD, PEF would seek alternative water supplies. Such alternative supplies might include the purchase of State Water Project entitlements or purchase from third party suppliers.

Other options, such as recycled water and well water are not available in quantities that make them feasible.

3.11.4.2 Cooling Tower Water Treatment

PEF has been conceptualized with a traditional treatment regime for the cooling water circulating through the cooling towers and condensers. This regime uses biocides to reduce biological growth in the cooling tower, circulating piping and condenser. If not controlled, this biofilm reduces heat transfer efficiency and promotes scaling and corrosion. Sodium hypochlorite and/or sodium hypobromite are typically used, along with other chemicals to adjust the pH balance of the water and prevent scaling and corrosion.

This chemical treatment regime carries an initial capital cost and a high annual operating cost, economic cost. It increases the risk and the cost of handling hazardous materials on the site and of disposing of hazardous waste. The chemicals add dissolved solids to the circulating water and cause a slight increase in the blowdown and makeup water requirements.

The project is examining opportunities for reducing chemical usage and increasing cycles of concentration to decrease water consumption and disposal. A number of sources report highly successful application of ozone injection for water treatment for cooling towers and other uses. Ozone is well established as the best biological control agent for many applications. With the correct water chemistry, the biological control and high pH provided by ozone injection also prevent scale adhesion and corrosion. In many cases, other chemical usage, along with its inherent handling costs and risks, is nearly or completely eliminated. It may be possible to increase cycles of concentration as dissolved solids precipitate, without adhering as scale, and are filtered out. The capital cost of the ozone system is offset by

reduced chemical, water, and disposal costs within one or two years.

At this time, there is little or no industry experience using ozone in large cooling towers (above 30,000 gpm). For larger towers, residence time in the cooling water circulating piping, condenser and cooling tower approaches or exceeds the time in which ozone dissociates at typical cooling water temperatures. Peak temperatures, exiting the condenser, may approach the upper effective temperature limit for ozone treatment.

It is expected that, by the time this project reaches the detail design phase, adequate data will be available to determine whether ozone water treatment or another treatment is a better alternative for this application. Preliminary indications are that an ozone injection system can be designed to work very effectively and economically with the water chemistry and cooling loop conditions at PEF.

3.11.4.3 Demineralized Water Treatment

Electrodeionization Systems (EDI). Electrodeionization technology is becoming the power generation industry's preferred technology design to replace traditional mixed-bed ion exchange units (demineralizers). This system, which is used in treatment of boiler feedwater, provides pure water without the need for regeneration chemicals. This technology will be evaluated by PEF in order to eliminate mixed bed ion exchange from the boiler feedwater system and avoid the on site handling and disposal of wastewater to regenerate the mixed bed ion exchange units. EDI systems are well suited for medium and high pressure boiler feedwater applications. The EDI product water can be used directly with no further polishing steps

EDI Process Description. EDI is a continuous process for producing high purity water using ion exchange membranes, resins and electricity. Direct current (DC) is the driving force for removing ionized and ionizable species from the feed stream, while continuously regenerating the resin pack.

The EDI system will be evaluated as an alternative to mixed bed ion-exchange. During the detailed design phase, adequate data will be available to determine if EDI would be a more economical and environmentally preferred choice to mix bed ion exchange. The main advantages of EDI would be:

1. High purity boiler feed water 16-18 Mohm-cm.

2. Potential capital cost savings over mixed bed technology.

3. Elimination of regeneration chemicals; no need for regeneration of mixed bed using sulfuric acid and caustic.

4. Facility size – a smaller footprint for equipment plot plan.

5. No backwash waste stream neutralization will be required.

6. Continuous routine operations. Mixed bed systems use a chemical batch process to regenerate the resin beds. EDI systems regeneration process is continuous. Less operator labor is required.

Preliminary evaluations of EDI indicate that these types of system can be designed to treat the boiler feed water to the proper specification for use on the PEF project.

3.11.5 Transmission Alternatives

Variations in the delivery points, transmission voltage, circuit configuration, structures, tower configurations, conductor selection, routing, and number of circuits have been considered in developing the proposed transmission interconnection to the system.

3.11.5.1 Delivery Points

Two delivery points have been considered for interconnecting the project to SCE's transmission system: the Pastoria Substation and the Pardee Substation. The Pastoria Substation is approximately 1.38 miles from the project site. Pardee Substation is approximately 39 miles from the project site.

Pastoria Substation and Pardee Substation are major 230 kV substations in the region served by the SCE system. As a delivery point, Pastoria Substation is expected to meet project objectives and reliability requirements for much lower cost than Pardee Substation.

3.11.5.2 Transmission Voltage

Pastoria Energy Facility is a nominal 750 MW plant that will sell into the existing electrical grid. To supply this quantity of energy to the market, it is necessary to transmit this power at high voltages; 115 kV or 230 kV. These high voltages are an efficient means of transmission since they minimize electrical energy losses on transmission lines. Only 230 kV transmission facilities exist in the immediate area. The other two voltages which exist in the immediate area are at the sub-transmission and distribution levels (66 kV and 12 kV levels respectively), neither of which would provide effective transmission for Pastoria Energy Facility.

3.11.5.2.1 Alternate Voltage, Circuit, and Structure or Tower Configurations. Since the transmission voltage level is 230 kV at the Pastoria Substation, 230 kV was chosen for the interconnection voltage to avoid unnecessary transformation beyond the step-up transformer

at the plant. An interconnection at the Pardee Substation would allow for a 230 kV transmission and connection.

A double-circuit configuration was chosen for the delivery of the plant output to the grid (see Figure 3.6-3). The conductor and phasing configuration allows for a reduction in electromagnetic fields.

Lattice towers will be used in the existing SCE transmission corridor for transmission line connecting the PEF switchyard to the Pastoria Substation. Further, lattice towers will be used as take-off structures at the PEF switchyard and at the Pastoria Substation. This tower structure will conform with the existing structures in the area.

3.11.5.3 Conductor Selection

Conductor selection considers two main factors: capability and conformity to other conductors utilized in the area. To best meet local conditions, a conductor size is selected to transmit the full output of the facility with a single circuit.

Every effort will be made to select a conductor that is common to other conductors utilized in the area. This will insure that operations, maintenance, repair, and replacement of the conductors is performed in the most effective manner.

3.11.5.4 Number of Circuits

A double circuit configuration, with a single circuit designed to adequately handle delivery of the PEF output, will be employed. The double circuit configuration will satisfy reliability requirements and will provide redundant export capability for the plant.

3.11.5.5 Transmission Methods

The two alternatives considered for supporting the proposed 230 kV transmission line from the project switchyard to SCE's Pastoria Substation were:

- Single shaft tubular steel poles
- Lattice towers.

Single shaft tubular steel poles provide a compact footprint. Based on the type of transmission structures used by the SCE transmission system and the economies of land use, the project has selected not to use of single shaft tubular steel pole transmission structures.

Lattice tower support structures requiring a large footprint are consistent with support structures used by SCE in the local area. Therefore, the project has elected to use lattice tower support structures.

3.11.5.6 Alternative Routes

3.11.5.6.1 Paralleling Existing Transmission Lines and Other Facilities. The proposed route provides a direct route to the Pastoria Substation and will minimize installation of towers and lines over undisturbed ground and agricultural land.

Other Routing Opportunities. The preferred alternative site has the shortest route (approximately 1.3 miles) to connect PEF with the SCE 230 kV transmission system. No other alternative transmission corridors were analyzed as part of this project.

3.11.6 Alternative Wastewater Disposal Methods

PEF requires disposal of a nominal 760 gpm of wastewater. The wastewater discharge is primarily made up of blowdown from the plant's circulating cooling water system. Additionally, the wastewater stream includes backwash from the demineralizer system, blowdown from the steam condensate system, and blowdown from the combustion turbine inlet air evaporative coolers. These all are discharged to the cooling tower basin and undergo additional concentration. Three alternative disposal methods were investigated:

- Discharge to leach field
- Disposal via injection into abandoned oil wells
- Zero discharge.

Leach field disposal will be used for the small quantity of sanitary wastewater produced by the plant. Use of disposal wells and zero discharge will be pursued concurrently for the bulk of the plant's wastewater. One method, or a combination of both methods, will be used as deemed appropriate after a close evaluation of the environmental and economic costs and benefits of each.

The relatively high water supply quality, which will allow the cooling towers to operate at up to 10 cycles of concentration, will help minimize the quantity of wastewater processed in the zero discharge system or disposed in injection wells.

3.11.6.1 Discharge to Leach Field

Leach field disposal is well established for sanitary wastewater at sites remote from treatment plants. This alternative will be used for the small quantity of sanitary wastewater at the PEF site. It is unacceptable for the large volume of cooling tower blowdown.

3.11.6.2 Disposal via Injection into Abandoned Oil Wells

This option is a preferred method for disposal of wastewater discharge for this project; because of the availability of abandoned oil wells on the Tejon Ranch, suitable geological structure within the oil field to accommodate the injection of wastewater, and negligible potential for contamination of drinking water aquifers. The injection wells will be permitted as Class I injection wells through the USEPA. Class I wells are used for injection of fluids beneath the lower-most formation containing an underground water source containing less than 10,000 ppm of total dissolved solids (TDS). Disposal of the wastewater, at an expected 2700 ppm TDS level, entails minimal environmental risk.

Use of the disposal well option will entail significant costs for well evaluation and rework. Operating costs will include leak surveys, well maintenance and performance testing, royalties to the well owner, pumping, filtration, and disposal of filtered solids. A supplemental disposal method may be required as available wells may not be able to handle the full wastewater discharge.

3.11.6.3 Zero Discharge

Zero discharge wastewater disposal is a second option for the project. The (ZD) system would partially or fully eliminate offsite pumping of wastewater and would reclaim a significant quantity of process wastewater for reuse in the plants recirculating cooling water system.

Based on preliminary analysis, the zero liquid discharge system would involve reverse osmosis concentration of the wastewater, evaporation and brine crystallization. Ancillary equipment, such as mix tanks and pumps would be required to support the primary process equipment.

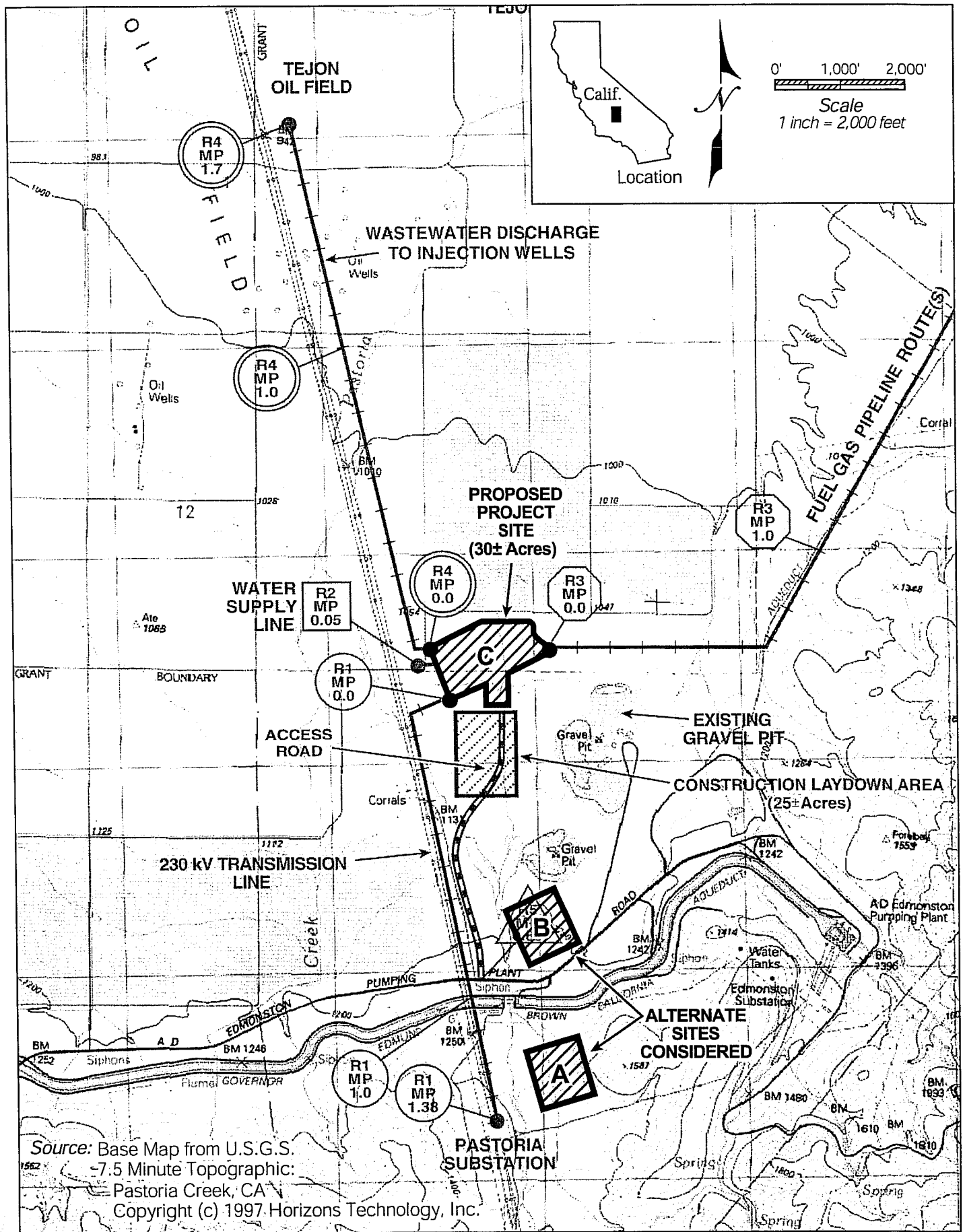
The addition of ZD equipment would increase the project's capital cost and operating and maintenance costs. The ZD system would also consume auxiliary power and steam. PEF's chemical handling and storage requirements would also increase.

A large quantity of brine salts will be produced and will require onsite handling and offsite shipping, handling and disposal. Adding ZD facilities will increase facility manpower requirements for operations and maintenance. Significant plot space will be required for the ZD equipment and for storing and handling the solid byproducts.

3.11.7 No Project Alternative

The No Project alternative would result in no project being built by Pastoria Energy Facility, LLC at the Pastoria site. This would not be consistent with the Project Developer's goals of

developing a project that would give the Developer a fair return on the project investment. The No Project alternative would not provide 750 MW of new capacity and energy to the Los Angeles area, nor would it provide a potential energy savings to the State of California. Finally, the No Project alternative would not provide energy and capacity to the State of California electrical supply market.



Pastoria Energy Facility	**Figure 3.11-1.** LOCATION OF ALTERNATE SITES CONSIDERED FOR PASTORIA ENERGY FACILITY	1999
Pastoria Energy Facility, LLC		

SAFETY AND RELIABILITY
(SECTION 4.0 FROM 99-AFC-7)

4.1 FACILITY SAFETY

4.1.1 Natural Hazards

The primary natural hazards of potential concern to a generating plant located in the general project area are seismic activity, wind, blowing sand and heat. This section discusses the risks presented by these natural hazards and design measures used to offset these risks. The proposed mitigation measures will ensure that natural hazards do not pose a significant risk to the Pastoria Energy Facility and its related linear facilities.

4.1.1.1 Seismic Hazards

The plant site and associated transmission line, pipelines, and access road are located at the southern end of the Great Valley Physiographic Province of California. The plant site area is located on the north-dipping surface of the alluvial fan of Pastoria Creek about 1 mile north of the mouth of Pastoria Canyon at the foot of the Tehachapi Mountains. The regional geologic structure is dominated by a number of large faults. In general, the geologic structure reflects right-lateral strike-slip movement of the Pacific Crustal Plate relative to the North American Crustal Plate, primarily across the northwest trending San Andreas Fault. The San Andreas Fault system is located approximately 15 miles from the plant site at its closest approach. Both the White Wolf Fault and the Pleito Fault, which has been mapped less than 1 mile south of the site, have been zoned as Earthquake Hazard Zones by the State of California. Other faults in the general project region are illustrated and discussed in Section 5.3 (Geological Hazards and Resources).

Strong seismic shaking is the most substantial hazard that can be expected in the project area. Other potential geologic hazards include liquefaction, slope failure, seismically-induced settlement, subsidence, collapsible soils, expansive soils, flooding, and erosion and sedimentation.

Site Conditions. A site-specific Geotechnical Investigation Report has been conducted and the results will be considered prior to the completion of the final design of the plant. The Geotechnical Investigation Report is provided as Appendix L.

Section 5.3 provides a detailed discussion of the geological characteristics in the vicinity of PEF that present a seismic risk to the generating plant and its linear facilities. To protect these facilities from seismic risks, all design and construction will be in conformance with current California Code Seismic Zone 4 requirements. The structural and seismic engineering

design criteria to be used for the project are included in Appendix D, Structural and Seismic Engineering Design Criteria.

4.1.1.2 Wind and Dust Hazards

All buildings will be designed for wind loads as stated in the current edition of the CBC. Particular care will be taken to minimize sand and grit intrusion for areas that will be occupied by personnel and for the main equipment locations. Buildings and equipment enclosures will be designed to minimize dust intrusion. Temporary structures will be erected to protect equipment during major overhauls and other maintenance that may require opening of the turbine enclosures.

If needed during construction, the use of wind breaks similar to a snow fence will reduce, but not stop the flow of sand blown by wind. Other techniques will include the use of water over the surface to enhance dust control, constructing temporary enclosures to reduce wind effect, and timely re-vegetation of barren construction areas.

4.1.1.3 Heat

All buildings will be designed with the appropriate climate-controlled environment for protection of personnel and equipment. This will include air conditioning, insulation, landscaping, overhead covers, ventilation, appropriate use of glass, and color selection to reduce heat retention.

4.1.2 Safety Precautions and Emergency Systems

Safety precautions and emergency systems will be implemented as part of design and construction to ensure safe and reliable operation of project facilities. Administrative controls will include classroom and hands-on training in operating and maintenance procedures and general safety items, and a well-planned maintenance program. These will work with the system design and monitoring features to enhance safety and reliability.

Safety, auxiliary, and emergency systems will consist of lighting, direct current (DC) backup for controls, fire and hazardous materials safety systems, security systems, and natural gas, steam, and chemical safety systems. The plant will include its own utilities and services such as emergency power, plant and instrument air, fire suppression, and potable water systems.

The laws, ordinances, regulations and standards that are applicable or potentially applicable to the Project, in context of the public and occupational safety and health protection measures, are addressed in Section 7.0.

4.1.2.1 Safety Precautions

4.1.2.1.1 Worker Safety. PEF will implement programs to assure that compliance with federal and state occupational safety and health program requirements is maintained. In addition to compliance with these programs, PEF will identify and implement plant specific programs that effectively assesses potential hazards and mitigate them on a routine basis.

A more complete discussion of worker safety is provided in Section 5.17.

4.1.2.1.2 Hazardous Materials Handling. Hazardous materials will be stored and used at PEF during both construction and operation. Design and construction of hazardous materials storage and dispensing systems will be in accordance with applicable codes, regulations, and standards. Hazardous materials storage areas will be curbed or diked to contain spills or leaks.

Potential hazards that are associated with hazardous materials will be further mitigated by implementing a hazards communication (HAZCOM) program. This program involves thorough training of employees on proper identification, handling and emergency response to spills or accidental releases.

Emergency eyewashes and showers will be provided at appropriate locations. Appropriate Personnel Protective Equipment (PPE) will be provided during both construction and operation of the Facility. A more detailed discussion of hazardous materials handling is presented in Section 5.15.

4.1.2.1.3 Security. The plant site will be enclosed by a security fence. Access gates will be provided as required. In addition to the perimeter security fence, the substation and transformer area will be fenced and provided with access gates. Security will be maintained on a 24-hour basis with either surveillance devices or personnel.

4.1.2.1.4 Public Health and Safety. The programs implemented to protect worker health and safety will also benefit public health and safety. Facility design will include controls and monitoring systems to minimize the potential for upset conditions that could result in public exposure to acutely hazardous materials. Potential public health impacts associated with operation of the project will be mitigated by development and implementation of an Emergency Response Plan, a Hazards Communication (HAZCOM) Program, a Spill Prevention Control Plan, safety programs, and employee training.

PEF will coordinate with local emergency responders, provide them with copies of the plant site Emergency Response Plan, conduct plant site tours to point out the location of hazardous materials and safety equipment, and encourage these providers to participate in annual emergency response drills.

4.1.2.2 Emergency Systems

4.1.2.2.1 Fire Protection Systems. PEF will have onsite fire protection systems and will be supported by local fire protection services. Section 3.4.11 includes a detailed description of the fire protection systems.

Portable and fixed fire suppression equipment and systems will be included in the project. Portable fire extinguishers will be located at strategic locations throughout the project site. Smoke detectors, sprinkler systems, and fire hydrants with hoses will be utilized. Based on detailed design, the fixed fire protection system may also include a carbon dioxide or a deluge spray system.

Employees will be given fire safety training, including instruction in fire prevention, the use of portable fire extinguishers and hose stations, and reporting fires to the local fire department. Employees will only suppress fires in incipient stage. Fire drills will be conducted at least twice each year for each work area.

Kern County Fire Department Station 54, located approximately 20 miles away in Lebec, will provide primary fire protection, fire fighting, and emergency response services to the PEF site. The County Fire Marshall will perform a final fire safety inspection upon completion of construction and, thereafter, will conduct periodic fire safety inspections. Prior to start-up the Fire Department will be requested to visit the project site to become familiar with the site and with project emergency response procedures.

4.1.2.2.2 Emergency Response. PEF will have an Emergency Response Plan. The Emergency Response Plan will address potential emergencies, including chemical releases, fires, and injuries, and will describe emergency response equipment and its location, evacuation routes, procedures for reporting to local emergency response agencies, responsibilities for emergency response, and other actions to be taken in the event of an emergency.

Employee response to an emergency will be limited to an immediate response to minimize the risk of escalation of the accident or injury. Employees will be trained to respond to fires, spills, earthquakes, and injuries. A first-aid facility with adequate first-aid supplies and personnel qualified in first-aid treatment will be provided on-site.

4.1.3 Aviation Safety – Power Generation Facility Stacks

The Federal Aviation Administration Regulations, Part 77, establishes standards for determining obstructions in navigation space and sets forth requirements for notification of proposed construction. These regulations require notification of any construction over

200 feet in height above ground level. The closest airfield with regularly scheduled commercial flights is Bakersfield, approximately 35 miles away.

The three planned power stacks will extend no more than 213 feet above ground. A Notice of Construction or Alteration may be required to be filed with the FAA. The stacks will be marked with emergency lighting as required by FAA rules. Local conditions, such as crop dusting operations, will be reviewed to determine the need for other aviation safety markings.

4.2 TRANSMISSION LINE SAFETY AND NUISANCE

4.2.1 Transmission Line Description

A double-circuit 230 kV transmission line, rated at 750 MW capacity, will be required to deliver PEF electric output to the Southern California Edison (SCE) transmission grid. The connection to the grid will be made at Pastoria Substation. The transmission line will consist of approximately 1.38 miles of new line construction (see Map 3.2-1).

4.2.2 Aviation Safety – Transmission Line

The new line will run parallel to the existing SCE transmission lines and will not add any new safety concerns for crop dusting operations.

The Federal Aviation Regulations, Part 77, establishes standards for determining obstructions in navigation space and sets forth requirements for notification of proposed construction. These regulations require notification of any construction over 200 feet in height above ground level. Notification is also required if the obstruction is less than specified heights and falls within the restricted airspace in the approach to airports. For airports with runways greater than 3,200 feet, the restricted space extends 20,000 feet (3.2 nautical miles) from the runway. For airports with runways 3,200 feet or less, the restricted space extends 10,000 feet (1.6 nautical miles).

Supporting structures for the proposed 230 kV transmission line will be less than 120 feet and will not encroach into restricted space. Therefore, the Notice of Construction or Alteration filing with the FAA is not required.

4.2.3 Audible Noise and Radio Interference

An electric field is generated in the air surrounding a transmission line conductor when the transmission line is in operation. A corona discharge occurs at the conductor surface when the intensity of the electric field at the conductor surface exceeds the breakdown strength of the surrounding air. The electrical energy released from the conductors during this process is known as corona loss and is manifested as audible noise and radio/television interference.

