8.0 ENGINEERING

8.1 OVERVIEW

Engineering aspects of the Duke Energy proposal to modernize Morro Bay Power Plant (MBPP) (Project) include the siting, design, and installation of two natural gas-fired combined cycle units and associated equipment. The two combined cycle units include four natural gas-fired combustion turbine generators (CTG), four associated duct fired heat recovery steam generators (HRSG) with 145 foot-tall stacks and two steam turbine generators (STG). The combined cycle units each have a nominal net capacity of 600 megawatts (MW) for a Project total nominal net capacity of 1,200 megawatts (MW).

The existing transmission, natural gas and water facilities can accommodate the loads required by the MBPP Project with minor modifications. New natural gas pipelines, electrical transmission lines, and seawater intake and outfall structures will not be required, except for short segments within the MBPP to connect the Project to the existing fuel supply, electrical transmission facilities and circulating (cooling) water systems.

Associated equipment includes three natural gas compressors and high pressure gas line extensions from the adjacent Pacific Gas and Electric (PG&E) metering station and regulator yard; electrical transmission tie-in lines from the new combined cycle units to the existing adjacent PG&E Morro Bay Switchyard; and connections to the existing Units 1 through 4 cooling water systems. Cooling water will be supplied to the new units from the existing plant seawater intake structures. Cooling water from the new units will be discharged through the existing outfalls of Units 1 through 4 into Estero Bay.

Beneficial aspects of the Project include the reduced disturbance by using existing structures, facilities and resources as follows:

- Using land previously occupied by fuel oil tanks.
- Using existing cooling water intake structures.
- Using the existing cooling water discharge structures.
- Connecting to and using the adjacent existing PG&E Morro Bay Switchyard.
- Connecting to and using available capacity on transmission lines.
- Connecting to and using available capacity on adjacent existing natural gas supply lines.
- Utilizing existing roadway entrances.
- Utilizing existing engineering facility, staff and security personnel.
- Connecting to existing communication facilities.

- Connecting to existing fire water system and sanitary sewer system.
- Connecting to existing potable water system.
- Connecting to existing oil/water separator system.
- Utilizing existing stormwater drainage system.
- Maintaining the excellent relationship between the local jurisdictional agencies and the MBPP staff.
- Maintaining the excellent relationship between the MBPP and the Morro Bay community.
- Reuse of the existing desalination evaporator.

8.2 SITE LAYOUT

The location of the new combined cycle units at the MBPP is shown in Figure 8-1. This location has taken into consideration a number of siting factors expressly cognizant of the fact that the site of an existing power plant in the Morro Bay community. Particular attention in the siting of the Project has been given to visual resources; in particular, locating new equipment with respect to existing berms, the natural landscape, and associated biological resources to minimize the impact on the existing landscape and vistas. The site layout also takes into account worker safety during construction, ease of construction, relationship between process functions, access for equipment and workers, and applicable laws, ordinances, regulations and standards (LORS).

The new combined cycle units incorporate low profile buildings covering the combustion turbines and steam turbines to improve the visual profile of the unit. The buildings will have removable roof sections to allow temporary crane access for maintenance. Special attention has been given to the color and visual texture of the buildings and equipment to compliment the existing landscape and surroundings.

The layout of the new combined cycle units is provided in Figure 8-2. The combined cycle units will be located within the existing onsite fuel oil tank area where Tanks 1 through 4 are located. This area is currently surrounded by berms with diverse surfaces including sparse vegetation, bare soil and thinly paved gravel. As part of the Project, prior to construction of the new units, the onsite tank farm will be removed. Any soil and ground water remediation associated with the removal of the onsite tank farm will be resolved as necessary by PG&E to comply with applicable LORS and the requirements of the responsible agencies.

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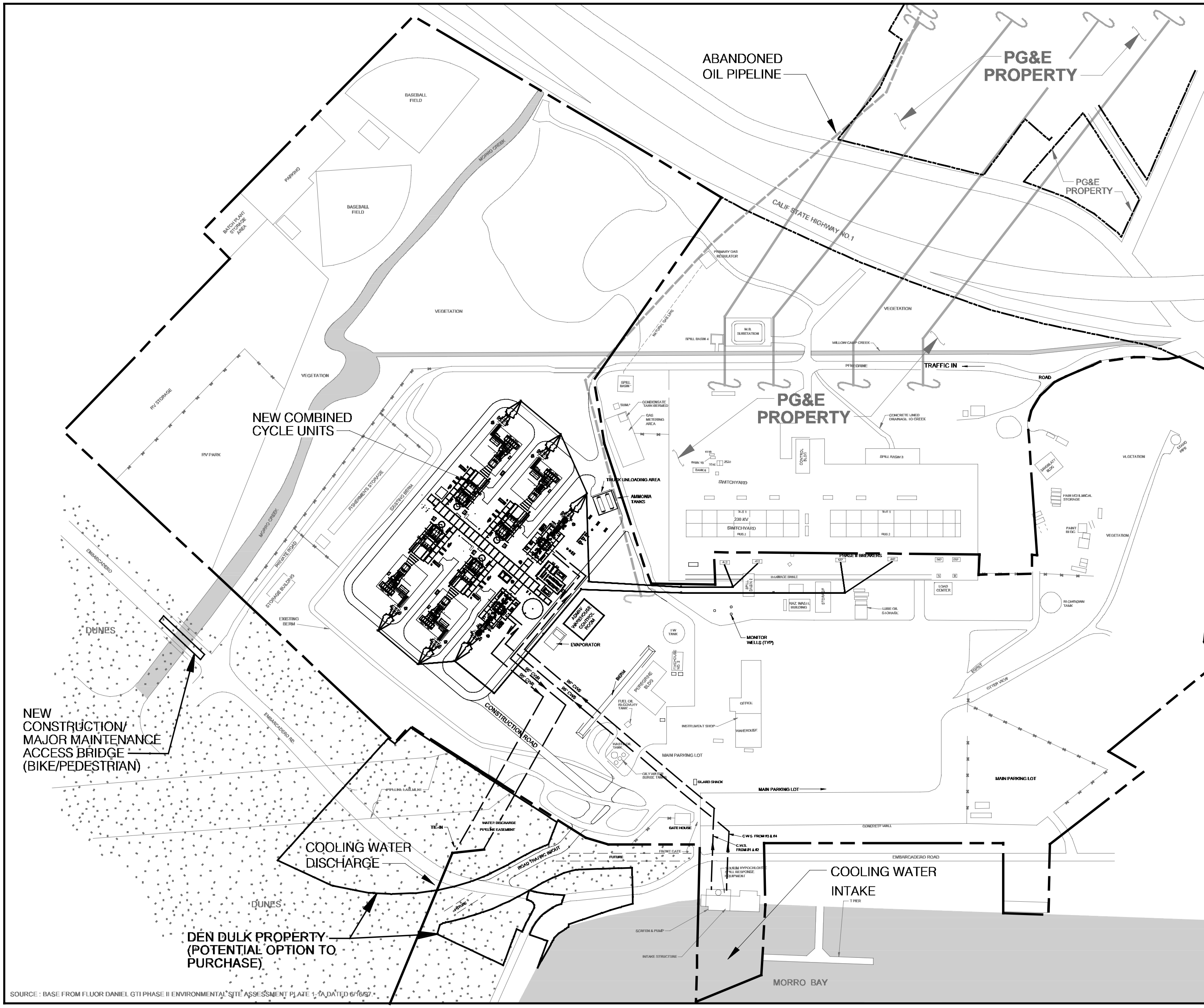