Energized electric transmission lines can also generate audible noise by a process called corona discharge, most often perceived as a buzz or hum. This condition is usually worse when the conductors are wet. The Electric Power Research Institute (EPRI) has conducted several transmission line tests and studies which measured sound levels for several power line sizes with wet conductors *(Transmission Line Reference Book, 345 kV and Above,* EPRI, 1975,1982). The *Transmission Line Reference Book, 345 kV and Above* also notes that the noise produced by a conductor attenuates (decreases) by two to three decibels (dB) for each doubling of the distance from the source.

Radio and TV interference, known as gap-type noise, is caused by a film on the surface of two hardware pieces that are in contact. The film acts as an insulator between the surfaces. This results in small electric arcs that produce noise and interference. This type of noise is not a problem in well-maintained transmission lines. Well-trained transmission line maintenance crews will maintain the project transmission line; therefore, problems that might occur can be readily pinpointed and corrected. Further, it is unlikely that the project transmission line would have any effect on radio or television reception, particularly noting the distance to the nearest residential development.

There are many factors contributing to the pre-project ambient noise levels in the plant area. The project transmission line will be designed such that noise from the line will continue to be well below undesirable levels. Any noise or radio/TV interference complaints will be logged, investigated and, to the degree possible, mitigated.

4.2.4 Induced Currents and Hazardous/Nuisance Shocks

4.2.4.1 <u>Introduction</u>

Touching metallic objects near a transmission line can cause hazardous or nuisance shocks, if it is not properly constructed. Since the electric fields of the transmission line are negligible above ground, and the line is built in conformance with California Public Utility Commission General Order 95 requirements and Title 8 CCR 2700 requirements, hazardous shocks are highly unlikely to occur as a result of the project construction and operation.

4.2.4.2 <u>Introduction: Electromagnetic Fields (EMF)</u>

EMF occur independently of one another as electric and magnetic fields at the 60-Hz frequency used in transmission lines, and both are created by electric charges. Electric fields exist when these charges are not moving. Magnetic fields are created when the electric charges are moving. The magnitude of both electric and magnetic fields fall off rapidly as the distance from the source increases (proportional to the inverse of the square of distance). For the PEF transmission line, the EMF levels are minimized by the phase-reversing

configuration of the double-circuit-tower line, as shown in Figure 3.6-3. Calculations of EMF are presented in Appendix P.

Transmission lines, distribution lines, house wiring, and appliances generate electric fields in their vicinity because of unbalanced electrical charge on unshielded energized conductors. Electric fields are expressed in volts per meter (V/m) or kilovolts (thousands of volts) per meter (kV/m).

Once electric currents are in motion they create magnetic fields. The strength of the magnetic field is proportional to the magnitude of the current in the circuit. Magnetic fields can be characterized by the force they exert on a moving charge or on an electrical current. A magnetic field is a vector quantity that is characterized by both magnitude and direction. Electric currents are sources of magnetic fields. Magnetic fields are measured in milligauss.

At the ground under a transmission line, the electric field is nearly constant in magnitude and direction over distances of a few meters. However, in close proximity to the transmission or distribution line conductors, the field decreases rapidly as distance from the conductor increases. Similarly, near small sources such as appliances, the field is not uniform and falls off even more rapidly with distance from the device. If an energized conductor is inside a grounded conducting enclosure, then the electric field outside the enclosure is zero and the source is said to be shielded.

In January 1991, the CPUC issued an Order Instituting Investigation (I.91-01-012, CPUC 1991) into the potential health effects from electric and magnetic fields emitted by electric power and cellular telephone facilities. In September 1991, the assigned CPUC Administrative Law Judge issued a ruling that created the "California EMF Consensus Group." This group of representatives form utilities, industry, government, private and public research, and labor organizations submitted a document entitled "Issues and Recommendations for Interim Response and Policy Regarding Power Frequency EMF's" on March 20, 1992 (California EMF Consensus Group 1992). Regarding the relevant policy consensus recommendation titled "Facility Siting," the group stated that the CPUC should recommend that utilities take public concern about electromagnetic fields into account when sitting new electric facilities. Although this group could not conclude that there is a relationship between EMF and human health effects, they also could not conclude that this relationship does not exist to any extent; therefore, they recommended that the CPUC authorize further research.

California does not presently have a regulatory level for magnetic fields. However, the values estimated for the project are well below those established by states that do have limits. Other states have established regulations for magnetic fields strengths that have limits ranging from 150 milligauss to 250 milligauss at the edge of the right-of-way, depending on voltage. The CEC does not presently specify limits on magnetic fields for 230 kV transmission lines.

4.2.4.3 Electric Fields: Project Effects

The magnetic fields of the project are largely determined by the line voltage and the distance of conductors from the point of measurement. Conducting objects such as vegetation, the earth or buildings perturb or distort the field and can in some cases act as shields which significantly reduce electric field levels. Increasing the distance from the conductors of the transmission line to potential receptors is the most effective way to reduce electric field effects in overhead transmission lines.

The electric field strengths from the proposed transmission line are estimated to be insignificant. While California does not have any regulatory level, these expected levels are well below those levels established by states that do have regulatory limits. States with regulations have ranges from 1.0 kV/m to 2.0 kV/m at the edge of the right-of-way to 11 kV/m within the right-of-way, depending on the line voltage. The CEC does not presently specify limits on electric fields for 230 kV transmission lines.

4.2.4.4 Magnetic Fields: Project Effects

Unlike the electric fields, magnetic fields are not necessarily perturbed or shielded by most common objects. Increasing the distance from the conductors of the transmission line to potential receptors is the most effective way to reduce magnetic field effects in overhead transmission lines. The height of overhead transmission lines above the ground level provides for a reduction in magnetic fields. The conductor phases of the proposed double-circuit tower line will be configured so that currents among the conductors will have a canceling effect on the total magnetic field produced by the circuits. This configuration is illustrated in Figure 3.6-3.

4.3 RELIABILITY AND AVAILABILITY

This section discusses the expected facility availability, equipment redundancy, ability to respond to varying utility needs for power, maintenance program, fuel availability, water availability, and project quality control measures.

4.3.1 Facility Availability

The Pastoria Energy Facility will employ heavy duty frame gas turbines fueled by natural gas. Gas turbines with natural gas firing have proven in the past few years to provide much higher availability than other types of power plants of comparable size. Generating plants with heavy frame gas turbines operating in continuous service have commonly demonstrated operating availability well above 90 percent over several years.

4.3.1.1 Range of Availability

Overall availability varies from year to year because of both random causes and the structure of the overhaul cycle. Forced unavailability changes somewhat from year to year because the numbers and lengths of forced outages vary in a random way. Planned unavailability varies also, but in a more predictable fashion, because the overhaul cycle requires different amounts of down time in different years. Typically, gas turbines are overhauled on a 6-year cycle with relatively short outages (on the order of one week to 10 days) in years 1, 2, 4 and 5, a somewhat longer outage (on the order of 2 to 3 weeks) in year 3, and a major outage (on the order of 4 to 7 weeks depending on size) in year 6. The gas turbine work usually controls the planned outage length. In years 1, 2, 4 and 5 the availability of each of the Pastoria Energy Facility units expressed as a percent can be expected to be in the mid 90's, in year 3 in the upper 80's to mid 90's, and in year 6 in the low to upper 80's. However, all of the planned outage work will be performed in the spring season and most other maintenance and repair work will be performed during off-peak hours (all of each weekend and 8 hours per night weekdays).

4.3.1.2 Basis for Forecasts of Availability

There has been insufficient operating time on advanced technology gas turbines, such as the ABB GT-24 or the GE 7FA or others of equivalent output that are candidates for selection, to provide hard data on their forced outage factors or maintenance and planned outage times.

4.3.1.2.1 Forced Outage Factor. Combined cycle units in continuous duty service with one advanced technology turbine-generator operating in continuous service have an equivalent forced outage factor (FOF) of 2.5 percent or less for the entire combined cycle.

The equivalent FOF for the Frame F alone is 1.5 percent or less. Several components of a Frame F can be responsible for a forced outage. Most forced outages in heavy frame gas turbines of mature design are caused by their auxiliaries and controls. The heavy rotation machinery in mature gas turbine designs rarely experience catastrophic failure and hence forced outage. Any developing damage is usually found during the regular inspections, and the affected part is replaced with little delay.

Finally, dry low NO_x combustors are fairly complex and can slow the disassembly and reassembly of the gas turbine. Data from equipment suppliers indicate that such combustors have increased the gas turbine repair times and thus the system forced outage factor by about 0.5 percent. The balance of plant and support systems are assumed to have installed spare pumps typical of combined cycle plants now operating and the equivalent FOF associated to them is less than 0.5 percent. The equivalent FOF for the steam turbine (STG) and balance of plant is 1.0 percent or less. The STG does not operate under the same rigorous conditions as the CTG. Therefore, the opportunity for a forced outage is not as prevalent.

4.3.1.2.2 Planned Outage Factor and Maintenance Outage Factor. The Planned Outage Factor and Maintenance Outage Factor include minor maintenance, off-line water washing, and planned maintenance outages. The planned outages (combustion inspection in years 1, 2, 4 and 5, hot gas path inspection in year 3 and major inspection in year 6) involve disassembly of the gas turbine to various degrees. Time for each inspection varies among manufacturers. Inspection duration is also dependent on the size of the maintenance crew and duration of work shifts. The experience with Frame F planned outages and interim maintenance permits high confidence in the forecasts of time required for both planned outages and minor maintenance.

4.3.1.3 Degradation in Output from Fouling and Wear

All gas turbines degrade in output from their new and clean condition because of fouling and wear. "Nonrecoverable" degradation from equipment wear increases rapidly in the first few thousand fired hours and then slows. Virtually all of the degradation due to wear will be recovered during the major overhaul conducted at the end of 6 years. Degradation due to fouling is corrected by frequent on-line and less frequent off-line waterwashing. The steam turbine also degrades, but at a slower rate and with a smaller impact.

4.3.1.4 Summary of Availability

The Pastoria Energy Facility is expected to provide a high availability and be more responsive than most generation facilities to the needs of the system for power during periods of peak load, and particularly in periods of high ambient temperature. Its outage rates are expected to be low. Planned outages will be taken in spring, and almost all other outages will occur during off-peak periods.

4.3.2 Equipment Redundancy

The following subsections identify equipment redundancy as it applies to project availability (see Table 4.3-1).

4.3.2.1 Combined-Cycle Power Island

The power island proposed for the PEF facility incorporates three heavy-duty combustion turbine generators (CTGs), each exhausting to a heat recovery steam generator (HRSG), and two steam turbine generators (STG's). The power island is arranged in two combined cycle power trains. Steam from two CTG/HRSG power feeds one STG (2x1 configuration). Steam from the third CTG/HRSG power block drives a second STG (1x1 configuration). Crossover piping may be installed to allow sharing of steam between the two power trains. Each STG

exhausts to a condenser where steam is condensed at low absolute pressure and steam recovered as condensate.

Operating at base load the power island produces 100 percent of the plant output. Failure of one CTG or HRSG will reduce plant output by 34 percent. The other two CTG/HRSG trains will continue to provide 66 percent of the plant output. Failure of both the STGs, feedwater supply, or combined steam delivery system will cause the plant to shut down since it is not designed to operate in the simple cycle mode.

4.3.2.1.1 <u>Combustion Turbine</u>. The combustion turbine-generator subsystems include the combustion turbine, inlet air cooling system, lube oil system, starting system, generator and excitation systems, and combustion turbine control and instrumentation. Redundancy is provided in combustion turbine subsystems where practical. For example, the lube oil system consists of redundant pumps, filters, and coolers, but redundant bearings are obviously impractical. The microprocessor based control system consists of redundant microprocessors, as well as redundant sensors for critical measurements. Technology advancements, as well as redundancy as illustrated above, have led to extremely high reliability for the combustion turbines considered for this project.

4.3.2.1.2 <u>Steam Turbine Generator</u>. The STG subsystems include the steam turbine generator and excitation system, lube oil system, and steam turbine control and instrumentation. Redundancy is provided in steam turbine subsystems where practical. For example, the lube oil system consists of redundant pumps, filters, and coolers. The microprocessor based control system consists of redundant microprocessors, as well as redundant sensors for critical measurements. Technology advancements, as well as redundancy as illustrated above, have led to extremely high reliability for the steam turbines considered for this project.

4.3.2.1.3 <u>Heat Recovery Steam Generators</u>. The HRSG subsystems include feedwater stop and check valves; steam stop valves; relief valves; continuous and intermittent blowdown valves; selective catalytic reduction (SCR); multiple shell and tube heat exchangers, and control instrumentation. Subject to final equipment selection, it is expected that the system will require HP, IP and LP sections each consisting of an economizer, evaporator, and superheater section. If a heat exchanger needs repair, it can be taken out of service and the remaining system can operate at a reduced capacity.

4.3.2.2 <u>Balance-of-Plant Systems</u>

The power island is served by the following balance-of-plant systems:

- **Boiler Feed System:** There is a separate boiler feed system for each HRSG. The HRSG low-pressure, intermediate pressure and high-pressure feed systems transfer feedwater

from the condenser hotwell to the high-pressure (HP), intermediate pressure and low-pressure (LP) sections of the HRSG using two 100 percent capacity condensate pumps and two 100 percent capacity boiler feed pumps per HRSG.

- **The Condensers:** The condensers are expected to be single shell, two pass, non-divided water box. The tube surface is designed with extra capacity for fouling and to permit plugging of leaking tubes so that complete repair can be accomplished during scheduled outages. The condenser air removal system consists of steam jet air injectors for both hogging and holding of condenser vacuum.

- **Cooling Towers and Circulating Water System:** The cooling towers cool the circulating water and make it suitable for cooling the condensers and auxiliary equipment. Three, 50 percent capacity circulating water pumps per cooling tower bank serve the combined power island. At high ambient temperatures the STG's and CTG's may be operated at reduced loads if one or more of the cooling tower cells is curtailed. A total of twenty-four (24) cells in the cooling tower provide cooling capacity required for high steam turbine efficiency.

- **Auxiliary Cooling Water System:** This system provides water for cooling plant components and rejects heat to the circulating water system via two 50 percent circulating pumps.

- **STG Cycle Make-up and Storage System:** This system transfers water from a demineralizer to the make-up feedwater for the HRSG. Redundancy is provided for the pumps. In addition, the storage capacity in the demineralized water storage tank provides adequate feedwater make-up capacity to allow repairs should the demineralized water supply be interrupted.

- **Compressed Air:** The compressed air system supplies dry compressed air at the required pressure and capacity for all instrument air demands, including pneumatic controls, transmitters, instruments, and valve operators. The system will include two 100 percent capacity air compressors and one 100 percent capacity, dual tower, desiccant air dryer with pre-filters and after-filters, an air receiver, instrument air headers, and distribution piping. The dual towers of the air dryer do not provide the usual effect of 100 percent redundancy because one will be unavailable much of the time while it undergoes regeneration.

4.3.2.3 Distributed Control System (DCS)

The distributed control system will be a redundant microprocessor-based system that will provide control, monitoring, and alarm functions for plant systems and equipment. The following functions will be provided:

- Control the heat recovery steam generator and other systems in response to unit load demands (the gas turbine-generator has its own control system)

- Provide control room operator interface

- Monitor plant equipment and process parameters and provide this information to the plant operators in a meaningful format.

- Provide usual and audible alarms for abnormal events based on field signals or software-generated signals from plant systems, processes, or equipment

- The DCS will have functionally distributed architecture comprised of a group of similar redundant processing units linked to a group of operator consoles and an engineering workstation by redundant data highways. Redundant processors will be identically programmed to perform the specific tasks for control information, data acquisition, annunciation, and historical purposes. Because of this redundancy, no single processor failure can cause or prevent a unit trip. Experience with similar systems has been that simultaneous malfunctions of two or more processors or, more important, between the DCS and the controlled equipment is extremely remote.

4.3.3 Fuel Availability

4.3.3.1 Source of Natural Gas Supply

The fuel for the Pastoria Energy Facility will be natural gas from the Kern River/Mojave pipeline. The Kern River Gas Transmission Company and Mojave Pipeline Company initiated service in 1992. The Kern River Pipeline stretches 900 miles from Opal, Wyoming to Kern County, California, with a 700 MMcf/day capacity. The Mojave pipeline originates in Topock, Arizona, connecting with El Paso's interstate pipeline and runs 370 miles to Kern County, California. The capacity of the Mojave-Kern pipeline is 400 MMcf/day.

The Kern River and Mojave pipelines interconnect near Daggett, California in a jointly owned pipeline with a capacity of 1100 MMcf/day. The Kern/Mojave pipeline is divided into two laterals: the east side lateral serves Kern County's east-side oil fields; the west lateral extends to McKittrick and interconnects with SoCal Gas at Wheeler Ridge. PEF will be served by the west-side lateral, which passes within 6 miles to the north of the site.

4.3.3.2 Availability of Gas

As stated in the CEC's 1995 natural gas market outlook, California has a total natural gas resource base of 1,056 trillion cubic feet (TCF) for surrounding basins. This resource base is

expected to satisfy current production levels for the next 60 years. Therefore, sufficient supplies of natural gas are projected to be available throughout the life of the project. Further, new pipelines have increased the supply diversity into the region through new access routes to multiple supply basins. These activities have largely eliminated the risk of supply curtailment in the region and have allowed access to more competitively priced supplies.

4.3.4 Water Availability

PEF will obtain water supplies from Wheeler Ridge-Maricopa Water Storage District (WRMWSD) as a customer in a new rate class that WRMWSD is creating for customers with high reliability requirements (see Appendix S, WRMWSD Letter). WRMWSD will serve PEF with water from the aqueduct when supplies are available and will pull water from its underground storage banks to serve the project when water supplies from the aqueduct are inadequate (see Table 3.4.8-6 for a list of the types of water available to WRMWSD from the aqueduct).

WRMWSD is a public agency with an elected Board of Directors. WRMWSD was created to provide water service to the south central region of Kern County. WRMWSD receives the majority of its water from the California Aqueduct and delivers that water to its primarily agricultural customer base. Since the aqueduct was complete, it has never been taken out of service.

WRMWSD's customers currently have surface water entitlements of approximately 197,000 acre-feet and they use approximately 190,000 acre-feet of that entitlement in a normal year. During dry years, the availability of water may be reduced. In such circumstances, WRMWSD and its customers are required to reduce their demand for surface water and/or supplement surface supplies with groundwater. Since most of WRMWSD's customers are agricultural, some customers reduce water demand by adjusting crop plans in dry years.

Just as the State of California has dry years, it also has wet years where the DWR has significant excess water. WRMWSD has always sought to obtain this excess water and to store this water in the underground aquifers as a buffer against dry years. This water storage banking reduces the impact and hardships to its customers that occur during dry periods. WRMWSD has had an ongoing practice of identifying, developing and using water banks and has stored approximately 1 million acre-feet of water. During dry years, WRMWSD will pump from groundwater banks to customers located convenient to the well sites, allowing WRMWSD to divert the reduced aqueduct water to other customers that are not as conveniently located.

As part of its ongoing water banking program, WRMWSD has identified a groundwater recharge area, located approximately 1.5 miles north of the site, as a new water bank. WRMWSD has conducted a demonstration project that has successfully recharged and stored

approximately 2,900 acre-feet of water in this bank. WRMWSD would like to increase the banking storage rate but is limited by its water distribution network. To resolve this problem, WRMWSD has determined that it is necessary to construct a 54-inch pipeline from the aqueduct to the basin in order to increase the water banking rate. This pipeline has been sited approximately 250 feet west of the site as shown on Figure 3.1-6.

4.3.5 Project Quality Control

This section summarizes the Quality Program that will be applied to the project. The objective of the Quality Program will be to maximize confidence that systems and components will be designed, fabricated, stored, transported, installed, and tested in accordance with the technical codes and standards appropriate for a power plant.

4.3.5.1 Quality Assurance

The Project Quality Program activities will generally be divided into the following stages:

- **Conceptual Engineering** - Typical activities include technical screening studies, preliminary evaluation of permitting requirements, developing plant cycle design criteria, estimating plant performance, definition of site specific characteristics, and estimating the plant capital costs to support economic studies. The Owner's Engineer performs this work.

- **Detailed Design** - Typical activities include preparation of specifications, drawings, lists and other technical data needed to describe, illustrate, or define systems, structures, or component of the plant. This work will be performed by a firm duly qualified and licensed in the State of California. Firms will be selected through a competitive procurement process administered by the Owner. It is anticipated that multiple contracts will be required to support design and construction of the plant and its associated linears. The Owner's Engineer will remain active during the project to review document packages and an execution approach for conformance with CEC's Certificate of Compliance requirements and the conceptual design.

- **Procurement Specification Preparation** - Work includes preparing and issuing formal, documented packages for suppliers of equipment, material or services. The specifications are reviewed by the Owner's Engineer prior to issuance for compliance with the project's technical and commercial requirements. The supplier's proposals are formally evaluated against the package before a purchase order or contract is awarded.

- **Supplier's Control and Surveillance** - Typical activities are those that the suppliers perform as required by their purchase order. These activities assure that the products or services to be provided conform to the requirements of the purchase order or contract.

- **Supplier Data Review** - These activities, to be performed by the Contractor that issues the purchase order, include reviewing selected supplier drawings, data, instruction, procedures, plans, and other documents to monitor conformance to the requirements of the purchase order or contract. Visits to supplier shops will be conducted as appropriate, as will visits by the Owner and/or the Owner's Engineer when required.

- **Shipping and Receipt Inspections** - These activities are the responsibility of the contractor and will generally be performed during construction. They include inspection and review of products during manufacture and/or at the time of shipment and delivery to the construction site. The Owner's Engineer will perform surveillance of this process.

- **Construction/Installation** - These activities include inspection and review of the construction storage, equipment and component installation, cleaning and initial testing of systems and components at the plant site. The Owner's Engineer will perform reviews and checks of the quality of work being installed and the systems and procedures used by the EPC Contractor to monitor the work being installed.

- **System/Component/Plant Testing** - These activities are performed by the EPC Contractor and witnessed by the Owner's Engineer. This ensures that the plant is first tested, then commissioned and started up in a documented and controlled manner. This is done to confirm system safety, and that the performance of systems and components conforms to the technical requirements and all guarantees. All such work is to be documented in detail.

4.3.5.2 Quality Control Records

The following quality control records will be maintained, as a minimum, for review and reference:

- Approved Environmental Permits
- Required Building Permits
- Project Procedures and Instruction Manual
- Design Calculations and Equipment Specifications
- Project Design Basis and Criteria
- Quality Assurance Audit Reports
- Piping and Instrument Diagrams
- One-Line and Three-Line Diagrams
- Conformance to Construction Record Drawings
- Procurement Specifications (Contract Issuance and Charge Orders)
- Purchase Orders and Charge Orders
- Contractor/Supplier's Quality Assurance and Quality Control Records.

For equipment purchase orders or services contracts, the EPC Contractors will prepare a list of qualified suppliers and subcontractors. Before a purchase order or contract is awarded, contractors will evaluate supplier/subcontractor track record, financial condition, personnel capability, past project performance and quality program. The evaluation may also include a survey of the supplier's facilities.

The Contractor will be responsible for providing documentation of all work performed in accordance with the quality requirements specified in the Contract between the Owner and the Contractor.

TABLE 4.3-1

MAJOR EQUIPMENT REDUNDANCY
2 x 1/ 1x1 CONFIGURATION

Quantity	Description	Size/Capacity[1]	Remarks[2]
3	Combustion Turbine	168 MW	N/A
2	Steam Turbines	185/90 MW	2x1 Configuration/1x1 Configuration
5	Generators		Sized to match CTs and STs
3	CT Inlet Air Filter	3,600,000 lb./hr	Evaporative/Refrigeration/Fogging
3	Inlet Air Cooling		N/A
3	Fuel Gas Filter – Separator	150,000 lb/hr	2 operating, 1 spare
1	Turbo Expander	230,000 lb/hr	
3	Heat Recovery Steam Generator (HRSG)	550,000 lb/hr	N/A
3	HRSG Stack		N/A
3	Catalytica – CO Emission Control		N/A
3	Catalytica – NO_x Emission Control		N/A
(3)	(Ammonia Injection Skid)		N/A - Alternate
(3)	(Aqueous Ammonia Storage Tanks)	(20,000 gal.)	N/A - Alternate
6	HP/IP HRSG Feedwater Pumps	1,700 gpm	1 operating, 1 spare – per unit
1	Make-up Water Clarifier	5,600 gpm	Gravity Flow
1	Make-up Water Storage Tank	2,300,000 gal	Includes Firewater Storage
3	Demineralized Water Pumps	170 gpm	2 operating, 1 spare
1	Demineralized Water Treatment Package	350 gpm	N/A
1	Demineralized Water Storage Tank	150,000 gal	N/A
5	Condensate Pumps	300 gpm	1 operating, 1 spare 2 operating, 1 spare (2x1 Configuration/1x1 Configuration)
6	Circulating Water Pumps	60,000 gpm /30,000 gpm	2 operating, 1 spare (2x1 Configuration/1x1 Configuration)
2	Wet Cooling Towers	1,100mm BTU/hr 600mmBTU/hr	2x1 Configuration/1x1 Configuration
1	Fire Water Pump Skid	3,000 gpm	N/A
3	Auxiliary Cooling Water Pump	750 gpm	2 operating, 1 spare
2	Plant Air Compressor & Dryer	750 cfm	1 operating, 1 spare
4	Step-up Transformers	18/230 kV	N/A
1	Stand-By Generator	600KW	Natural Gas Fired

[1] Approximate Size/Capacity for each piece of equipment. Final sizing and configuration will be determined during detailed design.
[2] N/A = 100% Utilization required.
( ) = Applicable to SCR alternative only.

CIVIL ENGINEERING DESIGN CRITERIA
(APPENDIX C FROM 99-AFC-7)

APPENDIX C

CIVIL ENGINEERING DESIGN CRITERIA AND CIVIL 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.

The edition and/or addenda to a law, ordinance, code, or standard that has been adopted and is in place at time of plant design and construction shall apply to work performed for this Facility.

2.1 FEDERAL

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.

2.2 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.

- 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 five 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.

- State of California Department of Transportation (Caltrans), Standard Specifications

- Title 24, California Code of Regulations (CCR) 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 6T8-5465, 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, CCR, Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq. Describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.

2.3 COUNTY

- Kern County Ordinances.

2.4 CODES AND INDUSTRY STANDARDS

The following general design requirements and procedures will be followed in development of project specifications regarding the use of Codes and Industry Standards:

- 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) and, with public facilities, appropriate public agency standards.

- 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 Uniform Plumbing Code (UPC).

- Occupational Safety and Health Administration (OSHA and CALOSHA).

The following Codes and Industry Standards shall be used:

- California Energy Commission (CEC). "Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California".

- International Conference of Building Officials. "Uniform Building Code" (UBC).

- California Building Code.

- 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).

  - “Standards for Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids” (AWWA C301).

  - “Standards for Reinforced Concrete Water Pipe, Non-cylinder Type, Not Prestressed” (AWWA C302).

  - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water Distribution (C900-1997).

  - Polyvinyl Chloride (PVC) Pressure Pipe, 14 inch through 36 inch, for Water Distribution (C905-1997)

- Asphalt Institute Pacific Coast Division. Asphalt Institute Handbook.

2.5 ENGINEERING GEOLOGY CODES AND STANDARDS

The site development activities will require certification during and following construction. The Geotechnical Engineer and Engineering Geologist will certify the placement of fills and the adequacy of the site for structural improvements in accordance with the Uniform Building Code (UBC), Chapter 70. The Geotechnical Engineer will address Sections 7006 (Grading Plans), 7009 (Cuts), 7010 (Fills), 7011 (Setbacks), 7012 (Terraces), 7013 (Erosion Control), and 7015 (Final Reports) of UBC, Chapter 70, The Engineering Geologist will address Sections 7006 (Grading Plans), 7009 (Cuts), 7012 (Terraces), 7013 (Erosion Control), and 7015 (Final Reports) of UBC, Chapter 70. Additionally, the Engineering Geologist will present findings and conclusions pursuant to PRC, Section 25523 (a) and (c); and 20 CCR, Section 1752 (b) and (c).

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

Federal

None are applicable.

State

The Warren-Alquist Act (PRC Section 25000 et seq.) and the CEC Siting Regulations (20 CCR Chapter 2) require that Applications for Certification address geologic and seismic issues. Detailed geologic and seismic information must be provided with respect to safety and reliability concerns and environmental impacts.

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

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. Seismic and geologic hazard plans and regulations are often addressed under the seismic safety elements of general plans or in local building and grading ordinances.

Industry Codes and Standards

In addition to the California Codes discussed above, other laws, standards, and ordinances that typically pertain to engineering geology include:

- California Business and Professions Code Section 7835 requires registration for

geologists (including engineering geologists) who practice for others.

- Uniform Building Code (1994 edition) Chapter 23, Section 2311, pertains to Earthquake Regulations; Chapter 29 pertains to Foundations; and Chapter 70 to Excavation and Grading.

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 Uniform Building Code (UBC) will be used.

3.1 GEOTECHNICAL INVESTIGATION

3.1.1 General

Geotechnical exploration, testing, and analysis will establish parameters required in the engineering of foundations. Criteria will be established to permit the most economical design that is compatible with life expectancy and service of structures.

3.2 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.

3.2.1 Wheeled 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, HS20 loads will be used for the design of roadway subgrade. Equipment loading such as scrapers (loaded), crawler cranes, and equipment transport trailers could exceed the typical HS20 loadings. They 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 plant systems will be provided as needed for construction, operations, and maintenance. The plant will be located and oriented to minimize costs of construction, while remaining operationally effective. Utility interconnections will be optimized as much as practical. Spill containment measures will be provided. Treatment systems will be provided for facility wastewater streams, if required, before discharge. Sanitary wastewater will be

discharged to an on-site septic tank and leach field designed to state and local standards.

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. Site runoff will be collected by area inlets to an underground storm drain system that discharges to Pastoria Creek, just west of the site. Any site run off likely to contain oil will be routed through an oil-water separator.

The following criteria will be followed regarding site infrastructure:

- Oil and chemical storage areas will be designed to contain spills.
- Culverts and sanitary sewer manholes will be installed as required.
- Locations and requirements will conform to County Ordinances.

3.3.2 Grading and Drainage

The site grading and 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 whenever possible. The surface drainage system will consist of mild slopes. The buildings and structures will be located with the ground floor elevation a minimum of six inches above the finished grade. The preferred slope of the graded areas away from structures will be 1 percent with a minimum slope of 0.5 percent. A storm sewer system (inlets and underground pipes) will be provided in areas where ditches are not feasible.

Site drainage facilities will be designed to protect buildings and major equipment from a 100-year storm. Temporary facilities will generally be designed for a 2-year rainfall.

Runoff from possible oil and chemical contamination areas, such as the transformer areas and chemical storage and handling areas, will be contained. Storm water contained in these areas will be routed through an oil/water separator or neutralization basin.

The main plant area will be graded with moderate slopes (1 % minimum preferred) for effective drainage.

3.3.2.1 Excavation and Fill

Excavation and fill will be balanced to the maximum extent possible.

3.3.2.1.1 Excavation. In areas requiring excavation, earth material will be removed to the required lines and grades. Any undesirable material will be removed and disposed of in accordance with applicable regulations. The remaining in-situ material will be graded and compacted to the depth and density determined by detailed design. Excavated material that meets the design requirements will be used as general site fill where possible.

3.3.2.1.2 Fill. Compacted fill material will be obtained from on site excavations to the maximum extent possible. The material will be placed and compacted to the grades and density determined by the design. At least 95 percent compaction will be provided under and within five feet of the foundation footprint and 90 percent for other areas.

3.3.2.2 Drainage Ditches

Drainage ditches will be designed to convey the 10-year runoff flow without producing a headwater elevation above the bottom of the roadway base course.

3.3.2.3 Stormwater Drainage

A stormwater drainage system will be used. Inlets will be constructed of cast-in-place or pre-cast concrete with top grates. Stormwater pipes will discharge runoff to the nearest open creek, swale or channel. Stormwater pipes will be sized to limit flow velocities resulting from the 10-year rainfall event to a maximum of 15 feet per second (fps). A minimum design velocity of 2 fps will be used to facilitate cleaning. The minimum cover requirement will be three feet. Storm Water runoff shall be collected on site and conveyed to Pastoria Creek.

3.3.2.4 Pre- and Post-Development Runoff Conditions

The peak flow associated with the 100-year storm event at the site, before modifications (pre-development), will be compared to the after-construction (post-development) conditions. It is anticipated that the post development runoff will slightly exceed the pre-development runoff condition.

3.3.2.5 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 areas of the site. Existing, sparse 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, 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 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, drainage piping), surfaced traffic and work areas, and seeded non-working areas. These measures will minimize the possibility of any appreciable erosion of the resulting sedimentation occurring on the project site.

3.3.3 Traffic and Transportation

Access within the plant site and switchyard will be provided by separate roads. All roads will be appropriately surfaced during the construction period. Periodic watering or applications of a dust palliative material will be used to minimize dust problems.

The minimum radius to the inside edge of pavement or aggregate surface at intersections of the road will be in conformance with Kern County ordinances.

3.3.4 Fencing and Security

Chain link security fencing will be provided around the power plant facility site, switchyard, 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.

3.3.5 Landscape Plan

The landscaping plan for the site shall be performed as defined in the CEC Presiding Members Preliminary Decision (PDMD).

3.3.6 Sanitary Waste System

Sanitary wastes will be conveyed to an on-site septic tank and leaching field sewer system in conformance with Kern County ordinances.

3.3.7 Geotechnical Investigation

A Geotechnical Engineering Investigation for the project will be conducted during the early stages of engineering.

STRUCTURAL AND SEISMIC ENGINEERING DESIGN CRITERIA (APPENDIX D FROM 99-AFC-7)

APPENDIX D

STRUCTURAL AND SEISMIC ENGINEERING DESIGN CRITERIA

1.0 INTRODUCTION

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
- Start-up, 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 engineering, design and construction. These criteria form the basis of the design for the structural components and systems for the project More specific design information will be developed during the detailed design phase to support equipment procurement and construction specifications. Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general criteria for natural phenomena, design loads, architectural features, concrete, steel, and seismic design. Section 4.0 describes the structural design methodology for structures and equipment. Section 5.0 describes the hazard mitigation for the project.

2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

The design and specification of work shall be in accordance with 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 structural engineering design and construction.

The edition and/or addenda to a law, ordinance, code, or standard that has been adopted and is in place at time of plant design and construction shall apply to work performed for this Facility.

2.1 FEDERAL

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.

2.2 STATE

- Business and Professional 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 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-TS-769, et seq.; Section 6-T8-3233, et seq.; Section ST8-3270, 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 UBC as minimum legal building standards.

- State of California Department of Transportation (Caltrans), Standard Specifications.

- State of California Occupational Safety and Health Administration (CALOSHA) Standards.

2.3 COUNTY

- Kern County Ordinances

2.3.1 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.

- 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 the recommended practices and the latest version of the American Concrete Institute (ACI), the International Conference of Building Officials, California Building Code (CBC), 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 CBC.

- 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 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.

- 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 the 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, California Building Code (CBC).

- Plumbing will conform to the Uniform Plumbing Code (UPC).

- Design will conform to the requirements of the Federal and California Occupational Safety and Health Administration (OSHA and CALOSHA).

- Design of roof coverings will conform to the requirements of the National Fire Protection Association (NFPA) and Factory Mutual (FM).

The following Codes and Industry Standards shall be used:

- California Energy Commission (CEC), "Recommended Seismic Design Criteria for Non-Nuclear Power Generating Facilities in California."

- International Conference of Building Officials, "Uniform Building Code" (UBC).

- California Building Code (CBC)

- Structural Engineers Association of California, "Recommended Lateral Force Requirements and Tentative Commentary".

- Applied Technology Council, "Tentative Provision for the Development of Seismic Regulations for Buildings," (ATC-3-06).

- American Institute of Steel Construction (AISC).

  – S335 - "Specification for Structural Steel Buildings-Allowable Stress Design and commentary."

- S303 - “Code of Standard Practice for Steel Buildings and Bridges.”
- S329 - “Allowable Stress Design Specifications for Structural joints using ASTM A325 or A490 Bolts.”
- M016 - “Manual of Steel Construction Allowable Stress Design.”

- American Iron and Steel Institute (AISI) “Specification for the Design of Cold-Formed Steel Structural Members,” Edition Cold-Formed Steel Design Manual Parts I-VII
- AWS D1.1 American Welding Society (AWS) “Structural Welding Code-Steel.”
- American Concrete Institute (ACI)
  - ACI 318/318R “Building Code Requirements for Structural Concrete (ACI 318) and commentary (ACI 318R)”
  - ACI 318.1 and Commentary - ACI 318.IR
  - ACI 530 “Building Code Requirements for Concrete Masonry Structures and Commentary (ASCE 5) (TN4S 402)”
  - ACI 212.3R “Chemical Admixtures for Concrete”
  - ACI 302.lR “Guide for Concrete Floor and Slab Construction”
  - ACI 35OR “Environmental Engineering Concrete Structures.”
- Structural and Miscellaneous Steel.
  - ASTM A569/A569M - Standard Specifications for Steel Carbon (0.15 m maximum percent) Hot-Rolled Sheet and Strip, Commercial Quality.
  - ASME/ANSI SIS-1 - Steel stacks, except for circumferential stiffening which shall be in accordance with British Standard 4076 and except that seismic design shall be in accordance with LTBC.
  - American Society for Testing and Materials (ASTM). The following codes and standards shall be included as a minimum:
    - ASTM A36/A36M “Standard Specification for Structural Steel”

- ASTM A53 “Standard Specification for Pipe, Steel Black and Hot-Dipped, Zinc Coated, Welded and Seamless”

- ASTM A276 “Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes”

- ASTM A500 “Standard Specification for Cold-forced Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes”

- ASTM A695 “Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel”

- ASTM A307 “Standard Specification for Carbon Steel Bolts and Studs”

- ASTM A153/Al53 “Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware”

- ASTM A182 “Standard Specification for Steel Wire, Plain, for Concrete Reinforcement”

- ASTM A185 “Standard Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement”

- ASTM A615/A615 “Standard Specification Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”

-- Masonry Institute of America, “Reinforced Masonry Engineering Handbook”

- American Water Works Association (AWWA)

- AWWA D100 - “Welded Steel Tanks for Water Storage, (AWS D5.2) Addendum D100A (AWS D5.2-84A)”

- AWWA C301 “Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids”

- AWWA C302 “Standards for Reinforced Concrete Water Pipe Non-cylinder Type, Not Prestressed.”

- American Association of State Highway and Transportation Officials (AASHTO) (GDHS-2), “A Policy on Geometric Design of Highways and Streets”

- National Fire Protection Association Standards (NFPA)
- Steel Structures Painting Council Standards (SSPC)
- American Society of Nondestructive Testing (ASNT-TC-lA).

The following general design rules and guidelines will be used in development of project specification regarding Codes and Industry Standards.

- International Standard Organization (ISO)3945 "Mechanical Vibration of Large Rotating Machines with Speed Range from 10 to 200 revs/sec-Measurement and Evaluation of Vibration Severity In Situ."

3.0 STRUCTURAL DESIGN CRITERIA

3.1 NATURAL PHENOMENA

The design criteria based on the natural phenomena are discussed below. Climatological data is from the National Climatic Data Center and represents available data for the years 1988 through 1998.

3.1.1 Rainfall

The rainfall design basis may vary for the different systems and system components. Precipitation amounts and intensities to be used with each design basis for various durations and return periods are obtained from the National Climatic Data Center combined with local and regional hydrological data.

3.1.2 Wind Speed

The design wind speed will be based on UBC and CBC edition wind speed maps for the area. This design wind speed will be used to determine wind loads for all structures as discussed in Subsection 3.2.3, Wind Loads.

3.1.2 Temperature

Systems and system component design criteria that require ambient temperature extremes shall use the range as reported by the National Climatic Data Center.

3.1.4 Seismicity

The plant site is located in seismic Zone 4, as determined from Figure No. 16-2 of CBC.

3.1.5 Snow

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

3.2 DESIGN LOADS, LOAD COMBINATIONS AND ALLOWABLE STRESSES

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

3.2.1 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.

3.2.2 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 that 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.

Consideration will be given to designing appropriate areas of the ground floor for support of heavy equipment such as construction and maintenance cranes. Grating floors will be designed for a minimum live loading of 75 pounds per square foot (psf).

Live loads may be reduced in accordance with the provisions of CBC Section 1606. Live load reduction will not be permitted in areas where equipment laydown loads are considered.

All roof areas will be designed for wind loads as indicated in Subsection 3.2.3, Wind Loads. Ponding loading effect due to roof deck and framing deflections will be investigated in accordance with AISC Specification Article K2. AU roof areas will be designed for a minimum of 20-psf live load in addition to calculated dead loads.

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.

Pipe loads for other areas will be treated as uniform loads per unit floor area, and will be carried to the columns and foundations as dead loads. Pipe loads will not be considered as reliable dead load for uplift.

Equipment loads will be specifically determined and located. For major equipment, structural members and bases will be specifically located and designed to carry the equipment load into the structural system. For equipment weighing less than the uniform live load, the structural system will be designed for the live load.

The combustion turbine support systems will be designed for the following loads:

- Deadloads
- Live loads
- Normal torque loads (turbine)
- Temperature and pressure loads
- Seismic loads
- Emergency loads, such as turbine accident loads, and any temperature and pressure loads present during the emergency.

3.2.3 Wind Loads

Wind loads for all structures will be based on CBC and ANSI. A step function of pressure with height under Exposure C conditions will be used. The Importance Factor shall equal 1.0. Allowance shall not be made for the effect of shielding by other structures.

The design wind pressures will be determined by multiplying the velocity pressures by the appropriate pressure coefficients given in CBC Table No. 16-H using Method 1.

The overturning moment calculated from wind pressure shall not exceed two-thirds of the dead load resisting moment. The uplift forces calculated from the wind load pressure shall not exceed two-thirds of the resisting dead load. For determining stresses, all vertical design loads, except roof live loads, shall be considered to act simultaneously with the wind pressure.

3.2.4 Steel Stacks

The steel combustion turbine exhaust stacks and supports shall be capable of enduring specified normal and abnormal design operating conditions in combination with wind or seismic loads for the design life of the facility. Effects of wind will include along-wind and across-wind response. The design will address the design considerations, meet the requirements, and utilize the design methods of Steel Stacks, ASME/ANSI STS-1, and AISC Manual of Steel Construction Allowable Stress Design, Ninth Edition. Design values for yield strength and modules 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 CBC.

3.2.5 Seismic Loads

Seismic loads will be determined in accordance with the requirements specified in Section 3.6, Seismic Design Criteria.

3.2.6 Construction Loads

The integrity of the structures 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.

3.2.7 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 lives plus roof live plus seismic.[1]

3.2.8 Allowable Stresses

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

3.2.8.1 Concrete Structures

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.

3.2.8.2 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 = 1.0 Fs.
- S = Dead + Wind = 1.33 Fs.

- S = Dead + Seismic = 1.33 Fs; frame members and connections will conform to the additional requirements of CBC Sections 1627 and 2211.
- S = Dead + Live = 1.0 Fs.
- S = Dead + Live + Wind = 1.33 Fs.
- S = Dead + Live + Seismic = 1.33 Fs; frame members and connections will conform to the additional requirements of CBC Sections 1627 and 2211.

[1] Note: Use live load only where required by CBC in combination with seismic.

3.3 ARCHITECTURE

General design criteria for the architectural systems are discussed in the following subsections.

3.3.1 Architecture - Engineered Buildings

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

- **Exterior Walls.** These will be metal wall panel systems of the factory assembled or field erected type with exposed fasteners and minimum thickness of exterior sheet of 24 gauge galvanized steel.

- **Installed Walls.** Installed walls will be watertight and will provide a "U" factor in accordance with the California Code of Regulations, Title 24 and the ASHRAE Handbook. Sound attenuation will be provided for sound absorption on walls enclosing equipment as required.

- **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 Laboratory (UL) certification level for class of opening and rating for door, frame, and hardware. Doors will conform to 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 assembled, and painted. Doors will be motor-operated with override manual operation.

- **Metal Roof Deck and Insulation System.** Roof deck and insulation system will be fluted steel decking with interlocking side laps.

- **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.

3.3.2 Architecture Prefabricated Metal Buildings

Prefabricated metal buildings (packaged to include exterior doors, wall louvers, windows, skylights, 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 hot rolled shapes conforming to "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of American Institute of Steel Construction. Metal roof coverings will be of pre-finished standing seam panels of 24-gauge minimum.

- **Steel.** Cold-formed components will conform to ASTM A570, Grade E, 42,000 psi minimum yield for material thicknesses equal to or less than 0.23 inch, or to ASTM A375, 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 wall covering 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.

3.4 CONCRETE

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

3.4.1 Materials

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

- **Reinforcing Steel -** shall meet the requirements of ASTM A615, Grade 60.

- **Cement -** will be Portland cement in all concrete mixes meeting the requirements of ASTM C150.

- **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.

3.4.2 Design

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

- Concrete strength 4,000 psi minimum (at 28 days)
- Reinforcing strength - 60,000 psi, Grade 60.

3.4.3 Mixes

Concrete strength will be determined by ASTM C39.

3.4.4 Reinforcing Steel Test

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

3.5 STRUCTURAL STEEL

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

3.5.1 Materials

- Structural steel shapes, plates, and appurtenances for general use will conform to ASTM A36.

- Structural steel required for heavy framing members may consider use of ASTM A572.

- Structural steel required for tube girts will conform to ASTM A500, Grade B. Connection bolts will conform to ASTM A325. Connections will conform to AISC Specification for Structural Joints. Welding electrodes will be as specified by the AWS. All structural steel will be shop primed after fabrication. Test reports certifying all material is in compliance with the applicable specification will be provided as required.

3.5.2 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 bracing at main column lines, and horizontal bracing at the roof and major floor

levels. 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.

Connections will be in accordance with AISC standard connection design for field bolted connections.

3.6 SEISMIC DESIGN CRITERIA

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

The project is located in Seismic Zone 4 according to the California Building Code (CBC). 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 California Building Code.

It should be noted that structures having one or more of the features listed in CBC Table 16L and Table 16-M shall be designated as having a vertical and a plan irregularity, respectively. All structures, regular or irregular, shall be designed by static or dynamic procedures in accordance with CBC Section 1627 - Criteria Selection.

Additional provisions for torsional irregularity, discontinuous lateral load-resisting element, story drift limitation, etc. shall be considered in accordance with Section 1628.6 through and including Section 1628.10 of the CBC Code.

3.6.1 STRUCTURES

3.6.1.1 <u>Water Treatment Area</u>

The superstructure will be constructed of ASTM A36 structural steel, the design for which will conform to Chapter 22 of CBC.

Lateral forces will be resisted by braced frames or moment-frame connections in conjunction

with bracing in the roof steel.

Seismic forces will be computed by the Static Force Procedure given by Chapter 16 of CBC. The seismic dead load, W, will include the total dead load of the superstructure and the weight of any permanent equipment attached to the superstructure.

Elements of structures and nonstructural components and equipment, including piping and cable tray and their supports, will be seismically designed in accordance with Sections 1630 and 1631 of CBC.

3.6.1.2 Control/Administration and Warehouse/Shop Buildings

The one-story Control/Administrative and Warehouse Shop Buildings will be approximately 50 feet by 90 feet in plan and 15 feet tall, and 40 feet by 40 feet in plan and 20 feet tall, respectively. The final dimensions will be determined following purchase of equipment. As with the water treatment structure, these buildings will be constructed of ASTM A36 structural steel and designed in accordance with CBC.

The seismic forces will be computed as described previously for the water treatment structure.

3.6.2 Non-building Structures

Non-building structures such as tanks, equipment skid, and the neutralization basin will be designed to resist seismic forces in accordance with Section 1632 of CBC.

4.0 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.

4.1 STRUCTURES

4.1.1 Combustion and Steam Turbine Foundations

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

4.1.1.1 Foundation Loads

Foundation loads will be furnished by the combustion turbine supplier 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
- Operating Dynamic Loads
- Emergency loads such as turbine accident Loads.

4.1.1.2 Induced Forces

The combustion turbines and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts, guides and variable supports designed to resist the equipment forces.