LOCATION OF NEW COMBINED-CYCLE UNITS

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-1

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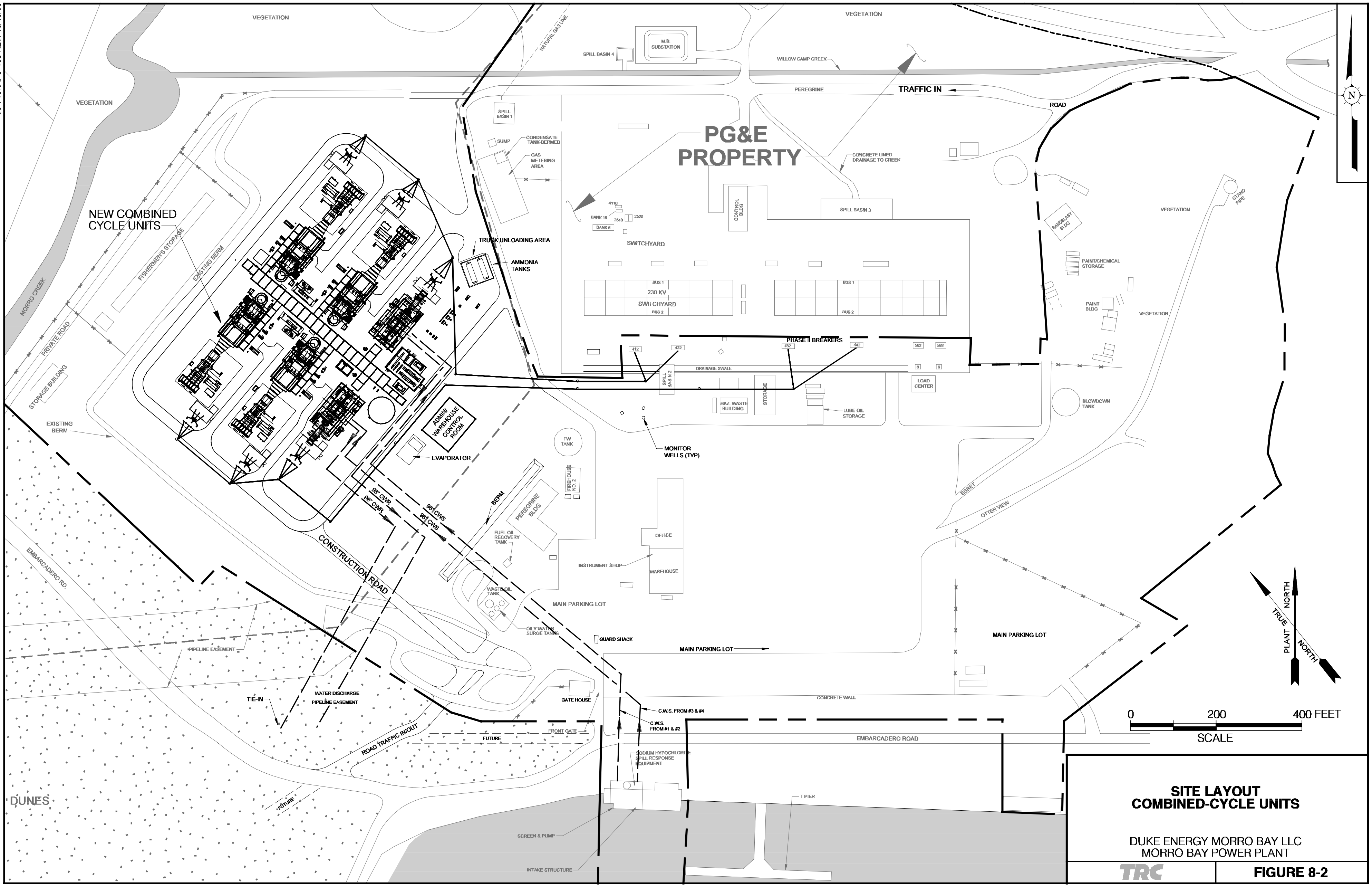


SITE LAYOUT COMBINED-CYCLE UNITS

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

FIGURE 8-2

The combined cycle units take advantage of the supporting in place infrastructure. Specific emphasis in the siting of the new units is placed on the use of existing structures to minimize the impact on additional land for new structures.

The land on which the Project will be constructed is at a existing elevation of about 23 feet above mean lower, low water level. Average annual rainfall at the MBPP is about 14 inches, with about 90 percent occurring between November and April. Year-round average daily temperatures in the Morro Bay area are mild, ranging between 45 to 70 degrees Fahrenheit (° F). Prevailing winds are from the west during winter, from the east during summer, and variable during the spring and fall.

The layout criteria for the new combined cycle units include the physical space requirements and relationships dictated by each of the major systems. Distances between various systems are minimized for economy, while maintaining the necessary clearances for maintenance and safety. Onsite electrical transmission, natural gas, and cooling water system interconnections will be optimized (see Figure 8-3). Sanitary wastewater will be routed to the Morro Bay municipal sewer system.

Internal access roads will continue to be used and modified as necessary for the Project. The site arrangement will minimize fill and/or excavation, while maintaining efficiency of Project construction, operation and maintenance. Stormwater run-off from the Project area will be collected by a storm drain system. The Project storm drain system will discharge to the existing site drainage system. Run-off or wastewater with a potential to be contaminated with oil will be routed through an oil/water separator before discharge. Spill containment measures have been provided and will continue to provide effective management of hazardous and nonhazardous waste.

The following criteria will be used in the design of site infrastructure:

- Oil and chemical storage areas will be designed to contain spills, and to manage risks in the event of an accident.
- Culverts and sanitary sewer will be installed, as required.
- Location and requirements for fencing or walls will conform to the local City of Morro Bay requirements.

8.2.1 SITE GRADING AND DRAINAGE

The site grading and drainage system will be designed to comply with applicable LORS. The general site grading will establish a working surface for construction of the new units and plant operating areas, provide positive drainage from buildings and structures, and provide adequate soil coverage for underground utilities (see Figure 8-4).

Onsite 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 6 inches above the finished grade. The preferred slope of the graded areas away from structures will be 2 percent with a minimum slope of 1 percent. A storm sewer system (inlets and underground pipes) will be provided in areas where ditches are not feasible.

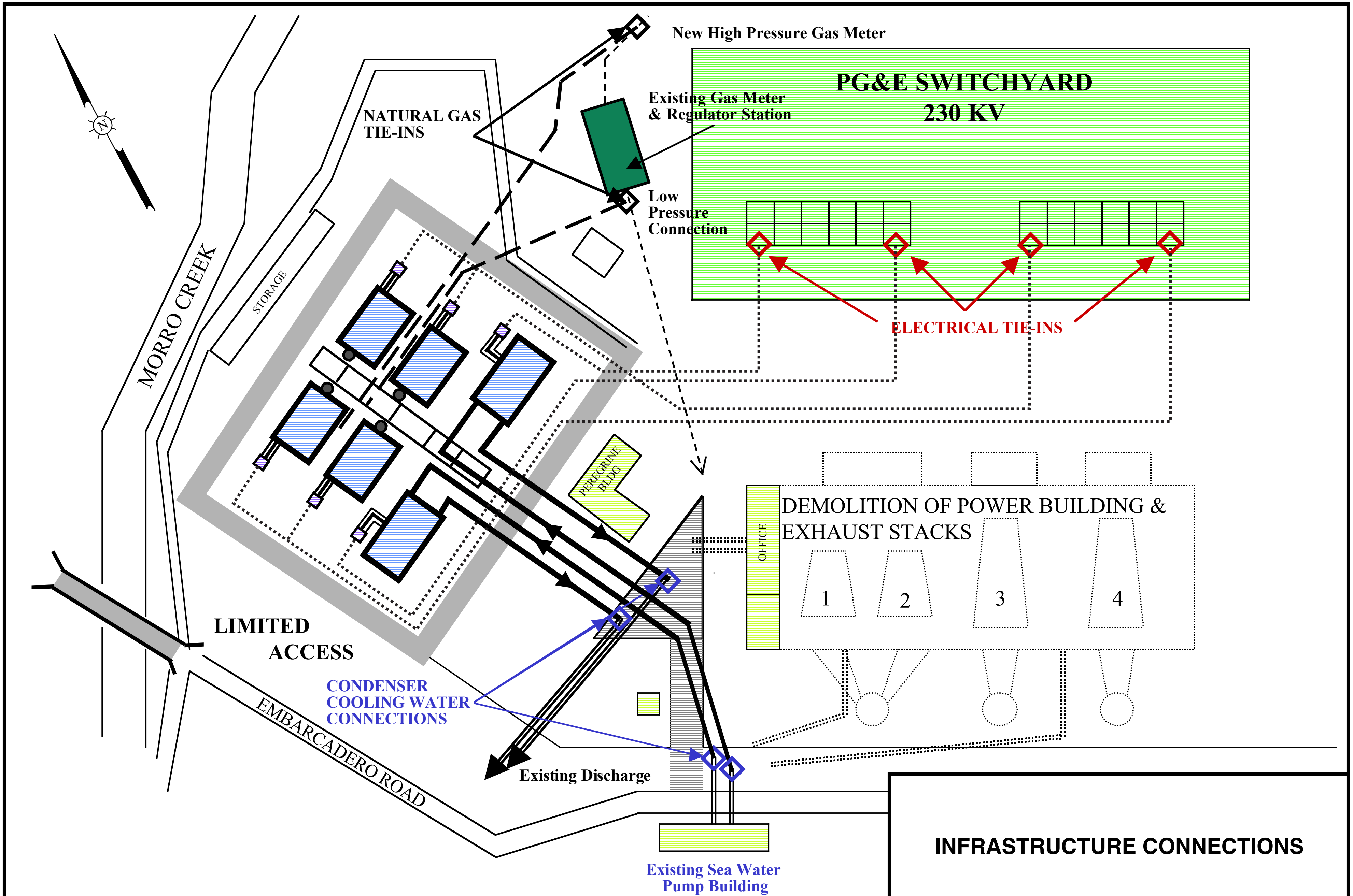
In general, site drainage facilities will be designed for the flow resulting from a 10-year storm frequency. Temporary facilities will generally be designed for a 2-year rainfall (see Figure 8-5). In addition, drainage facilities will be designed to prevent flooding of permanent plant facilities during a 100-year storm.