4.1.1.3 Structural Criteria

The foundations will be designed and constructed as monolithic reinforced concrete structures using the criteria from Appendix C, Section 3.1, Foundations and Appendix D, Section 3.4, Concrete. The foundation system will likely be a pile 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 Appendix D, Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, 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 Appendix D, Section 3.6, Seismic Design Criteria, for rigid equipment.

Load combinations and their respective strength factors for the foundation designs will be as indicated in Appendix D, Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.1.4 Analytical Techniques

The combustion turbine foundations will be designed using static analysis techniques assuming a rigid mat. The mats will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundations will be analyzed as combined footings assuming a linear soil pressure distribution. The mats will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading.

The combustion turbine foundations will be checked for dynamic response of the operating combustion turbines. Calculations 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 Richart, Hall, and Woods or similar procedure. Each 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 foundations will be proportioned such that the principal natural frequencies will be at least 25 percent removed from the equipment operating speed. Should the resultant foundation design prove to be uneconomical, the dynamic behavior of the foundation will be evaluated and compared to ISO (3495) 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, piers, or piles may be used to evaluate the dynamic behavior of the turbine foundations.

4.1.2 Heat Recovery Steam Generator (HRSG) Foundation

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

4.1.2.1 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 Load

- Live Load
- Wind load
- Seismic load
- Hydrostatic load
- Temperature and pressure Test Load.

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

4.1.2.2 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.

4.1.3 Stack and Foundation

The combustion turbine exhaust stacks will be carbon steel. The foundation system will likely be a pile supported reinforced concrete mat. The stacks will be sized using the volumetric flow rate of the exhaust gases.

4.1.3.1 Foundation Loads

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

- Dead Load
- Live Load
- Wind Load
- Seismic Load
- Temperature and Pressure Test Loads.

4.1.3.2 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.

4.1.3.3 Structural System

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

4.1.3.4 Structural Criteria

The predominant forces acting on the stacks will result from wind or seismic loading. The stacks will be designed as indicated in Appendix D, Subsection 3.2.4 Steel Stacks.

Wind loads will be determined from American Society of Civil Engineers (ASCE) ASCE 7, Minimum Design Loads for Buildings and Other Structures. Consideration will be given to along-wind and across-wind responses.

Seismic loads will be determined in accordance with CBC Section 1632 Nonbuilding Structures. The fundamental period will be determined using CBC Equation 28-5, 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. A simultaneous vertical seismic force equal to two thirds of the horizontal seismic force will be considered.

The shell thickness will account for 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.

The stack will be supported using an octagonal or circular shaped reinforced concrete mat footing. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix C, Section 3.1, Foundations and Appendix D, Section 3.4, 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 Appendix D, Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.3.5 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.

Steel framed structures will be designed as “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 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.

4.1.4 Buildings

The Control Room/Administration Building, Water Treatment Structure, and the Warehouse/Shop Building will provide support, enclosure, protection, and access to the systems contained within their boundaries.

4.1.4.1 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.

4.1.4.2 Induced Forces

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

4.1.4.3 Structural System

The buildings will be designed as an AISC Type 2 simple braced frame and moment frames. For the purpose of resisting seismic lateral loads, structures will be classified as regular structures with concentric braced frames in accordance with the definitions of Chapters 16 and 22 of the California Building Code.

4.1.4.4 Structural Criteria

The steel frames of the buildings will be designed and constructed using the materials and criteria set forth in Appendix D, Section 3.5, Structural Steel.

Environmental loading will be determined in accordance with Appendix D, Section 3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, Wind Loads.

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

The foundations of the buildings will be designed and constructed using reinforced concrete according to the criteria set forth in Appendix C, Section 3.1 Foundations and Appendix D,

Section 3.4 Concrete.

The foundation design will address:

- 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 Appendix D, Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.4.5 Analytical Techniques

The steel frames will be analyzed on a two dimensional plane frame or a three-dimensional space frame model. All loads will be applied as static forces.

The building foundations will be designed using static analysis techniques assuming rigid spread footings. Footings 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.

4.1.5 Cooling Tower Foundation

The cooling tower concrete basin will be divided into cells by partition walls. The basin and the foundation will be soil supported or pile supported rigid mat depending on the recommendation of the geotechnical engineer.

4.1.5.1 Foundation Loads

Foundation Loads will be determined using project specific design criteria.
The design of the cooling tower basin and foundation will include the following loads:

- Dead loads
- Live loads (including water)
- Operating weight
- Shut down weight

- Wind loads
- Seismic loads.

4.1.5.2 Induced Forces

The cooling tower will be supported by timber columns that will be securely anchored to the basin slab using cast-in-place stainless steel anchor bolts.

4.1.5.3 Structural System

The cooling tower supplier will determine the structural system.

4.1.5.4 Structural Criteria

The predominant forces acting on the cooling tower will result from wind or seismic loading.

Wind loads will be determined from American Society of Civil Engineers (ASCE) ASCE 7, Minimum Design Loads for Buildings and Other Structures. Consideration will be given to along wind and across-wind responses.

Seismic loads will be determined in accordance with CBC Section 1632 - Non-building Structures.

The foundation design will address the following consideration:

- Soil bearing capacities and earth pressures
- Allowable settlements
- Structure and environment loads.

Load combinations and their respective strengths will be as indicated in Appendix D, Subsection 3.2.8.1 Concrete Structures.

4.1.5.5 Analytical Techniques

The cooling tower foundation will be analyzed using static analysis techniques assuming a rigid mat. The mat will be sized such that bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The mat will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads.

4.2 TANKS

4.2.1 Vertical, Cylindrical Field Erected Storage Tanks

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

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

4.2.1.1 Foundation Loads

The design of tanks and foundations will include the following loads:

- Dead Loads
- Live Loads
- Wind Loads
- Seismic Loads
- Hydrodynamic Loads.

Foundation loading magnitudes from tanks will not exceed bearing allowable of the soil.

4.2.1.2 Induced Forces

Storage tanks will be properly anchored to the foundation.

4.2.1.3 Structural System

Storage tanks will resist lateral loading through shear in the tank walls. Overturning will be resisted by applicable dead loads or by anchor bolts connecting the tank wall to the foundation.

4.2.1.4 Structural Criteria

The foundation will be designed and constructed as a reinforced concrete ringwall using the criteria from Appendix C, Section 3.1, Foundations and Appendix D, Section 3.4, Concrete.

The tank structures will be designed and constructed using the criteria established in AWWA D100.

Environmental loading will be determined in accordance with Appendix D, Section 3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure

coefficient from Table No. 16-H of CBC.

Seismic loads will be determined in accordance with Appendix D, Section 3.6, Seismic Design Criteria and AWWA D100, Section 13.

The seismic overturning moment will be determined from AWWA D100, Section 13.3.3.1 for Z = 0.4. The structure coefficient will be determined from Table 16 of this AWWA Code. The value of Cl 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 Appendix D, Subsection 3.2.7 Load Combinations, Subsection 3.2.8, Allowable Stresses, and Section 3 of AWWA D100.

Design loads will be applied at the center of gravity of the tank. The design of the tank foundation will include the moment resulting from lateral displacement (hydrodynamics) of the tank contents in accordance with AWWA D100, Section 133.2.

Piping connections will be designed with a minimum 2 inches of flexibility in all directions as specified in AWWA D100, Section 135.

4.2.1.5 Analytical Techniques

The tank foundation will be designed using static analysis techniques. The foundation will be proportioned to resist the dead load of the tank and the overturning moment determined from AWWA D100. The foundation will also be proportioned to resist maximum anchor bolt uplift force. The foundation will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads.

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 will not be exceeded.

4.2.2 Horizontal, Cylindrical, Shop Fabricated Storage Tanks

The tanks will be constructed of carbon steel and provided with ladders, landing platforms, and handrails, as required, to provide 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.

4.2.2.1 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 Test Loads
- Hydrodynamic Loads.

4.2.2.2 Induced Forces

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

4.2.2.3 Structural System

The tanks will be supported by integral legs or saddle supports designed to resist gravity and environmental loading.

4.2.2.4 Structural Criteria

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix C, Section 3.1 Foundations and Appendix D, Section 3.4 Concrete. The foundation will likely be a pile supported rigid mat.

Environmental loading will be determined in accordance with Appendix D, Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

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 Appendix D, Section 3.6 Seismic Design Criteria.

Load Combinations and their respective allowable strengths will be as indicated in Appendix D, Subsection 3.2.7 Load Combinations and Subsection 3.2.8 Allowable Stresses.

4.2.2.5 Analytical Techniques

The 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 tanks will typically 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.

4.3 EQUIPMENT

4.3.1 Combustion Turbine Accessories

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

4.3.1.1 Equipment Loads

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

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

4.3.1.2 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.

4.3.1.3 Structural Criteria

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

Environmental loading will be determined in accordance with Appendix D, Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity specified in Appendix D, Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

The seismic loading and design of the combustion turbine and accessories will be in accordance with project specific criteria and CBC. 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 Appendix D, Section 3.6, Seismic Design Criteria.

The combustion turbine inlet air filtration equipment and inlet air duct support structures shall be designed to resist the loading specified in CBC Chapter 16. For the purpose 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 CBC.

Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in CBC Chapter 16 and Appendix D, Subsection 3.6.1, Buildings.

The air duct support structure will resist lateral seismic loading as a Concentric Braced Frame or as an Ordinary Moment Resisting Space Frame as defined by CBC. The design and detailing of the members and connections will comply with the provisions of CBC Chapter 22.

Lateral forces on elements of structural and nonstructural components win be determined in accordance with CBC Section 1630 with Z equal to 0.4, I equal to 1.0, and Cp in accordance with CBC Table 16-0. These seismic forces will be combined with forces due to normal operating loads.

Lateral forces on equipment will be determined in accordance with CBC Section 1630 with Z equal to 0.4, I equal to 1.0, and Cp in accordance with CBC Table 16-0 Equipment bases, foundations, support flames, 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 Appendix D, Subsection 3.2.7, 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.

4.3.1.4 Analytical Techniques

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

4.3.2 Main and Auxiliary Transformers

The main and auxiliary power transformers, transformer equipment, material and accessories will conform to the applicable standards of ANSI C57.12, NEMA TR1, ANSI/IEEE C59, 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.

4.3.2.1 Foundation Loads

Foundations load will be furnished by the transformer 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.

4.3.2.2 Induced Forces

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

4.3.2.3 Structural System

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

4.3.2.4 Structural Criteria

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

The foundation(s) will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix C, Section 3.1, Foundations and Appendix D,

Section 3.4 Concrete. The foundation will likely be a soil supported or pile supported rigid mat. The foundation will incorporate an integral containment basin capable of holding 130 percent of the transformer coolant contents prior to passage through an oil water separator.

Environmental loading will be determined in accordance with Appendix D, Section 3.1, Natural Phenomena, Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficients from CBC Table No. 16-H.

The seismic loading and design of the power transformers, transformer equipment, accessories, and foundations will be in accordance with project specific criteria and CBC 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 Appendix D, Section 3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1630 with Z equal to 0.4, I equal to 1.0, and Cp in accordance with CBC Table 16-0. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the foundation system win be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Appendix D, Subsection 3.2.7, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For any 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 Appendix D, Subsection 3.2.8 Allowable Stresses.

4.3.2.5 Analytical Techniques

The power transformers, transformer equipment, and accessories will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix F, Electrical Engineering Design Criteria.

The power transformer foundation(s) will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlements 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.

4.3.3 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.

4.3.3.1 Foundation Loads

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

- Dead Load
- Live Load
- Wind Load
- Seismic Load
- Temperature and Pressure Test Loads (as applicable).

4.3.3.2 Induced Forces

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

4.3.3.3 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.

4.3.3.4 Structural Criteria

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

The seismic loading and design of miscellaneous equipment will be in accordance with project specific criteria and CBC Chapter 16.

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 Appendix D, Section 3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1630 with Z

equal to 0.4, 1 equal to 1.0, and Cp in accordance with UBC Table 16-0. 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 Appendix D, Subsection 3.2.7, 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 Appendix D, Subsection 3.2-8, Allowable Stresses.

4.3.3.5 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.

4.4 PIPING

Piping will include all high point vents, low point drains, instrument piping, lube oil piping, steam piping and other piping as required for the complete system. Insulation, hangers, valves, and other piping accessories will also be provided. Piping, pipe supports, and pipe accessories will be constructed of carbon, alloy, and stainless steel.

The foundations and support superstructures will be designed to resist the loadings generated by the piping system.

4.4.1 Piping Loads

All piping loads will be determined using project specified loading, UBC and CBC specified loads. Typical loading for a piping system include the following:

- Dead Load
- Live Load
- Wind Load
- Seismic Load
- Temperature and Pressure Test Loads.

4.4.2 Induced Forces

The design and configuration of all hangers and accessories will utilize steel anchor bolts, fasteners, welds, and other pipe anchorage devices. All pipe anchorage will be designed to resist induced forces.

4.4.3 Structural Criteria

All piping, pipe supports, and pipe accessories will be designed to resist project specific loads, UBC, CBC specified loads, and loads from applicable codes and standards, and be in accordance with the criteria established in Appendix C.

Environmental loading will be determined in accordance with Appendix D, Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Appendix D, Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficients from Table No. 16-H of CBC.

The seismic loading and design of piping systems and pipe supports will be in accordance with project specific criteria. Seismic analysis of piping and components will be designed in accordance with Sections 1630 and 1631 of CBC.

Load combinations will be as indicated in Appendix D, Subsection 3.2.7, Load Combinations. These load combinations are to act in conjunction with those normally used in design and the applicable codes and standards specified in Appendix E. For all load combinations, including seismic, the stresses in the structural supporting members will remain in the elastic range. Structural allowable strengths will be as indicated in Appendix D, Subsection 3.2.8, Allowable Stresses.

4.4.4 Analytical Techniques

All piping, piping supports, and pipe accessories will be designed and constructed in accordance with applicable requirements of the codes and standards referenced in Appendix E.

Structural supports required for piping will be designed using static analysis techniques using the procedures established in Appendix E.

5.0 HAZARD MITIGATION

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

5.1 SEISMIC HAZARD MITIGATION CRITERIA

Appendices C and D describe the civil and structural design criteria that will be applied to the project. The selection of the seismic design criteria for the project was based on the following considerations:

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

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

- The seismic hazards will be assessed by studying the geologic features of the surrounding area. Major faults will be identified and information collected regarding each fault's proximity, capability, recurrence, and magnitude.

- The seismic risk associated with each source will be assessed considering historical magnitudes.

- Acceleration levels for various structural frequencies will be based on CBC Figure No 16-3, Normalized Response Spectra Shapes.

- Appropriate design criteria and analysis methods will be established for each major plant structure, equipment, and component consistent with seismic performance criteria.

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 supportive structure. Normal 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.

- The design of piping connections to structures, tanks, and equipment will consider the differential seismic displacements between components.

- Adjacent structures will be seismically isolated from one another.

- Structural elements will be designed to comply with special detailing requirements intended to provide ductility.

- Connections for steel structures will have a minimum load carrying capability without regard to the calculated load.

- Lateral and vertical displacements of structures and elements of structures will be limited to specified values.

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 minor repairs.

5.2 METEOROLOGICAL AND CLIMATIC HAZARD MITIGATION

Meteorological and climatic data will form the design basis for the project. 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.

- Plant drainage systems will be designed to convey the runoff from a rainfall event with a 25-year recurrence interval.

- Ground floor levels of structures will be placed above the 100 year flood plane levels.

- 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.

MECHANICAL ENGINEERING DESIGN CRITERIA
(APPENDIX E FROM 99-AFC-7)

APPENDIX E

MECHANICAL 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 programs/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
- Start-up, testing, and checkout; and
- 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 mechanical design criteria defined herein form the basis of the design for the mechanical components and systems of the project. More specific design information is developed during detailed design to support equipment and erection specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2 summarizes the applicable codes and standards and Section 3 includes the general design criteria for piping, valves, insulation, lagging, and freeze protection.

2.0 DESIGN CODES AND STANDARDS

The design and specification of all 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 design and construction is listed below.

- AFBMA - Antifriction Bearing Manufacturers Association

- AGMA - American Gear Manufacturers Association Specification 390 - Gear Classification

- AMCA - Air Movers Control Association

- ASA – Acoustical Society of America

- ASCE - American Society of Civil Engineers

- ASME - American Society of Mechanical Engineers Boiler and Pressure Vessel Code:

- Section II - Materials Specification
- Section V – Non-destructive Examination
- PTC 22 - Performance Test Code

- ASNT - American Society for Non-destructive Testing
- AWS - American Welding Society AWA-D-100 Welded Steel Tanks for Water Storage
- EJMA - Expansion joint Manufacturing Association
- EPA - Environmental Protection Agency
- HI - Hydraulic Institute
- IEEE - Institute of Electric and Electronics Engineers
- ISA - Instrument Society of America
- NBS - National Bureau of Standards
- NEMA - National Electrical Manufacturers Association
- OSHA - Occupational Safety and Health Administration, Department of Labor
- PFI - Pipe Fabrication Institute
- TEMA - Tubular Exchanger Manufacturers Association
- ASTM - American Society for Testing and Materials
- ASTM STANDARD MATERIAL SPECIFICATIONS
  - ASTM A36 - Standard Specification for Structural Steel
  - ASTM A53-Standard Specification for Pipe, Steel Black and Hot-Dipped Zinc-Coated Welded and Seamless
  - ASTM A105-Standard Specification for Forgings, Carbon Steel for Piping Components
  - ASTM A106-Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service

- ASTM A126-Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

- ASTM A182-Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges/Forged Fitting and Valves and Parts for High-Temperature Service

- ASTM A193-Standard Specification for Alloy-Steel and Stainless Steel Bolting

- Materials for High-Temperature Service

  - ASTM A194-Standard Specifications for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service

  - ASTM A213-Standard Specification for Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater, and Heat-Exchanger Tubes

  - ASTM A216-Standard Specifications for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

  - ASTM A217-Standard Specification for Steel Castings, Martenistic Stainless and Alloy for Pressure Containing Parts, Suitable for High-Temperature Service

  - ASTM A234-Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

  - ASTM A307-Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi, Tensile Strength

  - ASTM A312-Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

  - ASTM A335-Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service

  - ASTM A351-Standard Specification for Steel Castings, Austenitic, for High Temperature Service

  - ASTM A387-Standard Specification for Pressure Vessel Plates, Alloy Steel Chromium-Molybdenum

  - ASTM A403-Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

- ASTM A490-Specification for Heat-Treated, Steel Structural Bolts, 150 ksi Tensile Strength

- ASTM B61-Standard Specification for Steam or Valve Bronze Castings

- ASTM B62-Composition Bronze or Metal Castings

- ASTM B88-Standard Specification for Seamless Copper Water Tube

- ASTM Bl 1 I-Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock

- 3040ASTM B209-Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

- ASTM C195 (83)-Specification for Mineral Fiber Thermal Insulating Cement

- ASTM L411 (87)-Test Method for Hot-Surface Performance of High Temperature Thermal Insulation

- ASTM C533-Specification for Calcium Silicate Block and Pipe Thermal Insulation

- ASTM C612-Specification for Mineral Fiber Block and Board Thermal Insulation

- ASTM D1248-Specification for Polyethylene Plastics Molding and Extrusion Materials

- ASTM F441.-Specification for Chlorinated Polyvinyl chloride (CPVC) Plastic Pipe, Schedules 40 and 80

- ANSI - American National Standards Institute

  - ANSI/NFPA 70 - National Electrical Code (NEC

  - ANSI C50.10 - Synchronous Machines

  - ANSI C50.14 - Combustion-Gas Turbine Driven Cylindrical Rotor Synchronous Generators

  - ANSI C50.22 - Guide for Testing Insulation Resistance of Rotating Machinery

  - ANSI Bl.1 - Unified Inch Screw Threads (UN and UNR thread form)

- ANSI B2.1 - Pipe Threads Except Dryseal
- ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 lb.
- ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
- ANSI B16.9 - Factory-Made Wrought Steel Buttwelding Fittings
- ANSI B16.10 - Face-to-Face and End-to-End Ferrous Valves
- ANSI B16.11 - Forged Steel Fittings Socket-Welding and Threaded
- ANSI B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
- ANSI B16.79 - Wrought Copper and Copper Alloy Solder-joint Pressure Fittings
- ANSI B16.24 - Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300 lb
- ANSI B16.28 - Wrought Steel Buttwelding Short Radius Elbows and Returns
- ANSI B16.34 - Valves - Flanged, Threaded and Welding End
- ANSI B16.34 - Valves - Flanged, Threaded and Welding End
- ANSI B18.2.1 - Square and Hex Bolts and Screws, Inch Series
- ANSI B31.1. - Power Piping
- ANSI B36.10 - Welded and Seamless Wrought Steel Pipe
- ANSI B36.19 - Stainless Steel Pipe
- ANSI B73.1 - Specifications for Horizontal End Suction Centrifugal Pumps for Chemical Process
- ANSI B133.1 - Procurement Standards for Gas Turbines

• ASME - American Society of Mechanical Engineers

- ASME Section VIII - Rules for Construction of Pressure Vessels
- ASME Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

- ASME PTC-22 - Power Test Code for Gas Turbine Power Plants
- ASME B31.1 - Power Piping

- MSS - Manufacturers Standardization Society of the Valve and Fittings Industry

  - MSS-SP 55-71 - Quality Standard for Steel Castings-Visual Method

  - MSS-SP 61-76 - Butterfly Valves

  - MSS-SP 80-74 - Bronze Gate-Globe-Angle and Check Valves MSS-SP 84-85

  - Steel Valves-Socket Welding and Threaded Ends

- AWS - American Welding Society
  - AWS - D1.1 - Structural Welding Code-Steel

- AWWA - American Water Works Association.
  - AWWA-C504 - Rubber Seated Butterfly Valves
  - AWWA-D100 - Standards for Welding Steel Tanks

- OSHA - Occupational Safety and Health Act
- HEI - Heat Exchange Institute
- HI - Hydraulic Institute Standards
- TEMA - Tubular Exchanger Manufacturers Association SSPC - Steel Structures Painting Council, Volume 2

  - SSPC-PA2 - Measurement of Dry Paint Thickness with Magnetic Gages

  - SSPC-SPI - Solvent Cleaning

  - SSPC-SP2 - Hand Tool Cleaning

  - SSPC-SP3 - Power Tool Cleaning

  - SSPC-SP6 - Commercial Blast Cleaning

  - SSPC-SP8 - Pickling

  - SSPC-SP10 - Near-White Blast Cleaning

- California Code of Regulations, Title 8

  - Chapters 4 through 7, Groups 20 Flammable Liquids, Gases, and Vapors

  - Group 27, Fire Protection

- National Fire Protection Association (NFPA) codes
    - NFPA 10, Portable Fire Extinguishers
    - NFPA 12, Carbon Dioxide Extinguishing Systems
    - NFPA 13, Instillation of Sprinkler Systems
    - NFPA 14, Instillation of Standpipe and Hose Systems
    - NFPA 15, Water Spray Fixed Systems
    - NFPA 20, Centrifugal Fire Pumps
    - NFPA 22, Fire Water Storage Tank
    - NFPA 24, Private Fire Service Mains and Their Appurtenances
    - NFPA 26, Supervision of Valves Controlling Water Supplies for Fire Protection
    - NFPA 30, Flammable and Combustible Liquids Code

      NFPA 37, Stationary Combustion Engines and Gas Turbines
    - NFPA 70, National Electrical Code
    - NFPA 72E, Automatic Fire Detectors
    -
- California Building Code (CBC)
- UL - Underwriter Laboratory
- UFC - Uniform Fire Code.

Other recognized standards will be used as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The edition and/or addenda to a law, ordinance, code, or standard that has been adopted and is in place at time of plant design and construction shall apply to work performed for this Facility.

3.0 MECHANICAL ENGINEERING GENERAL DESIGN CRITERIA

3.1 PIPING

Piping will be designed, selected, and fabricated in accordance with the following criteria:

3.1.1 Design Temperature and Pressure

The design pressure and temperature for piping will be consistent with conditions established for the design of the associated system. The design pressure of a piping system will be based generally on either the maximum sustained pressure that may act on the system, plus 10 percent, or to the relief valve. The design temperature of a piping system generally will be based on the maximum sustained temperature which may act on the system plus 50ºF rounded up to the next 5ºF increment.