Run-off from industrial areas of MBPP is and will continue to be contained. Stormwater contained in these areas will be routed through an oil/water separator or neutralization basin and then drained to the wastewater collection system.

The main plant area will be graded with moderate slopes (1 percent minimum preferred) for effective drainage.

<u>Excavation and Fill</u>

Excavation and fill for construction of the Project will be balanced with onsite material to the maximum extent possible. In areas requiring excavation, earth material will be removed to the required 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.



SOURCE: DUKE ENERGY, 2000.

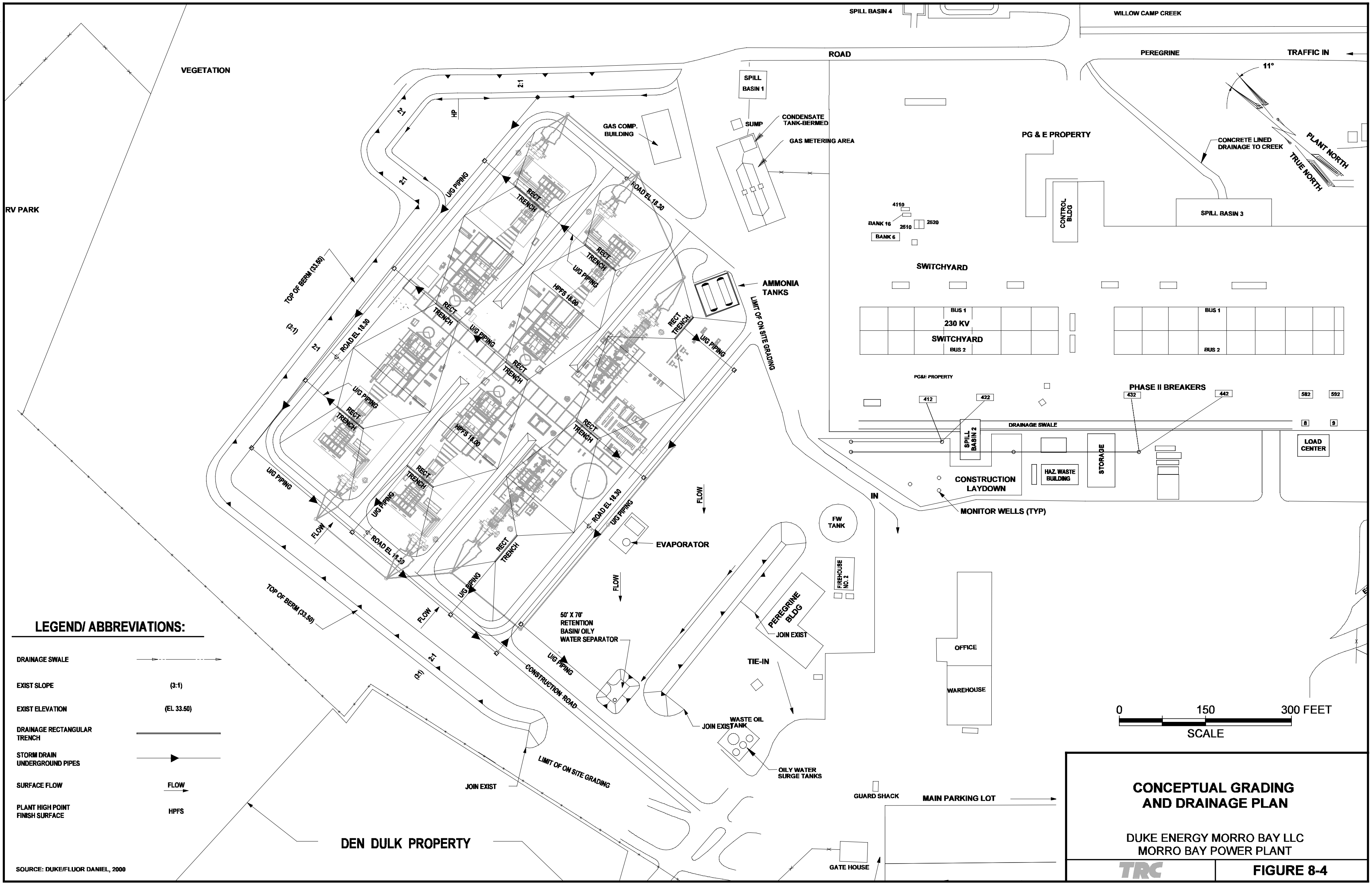
INFRASTRUCTURE CONNECTIONS

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-3

98-710RAFC-090 REV. 10/18/2000

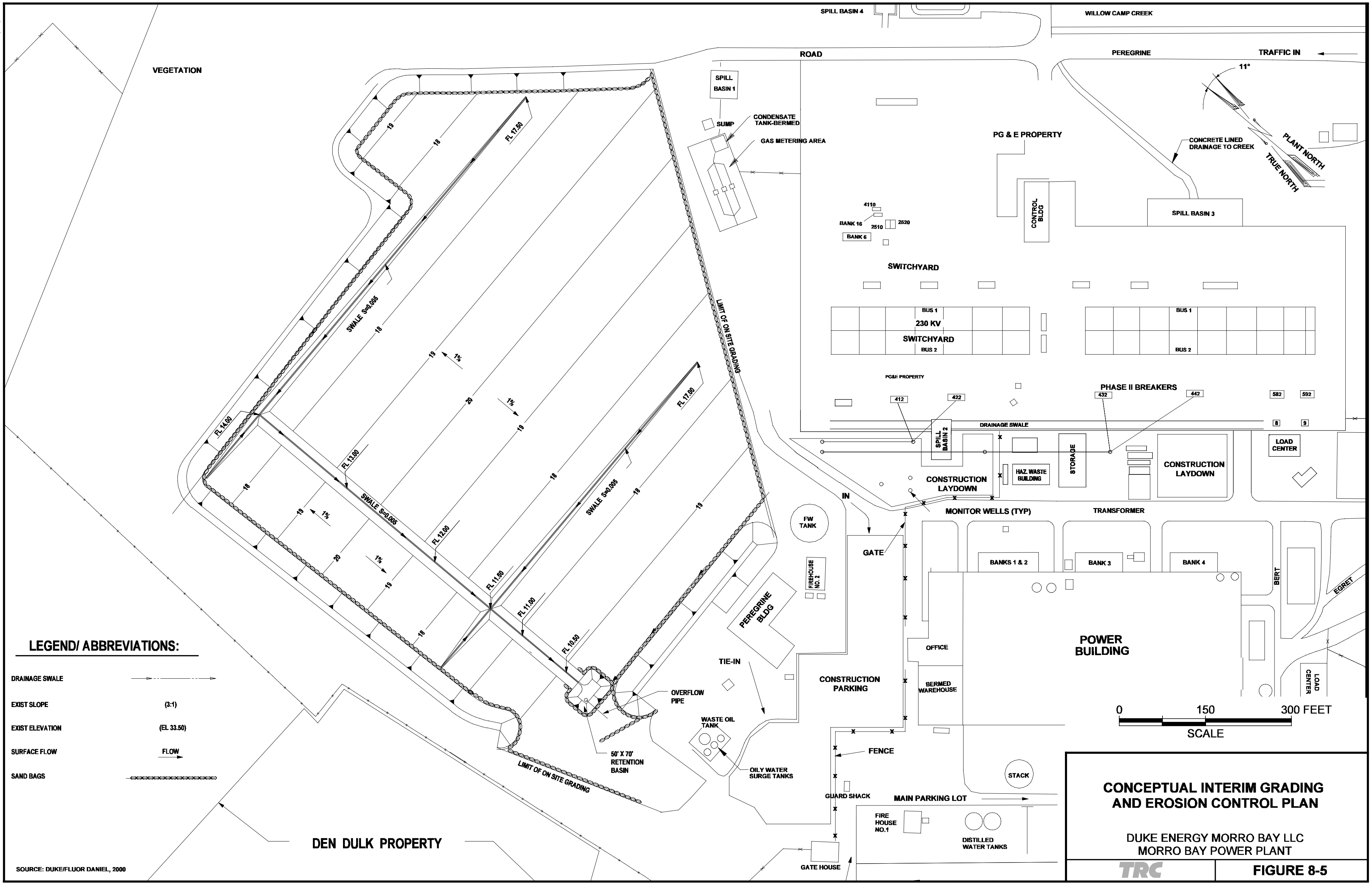


CONCEPTUAL GRADING AND DRAINAGE PLAN

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-4


98-710RAFC-090a REV. 10/20/2000
VEGETATION
SPILL BASIN 4
WILLOW CAMP CREEK
ROAD
PEREGRINE
TRAFFIC IN
SPILL BASIN 1
SUMP
CONDENSATE TANK-BERMED
GAS METERING AREA
PG & E PROPERTY
CONCRETE LINED DRAINAGE TO CREEK
PLANT NORTH
TRUE NORTH
11°
CONTROL BLDG
SPILL BASIN 3
BANK 16
BANK 6