3.1.2 General Design and Selection Criteria

Piping will be designed in accordance with the requirements of the Code for Pressure Piping, ANSI B31.1-Power Piping and other codes and standards referenced in Section 2, Codes and Standards. Pipe stress analysis will be performed in accordance with ASME / ANSI B31.1. All pipe supports will be suitable to restrain the piping where subjected to external loads as stipulated by the Uniform Building Code - Seismic and Wind Load Criteria.

Material selection will generally be based on the design temperature and service conditions in accordance with the following:

- Carbon steel piping materials will be specified for design temperatures up to and including 800ºF

- One and one-quarter percent chromium alloy steel piping materials will be specified for design temperatures ranging from 805ºF to 900ºF.

- Chromium alloy steel piping (2-1/4 percent) will be specified for design temperatures ranging from 905ºF to 1100ºF

- Scale free piping materials such as cleaned carbon steel, stainless steel or non-metallics will be used in piping applications requiring a high degree of cleanliness generally including injection water supply piping after strainers, air compressor inlet piping, miscellaneous lubricating oil system piping, and sampling piping after process isolation valves

- Fiberglass reinforced plastic piping materials will be used only in applications requiring corrosion-resistant materials.

The above listed materials, or other suitable piping materials listed in Section 3.1, Piping, will be used where required for special service to meet specific requirements.

3.1.3 Piping Materials

Piping materials will be in accordance with applicable ASTM, and ASME standards. Materials to be incorporated in permanent systems will be new, unused, and undamaged.

Piping materials will be in accordance with the following criteria:

- Carbon steel piping 2-inch nominal size and smaller will be ASTM A53 or A106, Grade B.

- Carbon steel piping 2-1/2 inch through 24-inch nominal size will be ASTM A53 Grade B seamless (welded seam pipe shall be used for low pressure air and water) or A106 Grade B, with the indicated grades as a minimum. Carbon steel piping larger than 24-inch nominal size will be ASTM A672 or API 5L Grade B.

- Low chrome alloy pipe shall be in accordance with ASTM A335 Grades P11, P22 or P5 seamless or welded.

- Stainless steel pipe will be ASTM A312 Grades TP304, TP304L, TP316, or TP316L seamless or welded. All stainless steel piping materials will be fully solution annealed prior to fabrication. The type 316 materials will be utilized for high resistance to corrosion. The type 30 and 316L materials will be utilized for applications requiring hot working (welding, etc.).

- Schedule numbers, sizes and dimensions of all carbon steel and alloy steel pipe will conform to ANSI B36.10. Sizes and dimensions of stainless steel pipe designated at Schedule 5S, 10S, 40S, or 50S will conform to ANSI B36.19. Schedule numbers, sizes, and dimensions of stainless steel pipe not covered by ANSI B36.19 will conform to ANSI B36.10.

- Steel Piping for acid service shall be Alloy 20.

- The use of galvanized steel pipe will be limited to systems where a degree of corrosion resistance is required or where codes require the use of galvanized steel pipe rather than black steel pipe. Galvanized carbon steel piping will be ASTM A53 Grade B and will be hot-dipped.

- Underground piping materials will be non-metallic, ductile iron, concrete or carbon steel (see 3.1-7). The material selection will be in accordance with service requirements. Metallic underground piping will be wrapped in accordance with American Water Works Association (AWWA) standards.

- Copper alloy pipe will conform to ASTM B43. Seamless Red Brass Pipe.

- Polypropylene lined pipe will be ASTM A53 steel pipe with an applied liner of polypropylene.

- Fiberglass reinforced plastic pipe will be selected accordance with the specific service requirements.

- Polyvinyl chloride (PVC) pipe will conform to ASTM D1785 or ASTM D2241.

- Chlorinated polyvinyl chloride (CPVC) pipe will conform to ASTM F441.

- High-density polyethylene pipe will conform to ASTM D3350 with a Plastic Pipe Institute rating of PE 3406 or 3408.

3.1.4 Tubing Materials

Tubing materials will generally be in accordance with the following criteria:

- Copper tubing 3/8 inch and smaller will be light drawn temper tubing conforming to ASTM B75. Copper tubing, 1/2 inch and larger, will be ASTM B88 Type K drawn temper.

- Stainless steel tubing will conform to ASTM A213, Type 316. All stainless steel tubing will be of the fully annealed type, with a carbon content greater than 0.04 percent.

Wall thickness for tubing will be as required for specific design pressure and temperature conditions.

3.1.5 Fitting Materials

Fittings will be constructed of materials equivalent to the pipe with which they are used, except for special cases such as lined steel pipe.

- Steel Fittings. Steel fittings 2-1/2 inches and larger will be of the butt welding type and steel fittings 2 inches and smaller will be of the socket welding type, except galvanized steel fittings will be threaded.

- Butt Welded Fittings. The wall thickness of butt weld fittings will be equal to the pipe wall thickness with which they are used. The fittings will be manufactured in accordance with ANSI B16.9. ANSI B16.28, and ASTM A234 or ASTM A403.

- Forged Steel Fittings. Forged steel fittings will be used for socket weld and steel threaded connections and will conform to ANSI Bl6.11.

- Cast Steel Flanged Fittings. Cast carbon steel flanged fittings will conform to ANSI B16.5 and will be of materials conforming to ASTM A216 WCB.

- Brass and Bronze Fittings. Screwed brass and bronze pipe fittings will conform to ANSI B16-15. Flanged brass and bronze pipe fittings will conform to ANSI B16.24.

3.1.6 Flanges, Gaskets, Bolting, and Unions

Flanged joints will be in accordance with the following requirements:

- Flanges mating with flanges on piping, valves, and equipment will be of sizes, drilling, and facings which match the connecting flanges of the piping, valves, and equipment.

- Flange class ratings will be adequate to meet the design pressure and temperature values specified for the piping with which they are used.

- Flanges will be constructed of materials equivalent to the pipe with which they are used.

- Steel flanges will conform to ANSI B16.5.

- Carbon steel flanges will be forged in accordance with ASTM A105.

- Chromium alloy steel and stainless steel flanges will be forged in accordance with ASTM A182.

- Brass and bronze screwed companion flanges will be plain faced and will conform to Class 150 or Class 300 classifications of ANSI B16.24. Drilling will be in accordance with ANSI Class 125 or Class 250 standards.

- Compressed fiber gaskets and spiral wound gaskets will be specified by flange type, piping system service and operating condition. Gaskets containing asbestos are not acceptable.

- Gaskets will be suitable for the design pressures and temperatures.

- Compressed fiber gaskets will be in accordance with ANSI B16.21, and materials will be suitable for a maximum working pressure of 600 psig and a maximum working temperature of 750ºF.

- Spiral wound gaskets will be constructed of a continuous stainless steel ribbon wound into a spiral with non-asbestos filler between adjacent coils. Spiral wound gaskets shall be in accordance with ANSI B16.20.

- Rubber gasket materials will be cloth-inserted sheet and shall be in accordance with ANSI B16.21.

3.1.7 Cathodic Protection

Cathodically protected, underground steel piping will be electrically isolated from aboveground piping and other steel components. Isolation will be achieved by installation of isolation flanges with insulating gaskets, tubes, and washers.

3.1.8 Piping Fabrication

Piping fabrication will generally be in accordance with the requirements of the Piping Fabrication Institute (PFI).

3.1.8.1 Welder Qualification and Welding Procedures

Welding procedures, welders, and welding operators will be qualified in accordance with ASME Section IX code requirements.

Backing rings will not be allowed for shop or field welds except where specifically required for structural purposes.

3.1.8.2 Nondestructive Examination and Inspection

Inspection and testing of piping will be performed in accordance with the requirements of ASME B31.1. Non-destructive examination will generally include visual, radiographic, magnetic particle and liquid penetrant, and ultrasonic examinations.

- Visual examination of welds will be performed by personnel qualified and certified in accordance with AWS QCI, Standard for Qualification and Certification of Welding Inspectors.

- Non-destructive examination shall be performed by personnel certified in accordance with ASNT Recommended Practice SNT-TC-IA.

- Radiographic examination will be performed on welds or welds to pressure retaining components as required by B31.1.

- Magnetic particle, ultrasonic and liquid penetrant examination will be performed as required ASME B31.1 Code.

3.1.9 Pipe Supports and Hangers

The term “pipe supports” includes all assemblies such as hangers, floorstands, anchors, guides, brackets, sway braces, vibration dampeners, positioners, and any supplementary steel required to attach pipe supports.

3.1.9.1 Design and Selection Criteria

All support materials, design, and construction will be in accordance with the latest applicable provisions of the Power Piping Code, ASME B31-1. Seismic design of piping systems will be in accordance with criteria as stipulated by the California Building Code.

3.2 VALVES

Valve pressure classes, sizes, types, body materials, and end preparations will generally be as described herein. Special features and special application valves will be utilized where required.

Steel body gate, globe, angle, and check valves will be designed and constructed in accordance with ANSI B16.34 as applicable.

3.2.1 Iron Body Valves

Iron body gate, globe, and check valves will have iron bodies and will be bronze mounted. The face-to-face dimensions will be in accordance with ANSI B16.10.

3.2.2 Butterfly Valves

Rubber-seated butterfly valves will be generally constructed in accordance with AWWA C504 Standard for Rubber-Seated Butterfly Valves. The valves will also generally conform to the requirements of MSS Standard Practice SP-67, Butterfly Valves.

3.2.3 Branch Line Isolation Valves

Isolation valves will be provided in 2-inch and smaller branch lines from main piping headers and equipment.

3.3 INSULATION AND LAGGING

The insulation and lagging to be applied to piping, equipment, and ductwork for the purposes of reducing heat loss, and personnel protection will be in accordance with the following criteria.

3.3.1 Insulation Materials and Installation

Insulation materials will be inhibited and of a low halogen content so that the insulation meets the requirements of ASTM C795 and ASTM C929 regarding stress-corrosion cracking of austenitic stainless steel. Insulation materials will contain no asbestos.

All piping operating above 140ºF will be insulated in areas required for personal protection. All piping will be insulated as required for energy conservation, prevention of condensation and noise attenuation.

Equipment and ductwork operating at elevated temperatures will be insulated with calcium silicate or mineral fiber insulation.

3.3.2 Lagging Materials and Installation

All insulated surfaces of equipment, ductwork, piping, and valves will be lagged.

3.3.3 Freeze Protection

All aboveground water and steam piping will be arranged, to the maximum extent possible, to allow drainage to protect the pipe from freezing. Electrical heat tracing may be used if required.

3.4 ROTATING EQUIPMENT

Rotating equipment standards will be developed for each specific type of equipment. Each standard will reference applicable industry standards and codes.
General service pumps will conform to ANSI B73.l.
Firewater Pump, Driver and accessories will conform to NFPA 20.

3.5 PRESSURE VESSELS

Vessels shall be designed and built in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, latest edition and addenda. In addition, the vessels and supports shall be designed for seismic and wind loadings in accordance with the Uniform Building Code (UBC) and the CBC.

3.6 STORAGE TANKS

Water tanks shall be designed and erected in accordance with AWWA D-100, latest edition. Seismic design will be in accordance with AWWA D-100 requirements and the wind loading will be in accordance with the CBC.

3.7 HEAT RECOVERY STEAM GENERATORS (HRSGS)

The HRSG's shall be designed and constructed in accordance with ASME Boiler and Pressure Vessel Code, Section L latest edition and addenda. The wind and seismic design criteria shall be in accordance with Uniform Building Code and the CBC.

ELECTRICAL ENGINEERING DESIGN CRITERIA
(APPENDIX F FROM 99-AFC-7)

APPENDIX F

ELECTRICAL ENGINEERING DESIGN CRITERIA

F. ELECTRICAL 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 electrical design criteria defined herein form the basis of the design for the electrical components and systems of the project. More specific design information will be developed during detailed design to support equipment and erection specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general design criteria for motors, power and control wiring, protective relaying, classification of hazardous areas, grounding, lighting, freeze protection, lightning protection, raceway, cable tray and conduit, and cathodic protection.

2.0 DESIGN CODES AND STANDARDS

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

The Anti-friction Bearing Manufacturers Association (AFBMA)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
Edison Electric Institute (EEI)
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)
Occupational Safety and Health Act (OSHA)
Underwriters' Laboratories (UL)
National Association of Corrosion Engineers (NACE).

In addition to the general codes and standards listed above, the following specific standards will be utilized:

Batteries

– NEMA IB 4-Determination of Ampere-hour and Watt-hour Capacity of Lead-Acid Industrial Storage Batteries for Stationary Service

– IEEE 450-Recommended Practice for Maintenance, Testing and Replacement of Large Lead-Acid Storage Batteries

– IEEE 484-Recommended Practice for Installation Design and Installation of Large Lead-Acid Storage Batteries for Generating Stations and Substations.

Battery Chargers

– NEMA AB 1-Molded Case Circuit Breakers

– NEMA PV 5-Constant-Potential Type Electric Utility (Semiconductor Static Converter) Battery Chargers.

Cable, Low Voltage Power, Control and Instrument

– ASTM B8-Concentric-Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft

– ASTM B33-Tinned Soft or Annealed Copper Wire for Electrical Purposes

– ICEA S-19-81, NEMA WC-3-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

– ICEA S-68-516, NEMA WC-8-Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

– NFPA 258-Standard Test Method for Measuring the Smoke Generated by Solid Materials

– NFPA 70-National Electric Code (NEC)

– ANSI/UL 44-Safety Standard for Rubber-Insulated Wires and Cable.

Cable, Medium Voltage Power

- ICEA 6-Ethylene Propylene Rubber Insulated Shielded Power Cables, Rated 5 through 69 kV
- ASTM B8-Concentric Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM B33-Tinned Soft or Annealed Copper Wire for Electrical Purposes
- ICEA S-66-524-Cross Linked-Thermosetting, Polyethylene-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy
- ICEA S-68-516-Ozone-Resistant Ethylene-Propylene Rubber Insulation for Power Cables Rated 0 to 35,000 Volts
- ICEA S-19-81, NEMA WC-3-Rubber Insulated Wire and-Cable for the Transmission and Distribution of Electrical Energy
- NFPA 70-National Electric Code (NEC).

Cable Tray

- NEMA VE-1 Cable Tray Systems

Cathodic Protection Equipment

- ANSI B1.1-Unified Inch Screw Threads
- ANSI B2.1-Pipe Threads
- ASTM A518-Corrosion-Resistant High Silicon Cast Iron
- ASTM B418-Cast and Wrought Galvanic Zinc Anodes for Use in Saline Electrolytes
- NEMA AB-1-Molded Case Circuit Breakers
- NEMA ICS-Industrial Controls and Systems
- NEMA WC-5, ICEA S-61-402-Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

– NEMA WC-7, SS-66-524-Cross-Linked-Thermosetting, Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

Circuit Breakers, High Voltage

– ANSI/IEEE C37.04-Rating Structure for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

– ANSI C37.06-Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

– ANSI/IEEE C37.09-Test Procedure for AC High Voltage Circuit Breakers rated on a Symmetrical Current Basis

– ANSI/IEEE C37.010-Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

– ANSI C37.11-Requirements for Electrical Control for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis.

Conduit

– UL 6, ANSI C80.1-Rigid Steel Conduit

– UL 797, ANSI C80.3-Electrical Metallic Tubing

– UL 514, ANSI C80.4-All Fittings

– UL 886-Hazardous Area Fittings

– UL 360-Flexible Liquid-tight Conduit

– NEMA TC6-PVC and ABS Plastic Utilities Duct for Underground Installation

– NEMA TC9-Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

– UL 651-Electrical Rigid Nonmetallic Conduit

– NEMA TC2, UL 514-Fittings for Electrical Rigid Nonmetallic Conduit.

Distribution Panels

- ANSI C971-Low Voltage Cartridge Fuses, 600 volts or less
- NEMA AB1-Molded Case Circuit Breakers
- NEMA PB1-Panelboards
- UL 50-Electrical Cabinets and Boxes
- UL 67-Panelboards
- NEMA ICS-Industrial Controls and Systems
- NEMA KSI-Enclosed Switches.

Grounding

- ASTM B8-Specifications for Concentric-Lay Stranded Copper Conductors
- NEC-National Electric Code
- NEMA CC-1-Electrical Power Connectors for Substations
- IEEE 80-IEEE Guide for Safety in AC Substation Grounding.

Lighting Fixtures

- NEMA FA1-Outdoor Floodlighting Equipment
- NEMA LE1-Fluorescent Luminaries
- UL 57-Standard for Safety, Electric Lighting Fixtures
- UL 844-Standard for Safety, Electric Lighting Fixtures for Use in Hazardous Locations
- UL 924-Standard for Safety, Emergency Lighting Equipment.

Lightning Arresters

- ANSI/IEEE C62.1-Surge Arresters for AC Power Circuits.

Secondary Unit Substations

- ANSI C37.13-Low-Voltage AC Power Circuit Breakers Used in Enclosures
- ANSI C37.16-Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors
- ANSI/IEEE C37.20-Switchgear Assemblies
- ANSI C37.50-Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures
- ANSI C37.51-Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies
- ANSI C57.12.00-General Requirements for Distribution, Power and Regulation Transformers
- ANSI/IEEE C57.12.01-General Requirements for Dry-Type Distribution and Power Transformers
- ANSI/IEEE C57.12.90-Test Code for Liquid Immersed Distribution, Power and Regulating Transformers
- ANSI/IEEE C57.12.91-Test Code for Dry-Type Distribution and Power Transformers
- ANSI C57.13-Requirements for Instrument Transformers
- NEMA CC1-Electrical Power Connectors for Substations
- NEMA TR-1-Transformers, Regulators, and Reactors
- NEMA ICSI-General Standards for Industrial Controls and Systems
- NFPA 70-National Electric Code.

Metal-Clad Switchgear and Nonsegregated Phase Bus

- ANSI C37.04-Rating Structure for AC High-Voltage Circuit Breakers on a Symmetrical Current Basis
- ANSI C37.04 Preferred Ratings and Related Required Capabilities for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

– ANSI C37.20-Switchgear Assemblies Including Metal-Enclosed Bus

– ANSI C57.13-Requirement for Instrument Transformers.

Motor Control Centers

– NEMA ST-20-Dry-Type Transformers for NEMA General Purpose Applications

– NEMA AB-1-Molded Case Circuit Breakers

– NEMA ICS-1-General Standards for Industrial Controls and Systems

– NEMA ICS-2-Industrial Control Devices, Controllers, and Assemblies

– UL 67-Electric Panelboards

– UL 489-Molded Case Circuit Breakers and Circuit Breaker Enclosures

– UL 508-Industrial Control Equipment

– UL 845-Motor Control Centers

– NFPA 70-National Electric Code.

Motors, Low Voltage

– NEMA MG1-Motors and Generators

– AFBMA 9/ANSI B3.15-Antifriction Bearing Manufacturers Association

– NEMA MG2 AFBMA 11/ANSI B3.16-Safety Standard for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators

– NEMA MG13-Frame Assignment for Alternating Current Integral Horsepower Induction Motors.

Motors, Medium Voltage

– ANSI/IEEE C50.41-Polyphase Induction Motors for Electric Power Generating Stations

– IEEE 112-Test Procedure for Polyphase Induction Motors and Generators

– NEMA MG1-Motors and Generators

– NEMA MG2-Safety Standard for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators.

Neutral Grounding Resistors

– ANSI C76.1-Requirements and Test Codes for Outdoor Apparatus Bushings

– IEEE 32-Requirements, Terminology, and Test Procedures for Neutral Grounding Devices

– NEMA CC1-Electric Power Connectors.

Relay Panels

– ANSI C37.20-Switchgear Assemblies Including Metal-Enclosed Bus

– ANSI 37.90-Relays and Relay Systems associated with Electric Power Apparatus

– NEMA WC-3, ICEA S-19-81-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

Transformers, Dry-Type.

– ANSI U1-General Requirements for Dry-Type Distribution and Power Transformers

– NEMA ST20-Dry-Type Transformers for General Application

– UL 506-Standard for Safety, Specialty Transformers.

Other recognized standards will be utilized as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

3.0 ELECTRICAL DESIGN CRITERIA

3.2 ELECTRIC MOTORS

3.2.1 General Motor Design Criteria

These paragraphs outline basic motor design guide parameters for selection and purchase of electric motors.

The following design parameters shall be considered:

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

3.2.1.1 <u>Safety Considerations For Motors</u>

The Occupational Safety and Health Act will be adhered to for personnel protection. Belt guards shall be specified for personnel safety and, when required, to prevent foreign objects from contacting belt surfaces. Guard screens will be provided over motor enclosure openings that would otherwise allow direct access to rotating parts. All electrical motors will be adequately grounded.

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

3.2.1.2 <u>Codes And Standards</u>

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

3.2.1.3 Testing Requirements

Each type of alternating current and direct current machine will be tested at the supplier's factory to determine that it is free from electrical or mechanical defects and to provide assurance that it meets specified requirements. The following criteria and tests will be used in testing each type of machine:

- Fractional horsepower, single-phase induction motors (less than 1 HP). Test procedures will be in accordance with IEEE 114. Test Procedure for Single-Phase Induction Motors.

- Integral horsepower, three-phase, 460 volt induction motors (from 1 HP to 200 HP).

- Routine tests listed in NEMA MG1-1251, Routine Tests for Polyphase Integral Horsepower Induction Motors.

- Test procedures will be in accordance with IEEE 112, Test Procedure for Polyphase Induction Motors and Generators.

- Induction motors rated above 600 volts (250 HP and above).

- Routine tests listed in NEMA MG1-20.46, Polyphase Induction Motors for Power Generating Stations, will be performed on each motor.

- The following additional tests and inspections will be performed on each motor larger than 500 horsepower.

- Locked-rotor current at fractional voltage

Direct Current Motors. The standard routine tests and inspections will be performed on each motor. These shall include the following.

- High potential dielectric test

- Measurement of resistance of all windings

- Inspection of bearings and bearing lubrication system

- No-load running armature current, shunt field current and speed in revolutions per minute, at rated voltage

- Full load armature current, shunt field current, and speed in revolutions per minute, at rated voltage.

- Test procedures will be in accordance with IEEE 113, Test Code for Direct Current Machines.

3.2.1.4 Electrical Design Criteria

Special requirements for individual motors and specifications for special application motors will be included in the individual specification's technical sections.

3.2.1.4.1 Rating Motors shall be selected to permit the connected load to develop its specified output continuously without encroaching on the service factor under normal operating conditions. The service factor shall be 1.15 for motors 200 horsepower and less. Motors larger than 200 horsepower shall have a service factor of 1.0.

Motors will be designed for full voltage starting and frequent starting, where required. Motors will be suitable for continuous duty in the specified ambient conditions. Intermittent duty motors will be selected where recognized and defined as standard by the equipment standards and codes.

The torque of all induction motors will be required to accelerate inertia loads of both motor and driven equipment to full speed without damage to the motor or other equipment. This will be accomplished at any voltage from 90 percent to 110 percent of motor nameplate voltage, except those to be individually considered. A 20 percent voltage drop from the specified motor nameplate rating will be allowed for motor starting.

3.2.1.4.2 Temperature Considerations Integral horsepower motors will be designed for an ambient temperature of 40°C. Motors located in areas where the ambient temperature exceeds 40°C will be designed for that ambient condition.

3.2.1.4.3 Windings and Insulation All insulated windings will have a minimum of Class F non-hygroscopic insulation systems rated for temperature rise and ambient temperature in accordance with NEMA MG1 standards. When ambient temperatures greater than 40°C are specified, the allowable temperature rise will be reduced in accordance with NEMA MG1 standards.

All insulated stator winding conductors and wound-rotor motor secondary windings will be copper. Where required, the windings will be treated with a resilient, abrasion resistant material.

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

3.2.1.4.5 <u>Space Heaters</u> Space heaters, if required, will be sized as required to maintain the motor internal temperature above the dew point when the motor is idle. Motor space heaters will not cause winding temperatures to exceed rated limiting values or cause thermal protective device over-temperature indication when the motor is not energized.

In general, all motors 25 horsepower or larger will have 120 volt, single-phase, 60 hertz, space heaters. The voltage rating of the heaters shall be at least twice its operating voltage of 120 volts. All 4,000 volt motors will have space heaters. Space heaters rated 1,200 watts and less will be suitable for operation on 120 volts, single-phase, 60 hertz. Heaters rated above 1,200 watts will be suitable for operation on 208 volts, three-phase, 60 hertz.

Space heater leads will be stranded copper cable with 600-volt insulation and shall include terminal connectors. Space heater leads will be wired to a separate terminal housing on 4,000 volt motors.