SWITCHYARD
230 KV SWITCHYARD
BUS 1
BUS 2
PG&E PROPERTY
PHASE II BREAKERS
DRAINAGE SWALE
SPILL BASIN 2
STORAGE
HAZ. WASTE BUILDING
CONSTRUCTION LAYDOWN
LOAD CENTER
MONITOR WELLS (TYP)
TRANSFORMER
FW TANK
IN
GATE
BANKS 1 & 2
BANK 3
BANK 4
BERT
EGRET
FIREHOUSE NO. 2
PEREGRINE BLDG
OFFICE
BERMED WAREHOUSE
POWER BUILDING
TIE-IN
CONSTRUCTION PARKING
WASTE OIL TANK
OILY WATER SURGE TANKS
FENCE
GUARD SHACK
MAIN PARKING LOT
STACK
FIRE HOUSE NO.1
DISTILLED WATER TANKS
GATE HOUSE
SWALE S=0.005
LIMIT OF ON SITE GRADING
FL 17.50
FL 17.00
FL 14.00
FL 13.00
FL 12.00
FL 11.50
FL 11.00
FL 10.50
1%
OVERFLOW PIPE
50' X 70' RETENTION BASIN
DEN DULK PROPERTY
LEGEND/ ABBREVIATIONS:
DRAINAGE SWALE
EXIST SLOPE (3:1)
EXIST ELEVATION (EL 33.50)
SURFACE FLOW FLOW
SAND BAGS
SOURCE: DUKE/FLUOR DANIEL, 2000
0 150 300 FEET
SCALE
CONCEPTUAL INTERIM GRADING AND EROSION CONTROL PLAN
DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT
TRC
FIGURE 8-5

Compacted fill material will be obtained from onsite excavations. 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 in close proximity to foundations and 90 percent for the remainder. Approximately 6 inches of topsoil will be placed on fill in any areas that are to be seeded or otherwise landscaped.

Drainage Ditches

Drainage ditches will be designed to convey the 50-year storm frequency run-off flow without producing a headwater elevation above the bottom of the roadway base course. Plant buildings and major equipment will be designed such that they will be protected from the 100-year storm frequency flood level.

Storm Sewer System

A storm sewer system will be used. Catch basin inlets will be constructed of cast-in-place or precast concrete with top grates. Storm sewer pipes will discharge run-off to the nearest existing drainage course. Storm sewer pipes will be sized to limit flow velocities to a maximum of 8 feet per second (fps). A minimum design velocity of 2 fps will be used to facilitate cleaning. The minimum cover requirement, loading, and material selection for pipes will be three (3) feet.

Predevelopment and Postdevelopment Run-off Conditions

The peak flow associated with the 100-year storm event at the site, before modifications (predevelopment), will be compared to the after-construction (postdevelopment) conditions. It is anticipated that the postdevelopment run-off will slightly exceed the predevelopment run-off condition.

Erosion and Sedimentation Control

Erosion and sedimentation control will be provided to retain sediment on site and to prevent violations of water quality standards. Project 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 new units. Final finish grading will begin when other grading operations are complete. Final grading may include seeding disturbed areas not occupied by plant facilities or surfaced with concrete, asphalt or crushed aggregate.

Temporary erosion and sedimentation control measures to be used during construction will be designed to prevent sediments from being displaced and carried off-site by stormwater run-off. Prior to beginning excavation activities, a silt fence or straw bales will be installed along the perimeter of the Project where run-off to offsite areas could occur. The silt fence will filter sediments from construction run-off (see Figure 8-5). 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 run-off from offsite 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 site will include the run-off collection system (ditches, inlets, drainage piping), surfaced traffic and work areas, and seeded nonworking areas. These measures will minimize the possibility of any appreciable erosion of the resulting sedimentation occurring on the Project site.

<u>Sanitary Waste System</u>

Sanitary wastes will be conveyed to the existing sewer system.

8.2.2 FLOOD PLAIN CONSIDERATION

The existing dike and berm system provides flood protection well above the regulatory base flood (100-year flood plain) elevation. For example, the top of the berm is at approximately 33 feet MLLW while the base flood elevation is at 23.73 feet MLLW. The exterior portions of the existing berm will be retained to continue to protect the site. If necessary, the dike and berm system will be modified and other measures implemented to meet Federal Emergency Management Agency standards for levee protection. In addition, hydraulic analyses are being conducted to determine whether or not the Project will result in any adverse flood effects elsewhere. Given that the dike and levee system have been present since at least the 1950s, before the FEMA program began and extant maps developed, and given that the Project will be contained within the existing berm system, no change from the status quo is expected. Preliminary hydraulic analysis shows that adequate freeboard (well in excess of 3 feet) is present to prevent flooding of the plant by a base flood event. Pending final analysis, a Professional Engineer will certify to such effect and certification will be provided to the Floodplain Administrator. If the construction portion of the site remains within the base flood elevation, new construction below the base flood elevation will be flood-proofed and structural considerations in the design of the new plant will include hydrostatic and hydrodynamic loads and effects of buoyancy as required by FEMA regulations or City of Morro Bay ordinance or both. In addition, in such event, a Professional Engineer will certify that construction materials and standards have been satisfied and certification will be submitted to the Floodplain Administrator.

8.2.3 SEISMIC CONSIDERATIONS

Earthquake resistant design techniques will form the basis for the design of major structural components and foundations for the Project. Seismic loads will be determined in accordance with seismic design criteria (see Appendix 8-4 - Structural Engineering Design Criteria). The Project is located in Seismic Zone 4 according to the California Building Code (CBC), 1998 edition.

Although several ground faults have been identified in the general Morro Bay area, no active fault traces have been identified that pass beneath the MBPP and there are no active faults in the immediate vicinity of the Project site. Geologic hazards are further discussed in Section 6.3 - Geologic Hazards and Resources. The design of structures and foundations will include:

- Dead loads (weight of the structure and attachments).
- Live loads (movement).
- Wind loads (forces imparted by wind).
- Seismic loads (forces imparted by earthquakes).
- Temperature (strength of the structure materials of construction at operating temperatures).
- Pressure loads (pressure differentials between the interior and exterior of the structural components [such as the stack] that could cause deformation).