3.2.1.4.6 <u>Nameplates</u> All motor nameplate data will conform to NEMA MG1-20.60 requirements. The following additional nameplate data will be included for 4,000 volt rated motors:

1. Frame size number

2. Service factor

3. Starting limitations

4. Direction of rotation and voltage sequence

5. AFBMA bearing identification number for motors furnished with rolling element bearings

6. For motors with connections to an external lubricant recirculating system, or with an integral forced lubrication system, oil pressure and oil flow required

7. For motors designed for service in hazardous areas.

    (a) Location class and group designation
    (b) Maximum operating temperature value or operating temperature code number.

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

3.2.2 4,000 Volt Squirrel Cage Induction Motors

3.2.2.1 Design and Construction

Design and construction of 4,000-volt motors will be coordinated with the driven equipment requirements.

All motor power lead terminal housings will be adequately sized to terminate the power conductors. For 4,000-volt motors, the power lead terminal housing will also be large enough to provide space to contain the stress cones after installation.

Separate terminal housings will be provided for the following:

- Motor power leads
- Motor accessory leads
- Motor temperature detector leads.

All leads will be wired into their respective terminal housings. All motor leads and their terminals will be permanently marked in accordance with the requirements of NEMA MG1, Part 2.

All motors will have the direction of rotation marked by an arrow or on the nameplate and the leads marked for phase sequence T1, T2, T3 to correspond to the direction of rotation and supply voltage sequence.

All 4,000 volt motors will be totally enclosed fan cooled (TEFC) or NEMA WPII.

Weather protected NEMA Type II enclosures will have standard space heaters, and removable, cleanable air filters.

Squirrel-cage induction motors will have rotors of fabricated copper alloy, cast aluminum or fabricated aluminum alloy.

3.2.2.2 Bearings

All horizontal motors will be provided with sleeve bearings when available and applicable.

Sleeve bearings on horizontal motors will be designed and located centrally, with respect to running magnetic center, to prevent the rotor axial thrust from being continuously applied against either end of the bearing. The motors will be capable of withstanding, without damage, the axial thrusts that are developed when the motor is energized.

Horizontal motors may be furnished with antifriction bearings if standard for motor size, enclosure, and speed.

Kingsbury type or antifriction thrust bearings will be provided for vertical motors.

Thrust bearings for vertical motors will be capable of operating for extended periods at any thrust loading imposed by the specific piece of driven equipment. This will be true during starting and normal operation and will not cause damage to the bearings, the motor frame, or other motor parts.

Bearing lubricants will contain a corrosion inhibitor. The type and grade of lubricant will be indicated on a nameplate attachment to the motor frame or end shield adjacent to the lubricant-filling device.

Insulation will be provided on bearing temperature detectors and on oil piping connections when required to prevent circulation of shaft current through bearings.

Bearings and bearing housings will be designed to permit disassembly in the field for inspection of the bearings or removal of the rotor.

3.2.2.3 Bearing Temperature Detectors

Thermocouple type bearing temperature detectors, complete with detector head and holder assemblies will be furnished when specified. Thermocouple lead wire insulation will be color coded with standard colors to represent the thermocouple metals.

3.2.2.4 Winding Temperature Detectors

Winding temperature detectors will be furnished, installed, and completely wired when specified. Temperature detectors will normally be three-wire resistance temperature detectors (RTDs).

3.2.2.5 Temperature Detector and Terminal Block Requirements

All temperature detectors will be ungrounded with detector leads wired to terminal blocks furnished in the accessory terminal housings. A grounding terminal for each temperature detector will be included with the detector lead terminals. The grounding terminals will be provided with internal wiring to a common ground connection in each terminal box. The internal wiring will be removable.

3.2.3 460-Volt Integral Horsepower Motors

3.2.3.1 Design and Construction

Design and construction of each 460-volt integral horsepower motor will he coordinated with the driven equipment requirements and the requirements of NEMA MG1 Standards.

The motors shall be totally enclosed, non-ventilated (TENV) or totally enclosed fan cooled (TEFC).

Motors for service in hazardous areas will he individually considered for type of enclosure depending upon the classification, group, and division of the hazardous area in question.

Motor power lead terminal housing will be sized to allow for ease in terminating the incoming power cable. Space heater leads will also be wired into this terminal housing.

3.2.3.2 Bearings

Horizontal motors will he provided with oil or grease lubricated sleeve bearings where required. Antifriction bearings may be furnished if standard for motor size, enclosure, and speed.

Sleeve bearings on horizontal motors will be designed and located centrally, with respect to the running magnetic center, to prevent the rotor axial thrust from being continuously applied against either end of the bearings. The motors will be capable of withstanding without damage the axial thrusts that are developed when the motor is energized.

Thrust bearings for vertical motors will be capable of operating for extended periods at any thrust loading imposed by the specific piece of driven equipment. This will be true during starting and normal operation and will not cause damage to the bearings, the motor frame, or other motor parts.

Bearings and bearing housings will be designed to permit disassembly in the field for inspection of the bearings or removal of the rotor.

3.2.4 Direct Current Machines

3.2.4.1 Design and Construction

All direct current machines will be designed and constructed for continuous operation and in accordance with the requirements of NEMA MG1.

3.2.4.2 Service Factor

For motors furnished with a service factor greater than 1.0, the motor nameplate will indicate the horsepower rating at 1.0 service factor, and the service factor. The motor will be designed to provide a continuous horsepower capacity equal to the rated horsepower at 1.0 service factor without exceeding the total limiting temperature rise stated in these specifications for the insulation system and enclosure specified.

3.2.4.3 Insulation and Windings

All insulated windings will have a minimum of Class B nonhygroscopic, or acceptable equivalent, sealed insulation system. All insulated winding conductors will be copper.

3.2.4.4 Bearings

Sleeve bearings for horizontal motors will be oil ring lubricated types or grease lubricated type unless otherwise required. The oil ring will be one piece construction.

3.2.5 Fractional Horsepower Motors

Type, design and construction of each general, special and definite purpose fractional horsepower motor will be coordinated with the driven equipment requirements and will be in accordance with the requirements of NEMA MG1. Motors for service in hazardous areas will be individually considered for type of enclosure depending upon the classification, group and division of the hazardous area in question. All bearings will be self-lubricating with provisions for re-lubrication, and will be designed to operate in any position or any angle.

3.2.6 Motor Operators for Non-modulating Valve, Gate, Or Damper Service

The following requirements are applicable to all electric operators required for non-modulating motor operators.

3.2.6.1 Rating, Design, and Construction

Motors will be designed for high torque, reversing service in a 50°C ambient temperature. Motors will have Class B or higher non-hygroscopic standard insulation plus two coats of epoxy resin. Requirements of NEMA MG1 and MG2 will apply.

Motors will be rated 460 volts, three-phase, 60 hertz unless otherwise required. The direct current (DC) motors will be rated 120 volts DC to operate from a nominal 125 volt battery.

The motor time rating for normal opening and closing service will not be less than whichever of the following is greatest:

- As required for three successive open-close operations
- As required for the service
- Not less than 15 minutes.

Sufficient torque will be provided to operate against system torque at 90 percent nominal voltage for alternating current (AC) motors and at 85 percent nominal voltage for DC motors.

Motors will be totally enclosed unless specified otherwise.

Motors for service in hazardous areas will be individually considered for type of enclosure depending upon the classification, group, and division of the hazardous area in question.

3.2.6.2 Bearings

Double-shielded, grease prelubricated, regreaseable, antifriction bearings will be furnished. Motor leads will be terminated in the limit switch compartment.

3.2.6.3 Space Heaters

All motor operators will be supplied with 120 volt AC, single-phase, space heaters. Space heater leads will be terminated in the limit switch compartment.

3.3 POWER AND CONTROL WIRING

3.3.1 Design Conditions

In general, conductors will be insulated on the bases of a normal maximum conductor temperature of 90°C in 40°C ambient air with a maximum emergency overload temperature of 130°C and a short circuit temperature of 250°C. In areas with higher ambient temperatures, larger conductors will be used or higher temperature rated insulation will be selected. Conductor size and ampacity will be coordinated with circuit protective devices. Cable feeders from 4.16 kilovolt (kV) power equipment will be sized so that a short circuit fault at the terminals of the load will not result in damage to the cable prior to normal operation of fault interrupting devices.

Instrument cable will be shielded to maximize electrical noise attenuation.

To be effective, instrument cable shields will be grounded on one end as follows:

1. The shields on grounded as well as ungrounded thermocouple circuits will be grounded at the thermocouple well.

2. Multi-pair cables used with thermocouples will have individually isolated shields so that each shield will be maintained at the particular couple ground potential.

3. Each RTD (resistance temperature detector) system consisting of one power supply and one or more RTDs will be grounded at only one point.

4. RTDs embedded in windings of transformers and rotating machines will be grounded at the frame of the respective equipment.

5. The low or negative potential side of a signal pair will be grounded at the same point where the shield is grounded. Where a common power supply is used, the low side of each signal pair and its shield will be grounded at the power supply.

3.3.2 Conductors

3.3.2.1 Design Basis

Electrical conductors will be selected with an insulation level applicable to the system voltage for which they are used and ampacities suitable for the load being served.

3.3.2.2 Cable Ampacities

The maximum ampacities for any cable will be determined in accordance with the National Electric Code and depend upon the worst case in which the cable will be routed (tray, conduit, duct, or direct buried). In addition to ampacity, special requirements such as voltage drop, fault current availability and environment will be taken into consideration in sizing of cable.

3.3.3 Insulation

Cable insulation and construction will be as follows:

3.3.3.1 Flame Retardance

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

3.3.3.2 Medium Voltage Power Cable

Power cable with 15 kV class insulation will be furnished for all 13.8 kV service and may be routed in trays, conduits or ducts. Power cable with 5 kV class insulation will supply all 4.16 kV service and may be routed in trays, conduits or ducts.

3.3.3.3 Low Voltage Power Cable 600 Volts

Power cable with 600V-class insulation will supply power to loads at voltage levels of 480VAC and below, and 125VDC and below. Cables may be routed in trays, conduits, or ducts.

3.3.3.4 Control Cable 600 Volts

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

3.3.3.5 Instrument Cable 600 Volts

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

Individual circuit requirements and individual equipment supplier's recommendations will determine the type of cable used.

3.3.3.6 Thermocouple Extension Cable

Thermocouple extension cable will be used for extension leads from thermocouples to junction boxes and to instruments for measurements of temperature. Cables may be routed in trays, conduits or ducts.

3.3.3.7 High Temperature Cable

High temperature cable will be used for wiring to devices located in areas with ambient temperatures above 70°C. Cables may be routed in conduit. Cable lengths will be minimized by terminating the cable at terminal boxes or conduit outlet fittings located outside the high temperature area and continuing the circuit with control or thermocouple extension cable.

3.3.3.8 Lighting and Receptacle Cable

Lighting and receptacle cable will be 600V, 75°C, type THWN insulation, or equal.

3.3.3.9 Grounding Cable

Grounding cable will be insulated or uninsulated bare copper conductor sized as required.

3.3.3.10 Switchboard and Panel Cable

Switchboard and panel cable will have 600V insulation. Cable will be NEC, Type SIS or XHHW, meeting the UL VW-1, flame test.

3.3.3.11 Special Cable

This type of cable will include cable supplied with equipment, prefabricated cable, coaxial cable, communication cable, etc. This cable will normally be supplied by a particular supplier.

Special cable will be routed in accordance with supplier's recommendations.

3.3.3.12 Miscellaneous Cable

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

3.3.4 Testing Requirements

Pre-operational tests will be performed on insulated conductors after installation.

1. Insulated conductors with insulation rated 5,000 volts and above will be given a field DC insulation test after installation as specified in Part 6 of ICEA Standards S-68-516 and S-66-524.

2. Low voltage cables will be either insulation resistance tested prior to connecting cables to equipment or functionally tested (at equipment operation voltage) as part of the checkouts of the equipment system.

3.3.5 Installation

Cable installation will be in accordance with the following general rules:

1. Cables will be routed as indicated in a cable schedule or on the drawings.

2. The pulling tension of cable will not exceed the maximum tension recommended by the cable supplier, and the pulling tension in pounds at a bend will not exceed the cable supplier's recommendations for sidewall pressures. Minimum bend radii shall not exceed the supplier's recommendations.

3. Care will be exercised during the placement of all cable to prevent tension and bending conditions in violation of the supplier's recommendations.

4. All cable supports and securing devices will have bearing surfaces located parallel to the surfaces of the cable sheath and will be installed to provide adequate support without deformation of the cable jackets or insulation.

5. Nylon ties will be used to neatly lace together conductors entering panelboards, control panels, and similar locations after the conductors have emerged from their supporting raceway and before they are attached to terminals.

6. The Electrical Construction Contractor will physically identify both ends of all circuits.

7. All spare conductors of a multi-conductor cable will be left at their maximum length to facilitate replacement of any other conductor in the cable. Each spare conductor will be neatly coiled and taped to the conductors being used.

8. In addition to the above requirements, cables will be installed in accordance with supplier's requirements and recommendations.

3.3.6 Connectors

This subsection defines methods of connecting cable between electrical systems and equipment. In this subsection, the term "connector" is applied to devices that join two or more conductors, or are used to terminate conductors at equipment terminals. This is done to provide a continuous electrical path.

Connector material will be compatible with the conductor material to avoid the occurrence of electrolytic action between metals.

Connectors will meet the bolt hole requirements of Paragraph CCl-4.05 of NEMA standard publication for Electric Power Connectors, Publication CC1.

All medium voltage and low voltage connectors will be pressure type and secured by using a crimping tool.

Medium voltage cables require stress cones at the termination of the cables. Stress cones will be of the pre-formed type suitable for the cable to which they are to be applied.

Cables will not be spliced in cable trays or conduits. Control and low-level instrument cable will be spliced only at pigtails and at the transition to high temperature wire. Connections will be made in conduit outlet fittings or junction boxes utilizing terminal blocks or an appropriate connector.

3.4 PROTECTIVE RELAYING

The selection and application of protective relays are discussed in the following paragraphs. These relays protect equipment in the Auxiliary Power Supply System, Generator Terminal Systems, 115 kV System, 66 kV system, Turbine-Generator System, and the electrical loads powered from these systems.

The following general requirements apply to all protective relay applications:

1. The protective relaying scheme will be designed to remove or alarm any of the following abnormal occurrences:

   (a) Three Phase, Phase-to-Phase and Phase-to-Ground electrical faults
   (b) Overcurrent
   (c) Undervoltage or overvoltage
   (d) Frequency variations
   (e) Overtemperature
   (f) Abnormal pressure

(g) Open circuits and unbalanced current
(h) Abnormal direction of power flow.

2. The protective relaying system will be a coordinated application of individual relays. For each monitored abnormal condition, there will exist a designated primary device for detection of that condition. A failure of any primary relay will result in the action of a secondary, overlapping scheme if possible to detect the effect of the same abnormal occurrence. The secondary relay may be the primary relay for a different abnormal condition. Alternate relays may exist which detect the initial abnormal condition but which have an inherent time delay so that the alternate relays will operate after the primary and secondary relays. Similar to secondary relays, the alternate relays may be primary relays for other abnormal conditions. All protective relays will be selected to coordinate with protective devices supplied by suppliers of major items and the thermal limits of electrical equipment, such as transformers and motors.

3. Secondary current produced by current transformers will be in the 5 ampere range, and voltage signals produced by potential transformers will be in the 120 volt range.

3.4.1 Generator Protective Relays

Protective relay packages will be provided to minimize the effects from the following faults and malfunctions:

1. Generator phase faults
2. Generator stator ground faults
3. Stator open circuits and unbalanced currents
4. Loss of excitation
5. Backup protection for external system faults
6. Reverse power
7. Generator potential transformer circuit monitoring
8. Under/Over frequency
9. Breaker failure.

Equipment furnished with the generator's excitation equipment will provide the following additional protection:

1. Under-excitation
2. Over-excitation
3. Generator field ground faults
4. Excessive volts per hertz.

Additional generator protective monitoring equipment will be provided to protect against the following:

1. High-bearing temperatures
2. Over-speed conditions
3. Excessive vibrations
4. Generator overheating.

A typical complement of protective relay functions for the turbine generator may be as follows. The actual protective relaying to be used will be developed during design stages; a microprocessor based Digital Generator System, solid state or electromechanical type relays may be used for the generator protection.

1. **Generator Differential Relay (Device 87-G1**). A generator differential relay will provide primary generator protection against three-phase and phase-to-phase faults within the generator. This relay will not detect ground faults within its zone of protection.

2. **Generator Ground Relays (Device 64-G).** Device 64-G will be a low voltage pickup, overvoltage relay. It will sense voltage across the generator neutral grounding transformer secondary resistor when a ground fault occurs in the generator, isolated phase bus duct, generator transformer low voltage windings, or the surge protection and potential transformer equipment.

3. **Negative Sequence Relay (Device 46).** The negative sequence relay provides protection against unbalanced phase currents that result from unbalanced loading, unbalanced faults, a turn-to-turn winding fault, and an open circuit. Negative sequence currents exceeding the generator allowable limits result in overheating of the generator rotor.

4. **Loss-of-Field Relays (Device 40).** The loss-of-field relay complete with timer will provide protection against thermal damage caused by under-excitation and loss-of-field. These relays provide backup protection for excitation system protective devices finished with the generator.

5. **Reverse Power Relays (Device 32).** Reverse power relays (Device 32) will provide protection of the turbine generator by detection of reverse power flow and motoring of the generator. Reverse power (Device 32) will initiate a normal sequential shutdown.

6. **Voltage Balance Relays (Device 60).** Voltage balance relay (Device 60) will monitor potential transformer circuits to the generator voltage regulator and protective relays. Upon loss of relaying potential, Device 60 will disable the loss-of-field relay (Device 40) to avoid false tripping of the unit. Upon loss of potential to the voltage regulator, Relay 60 will transfer the voltage regulator from the automatic to manual mode of operation. An alarm will be actuated upon loss of either potential.

7. **Underfrequency Relays (Device 81).** Under-frequency conditions will be detected by Device 81.

8. **Overvoltage and Undervoltage Protection (Devices 27 and 59).** The voltage regulator and excitation system includes interlocks and protective circuits to prevent operating the generator beyond its design limits. An under-voltage relay (Device 27) and an overvoltage relay (Device 59) will alarm if the voltage regulator fails to maintain voltage within design limits.

9. **Field Ground Fault Protection (Device 64F).** Grounds on the generator field will be alarmed by Device 64F, ground detection relay.

10. **Generator Backup Distance Relay (Device 21G).** This relay will provide backup protection against external system faults. The relay will operate only if an external system fault persists after all other primary system relays, including breaker failure, have failed to operate. The relay will trip the generator lockout relay.

3.4.2 Power Transformer Relays

3.4.2.1 <u>Generator Transformer</u>

The generator transformer is protected against the effects of the following conditions:

1. Phase faults
2. Ground faults
3. Sudden pressure.

This protection will be provided by the relays that are discussed in the following paragraphs.

Transformer Differential Relay (Device 87-T1) - a differential relay that provides transformer primary protection. It detects three-phase and phase-to-phase faults in the generator transformer low voltage delta-connected windings, three-phase, phase-to-phase, and phase-to-ground faults in the generator transformer high voltage wye-connected windings.

Transformer Ground Relay (Device 51-T1N) - a ground overcurrent relay that will provide sensitive backup protection for ground faults in the external system.

Transformer Sudden Pressure Relay (Device 63-T1) - rapid increase in pressure within the transformer tank associated with an internal fault will be detected by the sudden-pressure relay. This relay will be furnished with the transformer.

Loss of cooling and resulting high temperature will be alarmed.

3.4.2.2 <u>Auxiliary Transformers</u>

The auxiliary transformers are protected against the effects of the following conditions:

1. Phase faults

2. Ground faults
3. Sudden pressure.

This protection will be provided by the relays, which are discussed in the following paragraphs.

Transformer Differential Relay (Device 87) – a relay provides primary protection for the high voltage and low voltage windings of the auxiliary transformers; and, for the cable connecting each low voltage winding to each incoming main breaker in the plant metal-clad switchgear lineups. This relay offers protection against phase-to-phase and three-phase faults. It is relatively insensitive to ground faults on the secondary side of the transformer should the fault current magnitudes be less than the maximum available ground fault current.

Transformer Ground Fault Relay (Device 51-N) - provides primary overload protection to its neutral winding's resistor for ground faults on the switchgear buses or on feeders emanating from the switchgear lineups. This relay also provides backup protection for ground faults in the transformer low voltage winding, in the cable, on the switchgear buses, or on feeders emanating from the switchgear lineups. This one time overcurrent relay will be connected to the bushing current transformer on the neutral of the low voltage winding of the station auxiliary transformer.

A rapid increase in pressure within the transformer tank associated with an internal fault will be detected by a sudden-pressure relay, Device 63. This relay will be furnished with the transformer.

3.4.3 4 5 kV Motor Controllers

Each induction motor will be protected by main line fuses and a solid-state trip device (SSTD). The SSTD or CT operated motor protection module will provide primary equipment and cable time overcurrent, instantaneous overcurrent, open phase, and zero sequence protection. Both the long-time and instantaneous elements for phase protection will be adjustable.

3.4.4 480 VOLT SYSTEM

3.4.4.1 480 Volt Motor Control Centers

Motor control centers will be protected by their incoming feeder breakers having adjustable long-time and short time SSTD elements for phase protection and ground fault protection. The SSTD protects the MCC feeder circuit and the bus against sustained short-circuit currents and serves as backup protection for MCC feeder circuits.

Each magnetic starter within an MCC which supplies power to a motor will be equipped with an adjustable motor circuit protector and a thermal overload element in the starter to protect motors against overload.

Non-motor loads will be fed from MCC feeder circuit breakers. The feeder breakers will be thermal magnetic molded case breakers sized to protect supply cable and individual loads.

Motors, 200 hp and less, will be powered from MCC starters.

3.5 CLASSIFICATION OF HAZARDOUS AREAS

Areas where flammable and combustible liquids, gases, and dusts are handled and stored will be classified for determining the minimum criteria for design and installation of electrical equipment to minimize the possibility of ignition. The criteria for determining the appropriate classification are specified in Article 500 of the National Electrical Code (NFPA/ANSI C1).

In addition to defining hazardous areas by class and division, each hazardous element is also assigned a group classification (A, B, C, etc.). The group classifications of hazardous elements are specified in Article 500 of the NEC.

Electrical equipment in areas classified as hazardous will be constructed and installed in accordance with the requirements of Articles 501 and 502 of the National Electrical Code.

References for use in classification of areas, as well as specification of requirements for electrical installation in such areas, include the following:

National Electrical Safety Code ANSI C2
National Electrical Code ANSI C1, NFPA 70/ANSI C1
National Fire Codes, National Fire Protection Association codes, standards, and recommendations
American Petroleum Institute Recommended Practices

3.6 GROUNDING

The station grounding system will be an interconnected network of bare copper conductors and copper clad ground rods. The system will be provided to protect plant personnel and equipment from hazards, which can occur during power system faults and lightning strikes.

3.6.1 Design Basis

The station grounding grid will be designed for adequate capacity to dissipate heat from ground current under the most severe conditions in areas of high ground fault current concentrations, with grid spacing such that safe voltage gradients are maintained.

Bare conductors to be installed below grade will be spaced in a grid pattern to be indicated on the construction drawings. Each junction of the grid will be bonded together by an exothermic welding process.

Grounding stingers will be brought through the ground floor and connected to the building steel and selected equipment. The grounding system will be extended, by way of stingers and conductor installed in cable tray, to the remaining plant equipment. Equipment grounds will conform to the following general guidelines:

1. Grounds will conform to the NEC and NESC

1. Major items of equipment, such as switchgear, secondary unit substations, motor control centers, relay panels, and control panels, will have integral ground buses which will be connected to the station ground grid.

2. Electronic panels and equipment, where required, will be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations.

3. Motor supply circuits to 460-volt motors, which utilize three-conductor cable with a ground conductor, will utilize this ground conductor for the motor ground. For 460-volt motor supply circuits that utilize three single-conductor cables, a separate ground cable will be utilized.

4. All 4,000 volt motors will have a minimum of one 2/0 AWG bare copper ground conductor connected between the motor frame and the station ground grid.