8.3 FACILITY DESIGN

The following subsections discuss the design of the combined cycle units. Additional technical detail can be found in the following appendices:

- Appendix 8-1 - Process Flow Diagrams with Heat and Material Balances, Plant Performance
- Appendix 8-2 - Water Balance Diagrams and Analysis
- Appendix 8-3 - Civil Engineering Design Criteria
- Appendix 8-4 - Structural Engineering Design Criteria
- Appendix 8-5 - Mechanical Engineering Design Criteria

- Appendix 8-6 - Electrical Engineering Design Criteria
- Appendix 8-7 - Control Systems Engineering Design Criteria
- Appendix 8-8 - Chemical Engineering Design Criteria
- Appendix 8-9 - Electrical Power Load Summaries

8.3.1 COMBINED-CYCLE GENERAL POWER PLANT DESIGN

Each of the two combined cycle units at the MBPP consist of two natural gas-fired General Electric model PG7241 "7FA" CTGs, two three-pressure HRSGs, one reheat condensing STG, and auxiliary systems. Natural gas combustion provides the energy to drive the combustion turbines. Steam is generated from the exhaust heat of the combustion turbine exhaust gases by the HRSG associated with each combustion turbine. The steam drives the steam turbine generator to produce electricity. The three generators of each unit together produce approximately 600 MW net at 64.1° F, which is the average summer afternoon ambient temperature. Figure 8-2 shows the layout of the combined cycle units.

Duke Energy has negotiated firm commitments for General Electric 7FA combustion turbines. The 7FA CTG has a nominal rated efficiency of 10,540 British thermal units per kilowatt (Btu/kW) on a higher heating value (HHV) basis, in simple cycle operation, at full load. At this rating, approximately 32.4 percent of the fuel energy (HHV basis) is converted to electricity.

As shown in Table 8-1, by configuring the plant as combined cycle units (to capture turbine exhaust heat to raise steam which drives a steam turbine generator) the overall plant net heat rate can be reduced to 6,865 Btu/kW (HHV basis) at base load at the average summer afternoon ambient temperature of 64.1° F (7,200 Btu/kW [HHV basis] with duct firing). At this rating approximately 49.7 percent of the fuel energy (HHV basis) is converted to electricity. By comparison, the Moss Landing Units 6 and 7, with an approximate heat rate of 8,950 Btu/kW (HHV) (38.1 percent of fuel energy converted to electricity), are among the most efficient power plant units in the California State Independent System Operator (ISO)/California system.

TABLE 8-1
PLANT EFFICIENCY COMPARISON
(Basis: Current net rating with natural gas fuel at full load)

Morro Bay CC Units (1016 MW) Unfired	Morro Bay CC Units (1200 MW) Duct fired	Morro Bay Unit 1 & 2 (170 MW each)	Morro Bay Unit 3 & 4 (345 MW each)	Moss Landing Units 6 and 7 (750 MW each)
6865 Btu/kW HHV	7,200 Btu/kW HHV	10,500 Btu/kW HHV	9,500 Btu/kW HHV	8,950 Btu/kW HHV

The thermodynamic cycle where air is compressed, heated by combustion of a fuel and expanded to produce useful work is called the Brayton cycle. Combustion turbines compress air, heat the air in a combustion section, then recover useful shaft power by passing the hot compressed air through an expander. The air compressor, expander and generator are typically on a single shaft. Air is drawn through an inlet air filtration system, which removes dust and particulate matter larger than 10 to 15 microns. Particles larger than 10 to 15 microns damage turbine parts, adversely affecting performance over time. The filtered air is compressed in the CTG compressor section. Compressed air then flows into the CTG combustion section.

The combustion section of the CTG is where fuel is burned at high pressure (approximately 200 pounds per square inch gauge [psig]). Part of the compressed air is used for the combustion of the fuel. The balance of the compressed air is blended with the combustion products before it flows to the expander section of the CTG. These turbines will be equipped with the most advanced combustors to minimize the production of oxides of nitrogen (NO_2). The pressurized high temperature gas leaving the combustor is at approximately 2,400° F. This hot gas passes through the expansion turbine, which converts expansion energy to shaft energy - the rotation of the turbine shaft. The turbine shaft drives both the air compressor and the generator. The CTG exhaust gas leaves the turbine at approximately 1,130° F.

For the new units, a second thermodynamic cycle will be used to recover additional energy from the 1,130° F exhaust gas. The Rankine cycle is a thermodynamic cycle where heat is applied to change water to steam, which is then expanded through a steam turbine to produce useful work. Heat is recovered from the exhaust gas by passing it through the HRSG to raise steam for the STG. This facility is referred to as a combined-cycle because it employs two classical thermodynamic cycles; the Brayton cycle (CTG) and the Rankine cycle (STG).

The HRSG contains a selective catalytic reduction (SCR) system to reduce the concentration of nitrogen oxides (NO_x) 2 to parts per million (ppm) in the stack gas (adjusted to 15 percent oxygen on a dry basis). The SCR catalyst, located between the superheat/reheat coils and the high-pressure (HP) steam generation coils in a temperature zone at approximately 650 to 750° F, has essentially no impact on the heat transfer in the HRSG. Ammonia injection is required to provide the ammonia which reacts with the NO_x in the exhaust gas to make nitrogen gas and water vapor in the presence of the SCR catalyst. This Project will use aqueous ammonia and is designed for a maximum ammonia slip of 5 parts per million dry volume basis (ppmvd) in the stack gas at the end of the catalyst life.

Steam from the HRSG is expanded through a reheat steam turbine, driving a generator. The steam turbine exhaust steam is condensed back into water and recycled back to the HRSG. Seawater is used to cool the condensers. The seawater at the MBPP is normally between 55° F and 57.5° F, averaging 56.3° F year round. The existing Units 1 through 4 seawater intake structure will be reused to supply the new combined cycle units. Cooling water discharge from the combined cycle units will be routed to the existing Units 1 through 4 discharge into Estero Bay.

The combined cycle units are expected to have an overall availability of 95 percent or higher and to operate approximately 8,400 hours each year of which up to 4,000 hours would be duct fired. Actual utilization of the plant will depend on market forces. Full load heat balances are included in Appendix 8-1.