5. A grounding conductor will be routed parallel to all power conductors operating above 208/120 volts.

6. All ground wires installed in conduit will be insulated.

3.6.2 Materials

Grounding materials furnished are described below:

1. Rods will be copper clad steel. Ground rod length and diameter will be determined by soil resistivity and subsurface mechanical properties.

2. Cable will be soft-drawn copper with Class B stranding.

3. Exothermal welds, where required, will use molds, cartridges, and materials as manufactured by Cadweld or equivalent.

4. Clamps, connectors, and other hardware used with the grounding system will be made of copper and purchased from an approved supplier.

5. Ground wires installed in conduit will be soft-drawn copper with Class B stranding, and green colored 600 volt PVC insulation.

3.7 SITE LIGHTING

The site lighting system will provide personnel with illumination for the performance of general yard tasks, safety, and plant security. Power used to supply outdoor roadway and area lighting fixtures will be at 208 or 480 volts.

3.7.1 Light Source

The lighting system will be designed in accordance with the Illuminating Engineering Society (IES) to provide Illumination levels recommended by the following standards and organizations:

- ANSI/IES RP-7, 1979, Industrial Lighting
- ANSI/IES RP-8, 1977, Roadway Lighting
- Occupational Safety and Health Act (OSHA).

Light source size and fixture selections will be based on the applicability of the luminaries for the area under consideration during detail design.

3.7.2 Roadway and Area Lighting

Roadway and area lighting will be designed using high-pressure sodium light source. The light fixtures will be the cutoff types designed to control and direct light within the property line of the facilities. Roadway light fixtures will be installed on hot-dipped galvanized steel poles. Local task lighting will be installed on structures or equipment.

3.7.3 Lighting Control

Electric power to light fixtures located outdoors will be switched on and off with photoelectric controllers. Local task lighting will be controlled with conveniently located manual switches.

3.8 FREEZE PROTECTION

A freeze protection system will be provided for selected outdoor piping as required.

Parallel circuit type heating cable will be utilized where possible. These heating cable circuits can be assembled and installed in the field using the appropriate connection kits.

Power distribution panelboards will furnish power to the freeze protection circuits.

3.9 LIGHTNING PROTECTION

Lightning protection will be provided as required in NFPA 78.

3.10 RACEWAY AND CONDUIT

The design and specifications for the raceway and conduit systems used in supporting and protecting electrical cable will be in accordance with the provisions of the NEC.

3.10.1 Cable Tray

All cable trays except electronic trays will be of trough or ladder type construction with a maximum rung spacing of 9 inches, nominal depths of 4 to 6 inches, and various widths as required.

Cable tray shall be supported in accordance with NEMA standards.

Cable tray fittings will have a radius equal to or greater than the minimum bending radius of the cables they contain.

Solid bottom trays will be provided for all electric systems such as special noise-sensitive circuits and analog instrumentation circuits.

At any cross section of the tray, number of cables shall be limited as per NEC Article 318.

The minimum design vertical spacing for trays will be 9 inches measured from the bottom of the upper tray to the top of the lower tray. At least a 9-inch clearance will be maintained between the top of a tray and beams, piping, or other obstacles to facilitate installation of cables in the tray. If possible, a working space of not less than 24 inches will be maintained on at least one side of each tray.

Ventilated covers will be provided for vertical trays. Solid covers will be provided for all solid bottom trays. Solid covers will also be provided for the top tray of horizontal tray runs located under grating floor or insulated piping.

3.10.2 Conduit

Rigid Steel Conduit (hot dipped galvanized) will be used to protect cable routed to individual load/devices, in hazardous areas, and where the quantity of cable does not economically justify the use of cable tray.

Electrical Metallic Tubing (EMT) will be used indoors in non-hazardous areas for lighting branch circuits and communication circuits.

PVC conduit will be used for underground duct banks and some below grade concrete encased conduit.

Liquid-tight flexible metallic conduit will be used for connections to accessory devices such as solenoid valves, limit switches, pressure switches, etc. It will also be used for connections to motors or other vibrating equipment; and across areas where expansion or movement of the conduit is required.

Plastic or aluminum conduit will be used for specific environmental requirements.

Exposed conduit will be routed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings.

Conduit in finished areas, such as the offices and Control Room, will be concealed. Conduit will be routed at least six inches from the insulated surfaces of hot water and other hot surfaces. Where conduit must be routed parallel to hot surfaces, high temperature cable will be used. Conduit will be sized in accordance with the conduit fill requirements of the National Electrical Code.

3.10.3 Duct Bank and Manholes

Underground duct banks will be used for cable routed between outlying areas and other remote areas as necessary.

All underground duct banks will consist of PVC tubing encased in red dyed concrete. Minimum size of the plastic duct will be two-inches.

All underground duct banks will be installed in accordance with the following methods:

- Ducts will be sloped to manholes to provide adequate drainage. Low spots in duct runs will be avoided.

- Reinforcing steel, if required, will not form closed magnetic paths between ducts. Nonmetallic spacers will be used to maintain duct spacing.

Reinforced concrete manholes and electrical vaults will be provided, where required, so that cable may be installed without exceeding allowable pulling tensions and cable sidewall pressure. Each manhole will have the following provisions:

- Provisions for attachment of cable pulling devices

- Provisions for racking of cables

- Manhole covers of sufficient size to loop feed the largest diameter cable through the manhole without splicing

- Sealed bottoms and sumps

Conduit from manholes to the equipment at remote locations will be changed to rigid galvanized steel prior to emerging from below grade. All below grade rigid galvanized steel conduit will be wrapped and encased in concrete.

Ductbank and manholes shall be designed in accordance with the seismic criteria defined in Appendix D, Structural Design Criteria.

Ductbank will be designed to include spare capacity to allow for future growth and expansion.

3.11 CATHODIC PROTECTION SYSTEM

Consideration will be given to the need for cathodic protection and other corrosion control measures for all plant structures, including the following structures:

- The exterior surface of underground welded carbon steel pipe, copper pipe, stainless steel pipe, cast iron and ductile iron pipe, and prestressed concrete cylinder pipe.

- The bottoms of surface mounted steel tanks.

It is expected that buried bare copper ground grid components will be in close proximity to, but not in contact with, underground welded steel piping and welded steel tank bottoms. Measures will be taken for the control of corrosion so as not to materially reduce the total effectiveness of the plant electrical safety grounding systems.

The methods to be used for cathodic protection will be a sacrificial anode system or an impressed current cathodic protection system, or both. The detailed design will be determined after tests to determine minimum average soil resistivity or layer resistivity, which may be expected in pipe burial zones.

CONTROL SYSTEMS ENGINEERING DESIGN CRITERIA
(APPENDIX G FROM 99-AFC-7)

APPENDIX G

CONTROL SYSTEMS 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 programs/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
- Testing and checkout, start-up, and
- Project completion.

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

Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general design criteria for general conditions, instruments, modulating type control systems, motor controls, and control equipment locations.

2.0 DESIGN CODES, STANDARDS, LAWS AND REGULATIONS

The design specifications for all work will be in accordance with the applicable laws and regulations of the federal government, the State of California, and applicable local codes and ordinances. A summary of 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)
- Instrument Society of America (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)

- Scientific Apparatus Makers Association (SAMA)
- American Society for Testing and Materials (ASTM).

Other recognized standards will be utilized as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

3.0 CONTROL SYSTEMS DESIGN CRITERIA

3.1 GENERAL REQUIREMENTS

3.1.1 Ambient Conditions

All field-mounted instruments and control devices will be designed to withstand extremes of the outdoor ambient temperatures and relative humidities found at the site.

All instruments and control devices installed in air-conditioned areas will be designed for operating conditions of 25ºC ambient temperature and 50 percent relative humidity. In case of an air-conditioning failure, they shall operate in temperatures ranging from 10ºC to 40ºC for extended periods of time (several hours to several days) and 30ºC transients.

3.1.2 Power Supplies

All instruments and control devices will be designed to operate using the following power supplies:

- Electric

  - 120 volt alternating current (AC), 60 hertz, single-phase for logic and low torque drives
  - 125 volt direct current (DC) for logic and low torque drives
  - 480 volt ac, 60 hertz, 3-phase for high torque drives.

Any voltage required other than the above will be furnished by the equipment supplier.

- Pneumatic

  – Clean, dry, and oil free instrument air at 70 to 125 pounds per square-inch gage (psig). All necessary pressure reducing controls, where required, will be furnished by the equipment supplier.

3.1.3 Standard Ranges of Analog Signals

The ranges of analog signals will normally be as follows:

- Electric

  - 4 to 20 MADC

- Pneumatic

  - 3 to 15 psig

The use of any signal range other than the above will be avoided.

3.1.4 Contact Ratings

The ratings of all instrument contacts used for alarms and interlocks will have a minimum rating sufficient for use on microprocessor based systems.

The ratings of all microprocessor output contacts will be the supplier's standard rating.

3.2 INSTRUMENTS

3.2.1 Instrument Primary Piping/Tubing

Instrument primary piping/tubing is defined as the piping directly connected to the process (the outlet of the root valve), and terminating at the blowdown valve and at the point of connection to the instrument itself.

3.2.1.1 <u>Sizes of Instrument Primary Piping/Tubing</u>

Instrument primary piping/tubing will not be smaller than the connection at the process pipe root valve and/or the following:

- One-half inch outside diameter (O.D.) with a wall thickness of 0.065 inches.

- Three eighth inch outside diameter with a wall thickness of 0.065 inches may be used for those parts of a sampling system within a panel or a rack.

- Float-actuated level switch devices will be supported on connecting piping not smaller than one inch.

- Level controllers and transmitters of the displacement float type will be supported on connecting piping not smaller than two inches.

- Instrument columns for float actuated level switches and displacement float devices will be supported on connecting piping of not less than 2-1/2 inches.

3.2.1.2 Materials for Instrument Primary Piping/Tubing

All primary sensing, sampling and control systems will use stainless steel tubing conforming to ASTM 213, Grade TP 316, with compression type fittings. Instrument air supply will use Type K drawn tempered copper tubing.

3.2.1.3 Insulation and Freeze Protection of Instrument Primary Piping/Tubing

Instrument primary piping or tubing connecting to high temperature systems, which might become hot enough to injure personnel during blowdown of the instrument line, will be insulated where such hazard exists. Insulation materials, exterior finish, and metal lagging will conform to the standards adopted for the process piping.

All water-filled primary piping or tubing in plant areas subject to freezing will be insulated and freeze protected.

3.2.1.4 Criteria for Routing of Instrument Primary Piping/Tubing

Routing of instrument primary piping including piping from the process connection through the root valve and the instrument primary piping, will be in accordance with the following criteria.

Special fittings such as reservoirs and other devices will be installed at flow primary element connections as required by the design of the instrument, in accordance with instructions of the instrument supplier.

Instrument primary piping for liquid flow, and manometer level measurement systems should preferably slope downward from the primary element connections to the instrument. Instrument primary piping for flue gas and airflow measurement systems should preferably slope upward from the primary element connections to the instrument. If these requirements

cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than ½ inch per foot and must be adequately supported to maintain a constant slope.

3.2.1.5 Support of Instrument Piping

Instrument primary piping and stainless steel tubing will be supported in accordance with support requirements for process piping. Pneumatic signal and air supply tubing will be continuously supported. Continuous support will normally be provided by tubing tray.

3.2.2 Thermowells and Protecting Tubes

Fluid system temperature sensors will be equipped with 1-1/2 inch flanged thermowells and will be made of one piece, solid bored Type 316 stainless steel of stepless tapered design.

Temperature detectors in exhaust gas ducts will be mounted to permit replacement while in operation. Duct connections will consist of screwed couplings or adapter flanges welded to the ducts, into which the bushings on the protecting tubes can be threaded. Duct connections will be located to minimize the effect of temperature stratification within the ducts.

3.2.3 Thermocouples and Resistance Temperature Detectors

Temperature detectors will preferably be chromel-constantan type (ISA Type E) thermocouples with Type EX extension cable or chromel-alumel (ISA Type K) with Type KX extension cable. The elements, as a rule, will be separate from ground (ungrounded). A ground lug shall be provided in the thermocouple head.

Resistance temperature detectors (RTD's) will be of the three-wire 100 Ohm platinum type. All RTDs for measurement of fluid system temperature will be ungrounded, metal sheathed, ceramic packed, and suitable for the design temperature, pressure, and velocity of the fluid system.

Thermocouples and RTD's will have sheathed elements spring-loaded to provide good thermal contact with the well or protecting tube.

3.2.4 Transmitters

Transmitters will be used to provide the required 4 to 20 maDC signals for all control systems. Transmitters will be of the electronic two-wire type, capable of driving a load up to 750 Ohm, designed with provisions for tamper-proof zero and span adjustments.

3.2.4.1 Static Pressure and Differential Pressure Transmitters

Sensing elements for static pressure and differential pressure transmitters will be of either the capacitance or strain gauge type.

For water services, static pressure transmitters will be equipped with a two-valve manifold, and differential pressure transmitters will be equipped with a three-valve manifold.

3.2.4.2 Level Transmitters

Sensing elements for level transmitters will be of the following types:

- Static head devices for vessels exposed to atmospheric pressure; capacitance type devices; or air bubbler type devices if absorption of air by the liquid is not objectionable.

- Differential pressure type with constant head chamber for high pressure and temperature applications where installation of float cage becomes impractical. (Level transmitters of this type are the same as differential pressure transmitters.)

- Displacement float type or differential pressure type for enclosed vessels. Moving float type for fuel oil storage tanks.

3.2.4.3 Flow Transmitters

Flow transmitters for general applications will be of the differential pressure smart type.

- Primary Elements. Flow nozzles will be used for feedwater flow and other critical measurements where weld-in construction is required.

- Paddle type orifice plates will be used for other flow measurements where flanged construction and higher pressure loss are acceptable. Orifice flanges will be of the raised face weld neck type with dual sets of taps.

- Secondary Elements. Secondary elements for differential type flow sensors will be strain gauge or capacitance type differential pressure (DP) transmitters. Square root extraction required for the DP transmitters will be performed electronically in the control system that receives the transmitter output signal.

3.2.5 Temperature, Pressure, Level, and Flow Switches

Temperature, pressure, level and flow switches will generally have double-pole, double-throw (two Form C) contacts for each actuation point and will be equipped with screw type terminal connections on a terminal block for terminating field wiring.

3.2.5.1 Temperature Switches

Temperature switches will be actuated by filled-bulb type elements equipped with standard length armored capillary tubing.

3.2.5.2 Pressure Switches

Pressure switches will be actuated by disk or diaphragm type elements.

3.2.5.3 Level Switches

Level switches will be actuated by elements of the following types:

- Static head devices for vessels exposed to atmospheric pressure; air bubbler type devices may be used if absorption of air by the liquid is not objectionable. (Level switches of this type are the same as static pressure switches.)

- Differential type for high-pressure and high temperature applications. (Level switches of this type are the same as differential pressure switches.)

- Displacement float type or differential type for enclosed vessels.

- Moving float type for open tanks and sumps.

- Nuclear, admittance, or ultrasonic type for specialized applications.

3.2.5.3 Flow Switches

Variable area or differential pressure type actuating elements will be used for low flow and low pressure applications.

3.2.6 Local Indicators

3.2.6.1 Local Temperature Indicators (Thermometers)

Thermometers for local mounting will be 4-1/2 inch dial gas-actuated thermometers, or an acceptable equal. Thermowells will be furnished for all thermometers.

3.2.6.2 Local Pressure Indicators (Pressure Gauges)

Gauges for control air supply and signal pressures integral to an instrument will be in accordance with the instrument supplies standards. All other gauges will be 4-1/2 inch minimum dial size, or an acceptable equal. Dials will be scaled so that the normal operating range is in the middle third of the dial range. Gauges for fluids that may be corrosive to the gauge internals will be furnished with glycerin filled cases and diaphragm seals.

3.2.6.3 Local Level Indicators (Gauge Glasses)

Tubular gauge glasses will be used for low-pressure applications. Transparent or reflex gauges will be used for high-pressure applications. All gauge glasses will be equipped with gauge valves including a safety ball check.

3.2.6.4 Flow Indicators

Sight flow and variable flow indicators will be used for low-pressure and low temperature applications. The use of sight and variable flow indicators will be restricted to applications where quantitative measure of flow is not required.

Flow indicators for high-pressure and high temperature applications are not anticipated.

3.2.7 Solenoid Valves

Solenoid coils will generally be high temperature low wattage construction and will be designed for continuous duty. Three-way solenoid valves will be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures will be NEMA 4.

3.3 MODULATING TYPE CONTROL SYSTEMS

3.3.1 Electronic Control Systems

A distributed microprocessor-based control system will be used to implement plant controls strategies. This Distributed Control System (DCS) will integrate coordinated control, motor control data acquisition, and annunciation functions.

Control systems supplied with individual supplier's equipment will, to the extent practical, be designed to be integrated into the plant DCS.

3.3.2 Pneumatic Controllers

The use of pneumatic controllers will be minimized, but may be used for the following applications:

- Control loops which require only proportional or proportional plus reset action, but require no remote manual positioning by the Control Room operator, and

- Control loops that do not require any interface with any receiver installed in the central room.

3.4 MOTOR CONTROLS

3.4.1 Motor Interlocks

Motor interlocks will be designed in accordance with the following criteria and will be implemented in the DCS.

3.4.1.1 <u>Protective Interlocks</u>

The protective interlocks for each motor and its associated equipment will be designed as follows:

- To prevent the motor from being started if the starting permissives required for safe operation are not satisfied

- To automatically stop the motor under unsafe operating conditions when any action by the operator may be too slow to prevent the motor and its associated equipment from being damaged

- To automatically start any standby equipment as a result of a motor trip and/or as required by the process, and

- To provide status information to inform the operator of the equipment status at all times.

3.4.1.2 <u>Standby Starts</u>

Components in a system, such as turbine lube oil pumps, which are paired to back up each other, will have a standby mode imposed upon the protective interlock scheme. If the redundant pump is in the standby mode when the operating pump is tripped, or a process parameter indicates that the operating pump has failed, the standby pump will start. After a

pump has started in the standby mode, the pump will not stop automatically, except on a trip condition. An alarm will be sounded to alert the operator that the pump has standby-started.

3.4.1.3 Automatic Starts and Stops

Equipment in some systems will operate in an automatic mode in which the starting and stopping of a motor are initiated automatically. An example of the automatic mode would be a link fill pump that automatically starts at a low level and stops at a high level. Automatic motor actuation will not be alarmed unless the automatic action is initiated by a protective interlock.

3.4.2 Sequential Controls

Sequential controls apply control logic to a system or group. The basic functions are to coordinate the operation of all components within a functional group and to automatically start or stop all components in a predetermined sequence without the operator initiating any step-by-step control during the process. Sequential controls will be used on the various water treatment systems.

3.4.3 Hardware Selection

3.4.3.1 Logic Systems

The main plant controls will utilize DCS type hardware data linked to the combustion turbine control systems. Controls purchased as part of an equipment package may utilize electromechanical or solid-state hardware, or may be hybrid.

3.4.3.2 Local Control Hardware

Small fans and pumps may be controlled by local control switches, if advantageous.

3.5 LOCATION OF CONTROL EQUIPMENT

Control equipment refers to the control devices used to implement the modulating control and motor control systems.

All pneumatic controllers will be field-mounted locally. All other control devices will be either mounted on a control panel in a control cabinet, or on local stands.

3.5.1 Control Areas

Control areas will include the Control Room, the electronic equipment room, and local areas in which local control stations and local control panels are located.

3.5.1.1 Control Room

The Control Room will contain the desk type control consoles from which the operator will conduct all normal and emergency operations of the unit. The Control Room will contain all auxiliary control panels. The control room will be environmentally controlled.

The alarm, utility, and log printers will also be located in the Control Room.

3.5.1.2 Electronic Equipment Room

The electronic equipment room for the installation of control equipment, computer cabinets, turbine supervisory system, and other solid-state electronic equipment will be provided in an area adjacent to the Control Room. The electronic equipment room will be environmentally controlled.

3.5.1.3 Local Control Areas

Local control areas will be established for systems where it is advantageous to have operator control in the vicinity of the equipment being controlled.

CHEMICAL ENGINEERING DESIGN CRITERIA
(APPENDIX H FROM 99-AFC-7)

APPENDIX H

CHEMICAL 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 programs/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
- Start-up, testing, and checkout
- Project completion.

The purpose of this appendix is to summarize the codes, standards and general engineering design criteria for the systems storing, handling or otherwise using of chemicals on the Project. These criteria form the basis of the design for these components and systems of the Project. More specific design information will be developed during detailed design to support equipment and erection specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general design criteria for design water quality, chemical conditioning, chemical storage, and waste water treatment.

2.0 DESIGN CODES AND STANDARDS

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

- ASTM - American Society for Testing and Materials

  - ASTM D1888 - Referee Method B for TDS
  - ASTM D859 - Referee Method B for Silica as $Si0_2$
  - ASTM D888 - Referee Method A for Dissolved Oxygen
  - ASTM D313 - Referee Method D for $C0_2$.

- OSHA - Occupational Safety and Health Administration.

Other recognized standards will be used as required to serve as design, fabrication, and

construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

3.0 GENERAL DESIGN CRITERIA

The conceptual design of the plant water system includes the following two options:

- California Aqueduct water owned by Wheeler Ridge-Maricopa Water District
- Zero discharge and water reuse.

The system selected will be based on an economic evaluation of the options and plant reliability requirements. For a discussion of the make-up and sources of water considered and selected, see Section 3.4.8 – Water Supply and Treatment.

The California Aqueduct water will be used for evaporative cooling of the turbine inlet air, HRSG boiler feed water, and cooling tower makeup.

The plant potable water will be generated by an on site treatment system. All sanitary sewage water produced will be sent to an on site sanitary waste treatment system. An on site leach field will handle sanitary liquid discharges.

3.1 WATER TREATING SYSTEM

The water treating systems will consist of an inlet clarification cooling water treatment system, HRSG make-up water treatment system and a possible wastewater recovery and reuse system.

Each system will be of reliable and proven design for each of the unit operations. Water storage tanks will be designed with a working capacity reserve to meet expected maintenance downtime of water treatment equipment. Redundancy will be provided if required for equipment that is identified to be critical and could affect plant operations.

3.1.1 Water Quality

The plant water treatment systems will treat the California Aqueduct water to meet the minimum water and steam quality required to safely operate the combustion turbines, steam turbine, HRSG and cooling tower equipment as required per industry and equipment supplier standards.

The HRSG cycle make-up water quality will be mixed bed water quality. The boiler feedwater quality will be the quality required to produce steam of purity as required by the steam turbine supplier at the design blowdown rate of the HRSG.

The water quality data for the California Aqueduct water and wastewater composition are shown in Appendix B.

3.1.2 Chemical Treatment

The California Aqueduct water chemical treatment system will include the following subsystems:

- Coagulant and polymer feed system for clarification and hypochlorite feed system for biological control. The system will provide for continuous monitoring and control of parameters and feed specified quantities of chemicals for optimum results as specified by the chemical treatment supplier.

The cooling water chemical treatment system will include the following subsystems:

- Circulating water sodium hypochlorite feed system, corrosion inhibitor feed system, dispersant feed system and cooling tower acid feed system. The system will provide for continuous monitoring and control of parameters and feed specified quantities of chemicals for optimum results as specified by the chemical treatment supplier.

The HRSG makeup water chemical treatment system will include the following subsystems:

- Oxygen scavenger feed system, neutralizing amine feed system, and phosphate feed system. The system will provide for continuous monitoring and control of parameters and feed specified quantities of chemicals for optimum results as specified by the chemical treatment supplier. The wastewater chemical treatment system will include the evaporator acid feed system and evaporator caustic feed system. The system will provide for continuous monitoring and control of parameters and feed specified quantities of chemicals for optimum results as specified by the chemical treatment supplier.

The above systems will be designed using materials of construction suitable for the service conditions and the nature of chemical fluids being handled.

3.2 CHEMICAL STORAGE

3.2.1 Storage and Handling

All bulk storage tanks will be designed using materials of construction suitable for the nature of chemicals being stored. Tanks requiring lining will be identified and will be compatible with the storage tank contents.

Chemicals will be delivered by truck, and the truck unloading station will be suitably designed taking into account all the applicable codes and standards for handling of corrosive chemicals.

The exact size of each chemical tank will be determined based on expected weekly/monthly or annual usage with a suitable minimum storage available to receive all scheduled bulk shipments. In general, bulk tanks may be sized to store a minimum of 1.5 times the normal bulk shipment.

For aqueous ammonia, the storage tank will be designed to provide an average of two weeks of working capacity storage.

3.2.2 Containment

All chemical storage areas will be suitably curbed or diked with drain piping to the neutralization sump. The curbing or dike will allow a full tank capacity spill to be contained including an allowance for rainwater. For multiple tanks located within the same curbed area, the largest single tank will be used to size the curbing and drain piping.

Design of the aqueous ammonia storage tank and truck fill areas will include all safety precautions to contain spills and a safety response procedure to react to any ammonia vapor release. Emergency showers and eye wash will be provided. in the work area. All OSHA safety regulations for storage and handling will be strictly followed.

3.3 COATINGS

Storage tanks, piping and chemical storage applications will be provided with a protective coating system as required. The specific requirements for selection of an appropriate coating will be identified during detailed engineering.

3.4 PLANT DRAINS AND WASTE WATER

The plant drain system will receive, segregate, treat and transfer all plant process and maintenance liquid streams to the wastewater collection and treatment system. Two options are proposed for disposal of wastewater:

- Discharge and injection to new or existing Class I injection wells
- Treatment of wastewater in a zero discharge facility. Water would be recycled to inlet of water treatment plant for reuse.

The sanitary wastewater will be discharged to a new on site leach field.

ELECTRIC AND MAGNETIC FIELDS CALCULATIONS (APPENDIX P FROM 99-AFC-7)

APPENDIX P

ELECTRIC AND MAGNETIC FIELDS CALCULATIONS

Electric and magnetic fields were calculated using the Bonneville Power Administration Corona and Field Effects program for all combinations of possible phasing under worst case conditions. These conditions result in the calculation of the highest electric and magnetic fields that would be expected adjacent to the right of way. These conditions include modeling the fields from three existing 230 kV transmission lines in an immediately adjacent corridor. Comparison of the results showed one phasing arrangement resulted in nearly the lowest electric and magnetic fields on the right of way and the lowest electric and magnetic fields adjacent to the right of way. The phasing arrangement which produced the lowest electric and magnetic fields was selected as the recommended conductor arrangement of CBA ABC from west to east bottom to top. This phasing arrangement also results in an industry standard arrangement that is understood by crews working on the lines.

Assumptions for magnetic field calculations:

1. Maximum current (1395 amps/phase) available from the project at full future output of 1025 MW operating at the minimum plant voltage.
2. Maximum currents calculated using the SCE stressed 2002 Light Spring adjusted to result in maximum flow on the adjacent corridor.
3. Expected double circuit bundled conductor construction.
4. Maximum conductor sag resulting in minimum code ground clearance of the PEF line and all lines in the adjacent corridor.
5. All calculations are made for fields one meter above the ground.

Assumptions for calculation of electric fields:

1. Maximum system operating voltage of 240 kV.
2. Expected double circuit bundled conductor construction.
3. Maximum conductor sag resulting in minimum code ground clearance of the PEF line and all lines in the adjacent corridor.
4. All calculations are made for fields one meter above the ground.

Two sets of calculations were performed enveloping the expected initial conditions (925 amps and 10 feet additional ground clearance) and the worst case condition (1395 amps and minimum ground clearance) for comparison to worst case conditions.

Three Figures are included.

Figure 1 shows predicted magnetic fields for the recommended phasing under worst case conditions.

Figure 2 shows predicted electric field for the recommended phasing under worst case conditions.

Figure 3 shows predicted magnetic fields for the expected or as-built conditions.

Assuming an easement width of 100 feet with the centerline of the transmission structure in the center of the easement, the magnetic fields are calculated to as listed in the table below.

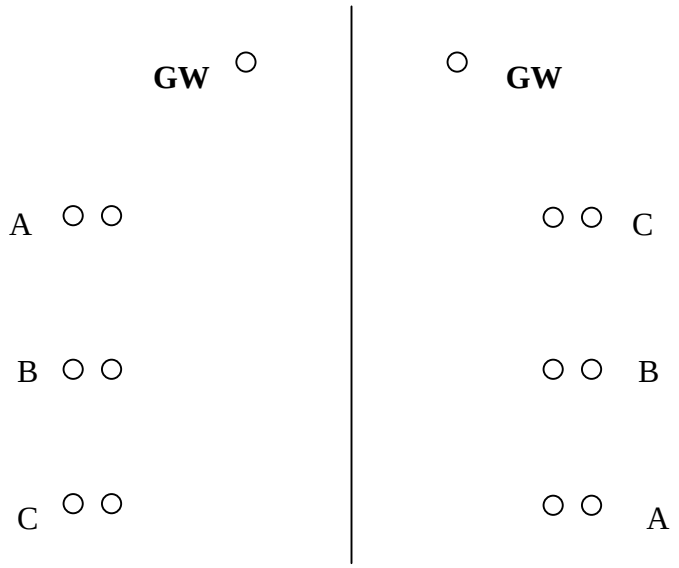
Magnetic Fields in Milli Gauss (mG)	Easement Edge-50 feet from centerline	100 feet from centerline	150 feet from centerline
Worst Case	40.96	11.76	9.85
Expected Peak	19.95	9.96	9.55

Electric Fields in kV/meter	Easement Edge-50 feet from centerline	100 feet from centerline	150 feet from centerline
	0.75	0.04	0.04

Table 1 depicts the recommended phasing arrangement.

Recommended Phasing Arrangement
Table 1

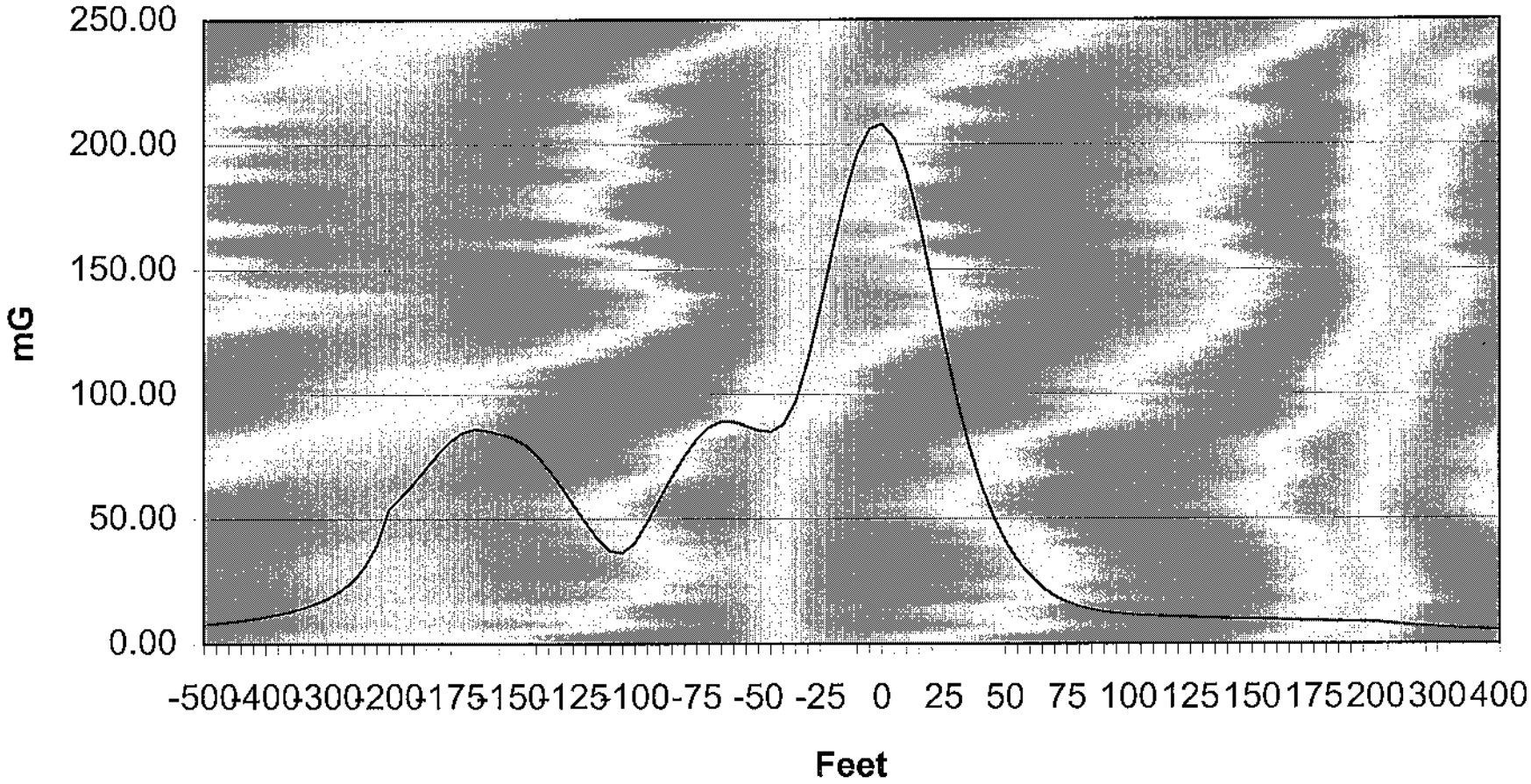
Looking North



Pastoria Energy Facility

CBA ABC

Figure 1

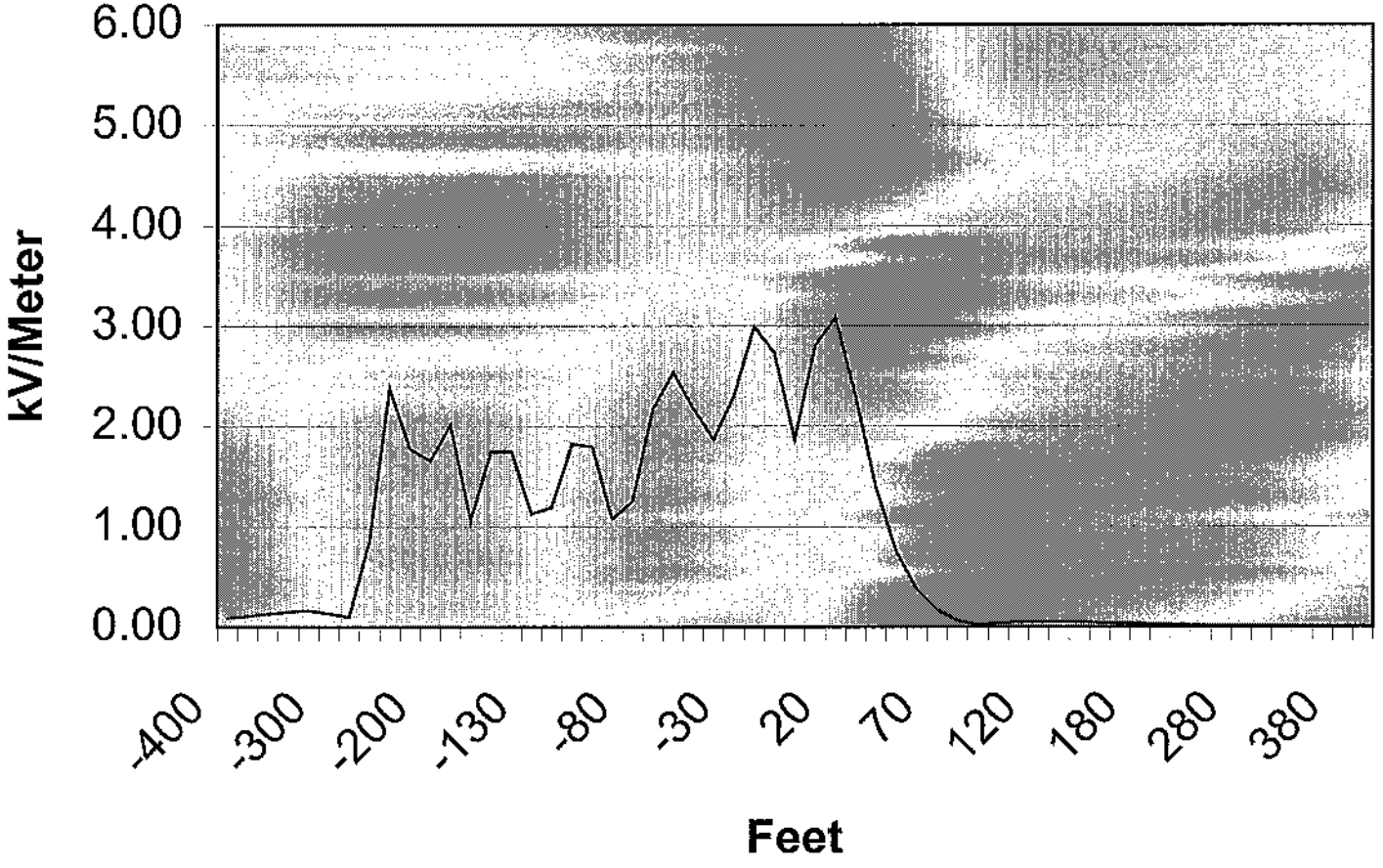


NPH=	15.00	Calculated	CBA ABC
Feet	Vert	Milligauss	
-500	3.28	7.80	
-480	3.28	8.27	
-460	3.28	8.80	
-440	3.28	9.40	
-420	3.28	10.09	
-400	3.28	10.90	
-380	3.28	11.85	
-360	3.28	12.98	
-340	3.28	14.35	
-320	3.28	16.05	
-300	3.28	18.22	
-280	3.28	21.07	
-260	3.28	24.97	
-240	3.28	30.62	
-220	3.28	39.37	
-200	3.28	53.90	
-195	3.28	58.84	
-190	3.28	64.33	
-185	3.28	70.19	
-180	3.28	76.03	
-175	3.28	81.16	
-170	3.28	84.69	
-165	3.28	86.01	
-160	3.28	85.43	
-155	3.28	84.12	
-150	3.28	82.58	
-145	3.28	79.94	
-140	3.28	75.56	
-135	3.28	69.67	
-130	3.28	62.87	
-125	3.28	55.70	
-120	3.28	48.54	
-115	3.28	41.97	
-110	3.28	37.23	
-105	3.28	36.34	
-100	3.28	40.61	
-95	3.28	48.72	
-90	3.28	58.05	
-85	3.28	66.97	
-80	3.28	75.02	
-75	3.28	81.84	
-70	3.28	86.72	
-65	3.28	89.03	
-60	3.28	88.89	
-55	3.28	87.23	
-50	3.28	85.43	
-45	3.28	84.94	
-40	3.28	87.76	

-35	3.28	97.03
-30	3.28	113.67
-25	3.28	135.00
-20	3.28	157.98
-15	3.28	179.44
-10	3.28	196.19
-5	3.28	205.99
0	3.28	207.94
5	3.28	202.01
10	3.28	188.60
15	3.28	168.93
20	3.28	145.47
25	3.28	121.28
30	3.28	98.86
35	3.28	79.56
40	3.28	63.68
45	3.28	50.97
50	3.28	40.96
55	3.28	33.15
60	3.28	27.13
65	3.28	22.54
70	3.28	19.11
75	3.28	16.62
80	3.28	14.87
85	3.28	13.65
90	3.28	12.80
95	3.28	12.20
100	3.28	11.76
105	3.28	11.42
110	3.28	11.15
115	3.28	10.93
120	3.28	10.74
125	3.28	10.57
130	3.28	10.41
135	3.28	10.26
140	3.28	10.12
145	3.28	9.98
150	3.28	9.85
155	3.28	9.71
160	3.28	9.58
165	3.28	9.45
170	3.28	9.32
175	3.28	9.19
180	3.28	9.06
185	3.28	8.94
190	3.28	8.81
195	3.28	8.69
200	3.28	8.57
220	3.28	8.12
240	3.28	7.70

260	3.28	7.31
280	3.28	6.96
300	3.28	6.64
320	3.28	6.34
340	3.28	6.07
360	3.28	5.82
380	3.28	5.58
400	3.28	5.37

Pastoria Energy Facility E-Fields
CAB BAC
Figure 2



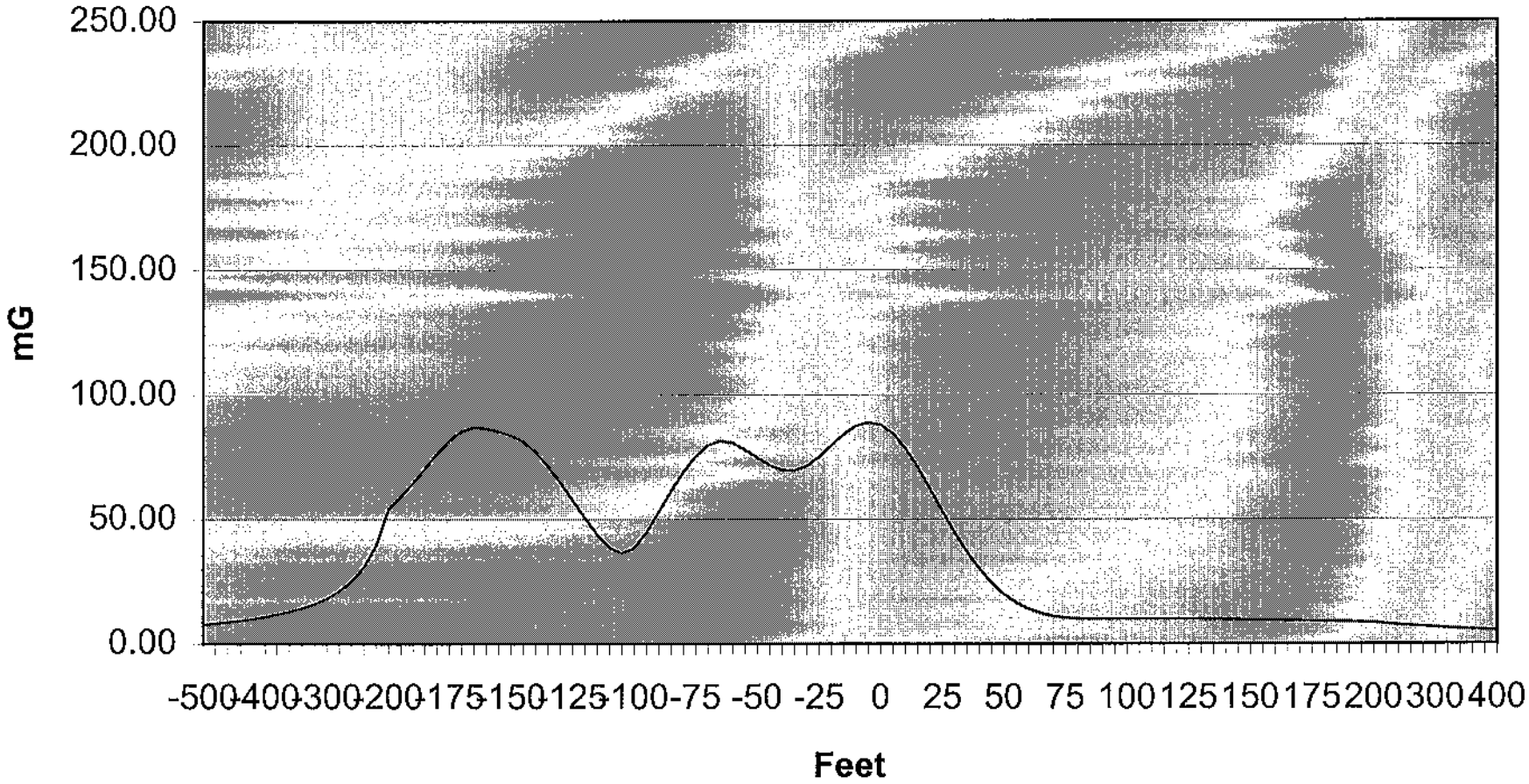
Dist	Vert	kV/M	CBA ABC
-400	3.28	0.09	
-380	3.28	0.11	
-360	3.28	0.13	
-340	3.28	0.15	
-320	3.28	0.16	
-300	3.28	0.13	
-280	3.28	0.10	
-260	3.28	0.86	
-240	3.28	2.38	
-220	3.28	1.77	
-200	3.28	1.65	
-180	3.28	2.01	
-160	3.28	1.06	
-150	3.28	1.75	
-140	3.28	1.75	
-130	3.28	1.13	
-120	3.28	1.19	
-110	3.28	1.82	
-100	3.28	1.80	
-90	3.28	1.07	
-80	3.28	1.25	
-70	3.28	2.17	
-60	3.28	2.54	
-50	3.28	2.18	
-40	3.28	1.87	
-30	3.28	2.30	
-20	3.28	2.99	
-10	3.28	2.73	
0	3.28	1.87	
10	3.28	2.80	
20	3.28	3.08	
30	3.28	2.30	
40	3.28	1.38	
50	3.28	0.75	
60	3.28	0.37	

70	3.28	0.17	
80	3.28	0.06	
90	3.28	0.02	
100	3.28	0.04	
110	3.28	0.05	
120	3.28	0.05	
130	3.28	0.05	
140	3.28	0.05	
150	3.28	0.04	
160	3.28	0.04	
180	3.28	0.03	
200	3.28	0.02	
220	3.28	0.02	
240	3.28	0.02	
260	3.28	0.01	
280	3.28	0.01	
300	3.28	0.01	
320	3.28	0.01	
340	3.28	0.01	
360	3.28	0.01	
380	3.28	0.01	
400	3.28	0.01	

Pastoria Energy Facility

CBA ABC

Figure 3



Feet	Vert	Milligauss	
-500	3.28	7.79	CBA ABC
-480	3.28	8.25	Actual Initial c
-460	3.28	8.78	Estimated act
-440	3.28	9.38	
-420	3.28	10.07	
-400	3.28	10.87	
-380	3.28	11.82	
-360	3.28	12.94	
-340	3.28	14.31	
-320	3.28	16.00	
-300	3.28	18.16	
-280	3.28	21.00	
-260	3.28	24.89	
-240	3.28	30.54	
-220	3.28	39.32	
-200	3.28	53.95	
-195	3.28	58.96	
-190	3.28	64.52	
-185	3.28	70.49	
-180	3.28	76.47	
-175	3.28	81.76	
-170	3.28	85.47	
-165	3.28	86.96	
-160	3.28	86.48	
-155	3.28	85.22	
-150	3.28	83.72	
-145	3.28	81.20	
-140	3.28	77.02	
-135	3.28	71.38	
-130	3.28	64.82	
-125	3.28	57.85	
-120	3.28	50.77	
-115	3.28	44.03	
-110	3.28	38.63	
-105	3.28	36.32	
-100	3.28	38.40	
-95	3.28	44.51	
-90	3.28	52.76	
-85	3.28	61.18	
-80	3.28	68.86	
-75	3.28	75.28	
-70	3.28	79.69	
-65	3.28	81.46	
-60	3.28	80.63	
-55	3.28	78.00	
-50	3.28	74.69	
-45	3.28	71.71	
-40	3.28	69.84	
-35	3.28	69.63	

-30	3.28	71.42
-25	3.28	75.01
-20	3.28	79.61
-15	3.28	84.12
-10	3.28	87.48
-5	3.28	88.86
0	3.28	87.83
5	3.28	84.28
10	3.28	78.43
15	3.28	70.80
20	3.28	62.12
25	3.28	53.13
30	3.28	44.51
35	3.28	36.72
40	3.28	30.00
45	3.28	24.42
50	3.28	19.95
55	3.28	16.50
60	3.28	13.95
65	3.28	12.19
70	3.28	11.06
75	3.28	10.41
80	3.28	10.09
85	3.28	9.95
90	3.28	9.92
95	3.28	9.93
100	3.28	9.96
105	3.28	9.98
110	3.28	9.99
115	3.28	9.98
120	3.28	9.96
125	3.28	9.92
130	3.28	9.87
135	3.28	9.80
140	3.28	9.73
145	3.28	9.64
150	3.28	9.55
155	3.28	9.45
160	3.28	9.35
165	3.28	9.25
170	3.28	9.14
175	3.28	9.03
180	3.28	8.92
185	3.28	8.81
190	3.28	8.70
195	3.28	8.58
200	3.28	8.47
220	3.28	8.05
240	3.28	7.64
260	3.28	7.27

280	3.28	6.92	
300	3.28	6.61	
320	3.28	6.31	
340	3.28	6.05	
360	3.28	5.80	
380	3.28	5.57	
400	3.28	5.36	