8.3.1.1 Circulating Water System

The steam turbine condenser and other plant auxiliary cooling requirements are met by once-through seawater cooling. The existing seawater intake currently used for Units 1 through 4 will be used for the combined cycle units Directly behind the existing traveling screens are eight pump bays previously dedicated to Units 1, 2, 3 and 4 that will be used to supply seawater to the combined cycle units. The cooling water return from the combined cycle units is routed to the existing Units 1, 2, 3 and 4 discharge tunnel. The discharge tunnel flows into a short outfall canal at the base of Morro Rock, which discharges into Estero Bay to the north of the MBPP. The modifications to the existing Units 1, 2, 3 and 4 circulating water system are described in greater detail in Section 6.5 - Water Resources.

Cooling water requirements for the combined cycle units are significantly reduced in comparison to the existing Units 1 through 4. The new combined-cycle cooling water requirement is 330,000 gallons per minute (gpm) for a net plant output of 1200 MW. The existing Units 1 through 4 together draw approximately 464,000 gpm (490,000 gpm in the original design) for a net output of approximately 1,002 MW.

The cooling water discharge temperature rise through the combined cycle units will be limited to 20° F above the intake temperature; and the intake velocity will be reduced by almost 40 percent from a current rate of 0.5 feet per second (ft/sec) to approximately 0.3 ft/sec.

The potential for biological growth is high in equipment using seawater for cooling. Biofouling in heat transfer equipment, such as condensers restricts flow, promotes corrosion, reduces overall heat transfer efficiency and adversely affects the efficiency of the plant. To minimize biofouling of the condensers the circulating seawater must be chemically treated. A chemical feed system consisting of a storage tank with injection pumps will be used intermittently, as required, to supply sodium hypochlorite (12 to 14 percent solution), a biofouling inhibitor, into the cooling water supply lines immediately before the condenser to reduce biofouling of the condensers. Household bleach, by comparison, is a 5 percent solution of sodium hypochlorite. Residual chlorine will not exceed the permitted quantity of 200 parts per billion (ppb) in the outfall. By comparison, the chlorine residual in drinking water delivered to the consumer is typically controlled to between 500 to 1,000 ppb (0.5 to 1.0 ppm) based on taste, flavor and required disinfectant efficacy. The maximum residual disinfectant level permitted under Code of Federal Regulations (CFR) Title 40, Part 141.54 and 141.65 is 4 milligrams per liter (mg/L) (approximately 4,000 ppb) for chlorine in drinking water during normal public delivery system operation.

Of the commonly available forms of chlorine used for disinfection, a 12 to 14 percent solution of sodium hypochlorite is favored over alternatives such as chlorine gas or calcium hypochlorite (solid). Although the 12 to 14 percent solution is more expensive than chlorine gas, it is less expensive and easier to handle than the solid form. Capital and maintenance costs are lowest for the sodium hypochlorite, and sodium hypochlorite represents the safest alternative for workers and the surrounding community. Units 1 through 4 currently utilize this technology to prevent biofouling, with procedures and chemical limits closely regulated by the California Regional Water Quality Control Board - Central Coast Region (RWQCB).

Integral to the design of the circulating water system will be provisions for demusseling. Mussels are a shellfish that attach themselves to surfaces in the cooling water system. Left undisturbed, mussels will multiply and grow until cooling water flow is impeded. Reducing or blocking cooling water flow adversely affects the performance of the unit. The goal of demusseling is to periodically clear the system of the infestation before the shells get too big to pass through small passages in the cooling system such as condenser tubes. No toxins or chemicals are used by the MBPP for demusseling. This procedure recirculates heated cooling water using the online condenser to supply the heat. Heated water is recirculated by restricting the condenser discharge flow and stopping one of the two cooling water pumps. Water supplied by the pump still in operation reverses the flow through half of the condenser causing it to flow back to the intake structure. At the intake structure the intake stop logs have been lowered to prevent flow of the heated water to the harbor and direct it to the pump still operating.

The demusseling procedure lasts several hours, depending on the treatment temperature, but is expected to require about 1 hour at the highest temperature. The procedure is repeated, as necessary, approximately every 4 to 6 weeks.

8.3.1.2 Service Water System

Makeup water for the combined cycle units comes primarily from seawater which has been desalinated by a vapor compression evaporation system, followed by a polishing demineralizer. Blow down is demineralized. The demineralized water is stored in the demineralized water storage tank. Demineralized water is used for steam cycle makeup, for periodic water wash of the combustion turbine, and for makeup to other combined-cycle systems requiring water of high purity.

8.3.1.3 Wastewater System

Wastewater from equipment sumps is typically treated by an oil/water separator. The treated water is discharged from the plant through the existing plant drainage system. Additional information on waste handling and control is contained in Section 6.14 - Waste Management.

8.3.1.4 Pollution Control

The oxides of NO_x in the combustion turbine exhaust will not exceed 9 ppmvd (corrected to 15 percent oxygen) by dry low NO_x (DLN) combustion technology when operating above 50 percent of full load. In addition to the DLN technology, an SCR system will be utilized in the combined-cycle configuration as best available control technology (BACT). The SCR system consists of the reduction catalyst and an aqueous ammonia injection system. The catalyst and ammonia injection grid are arranged within the HRSG so that the ammonia injected into exhaust gases will combine with the NO_x in the presence of the catalyst to reduce the NO_x in the HRSG stack gas to a maximum of 2 ppmvd (adjusted to 15 percent oxygen on a dry volume basis).

Aqueous ammonia solution (approximately 29 weight percent) is vaporized and injected into the hot exhaust gas path of the HRSG at a point upstream of the SCR to assure distribution over the catalyst. The ammonia and the NO_x chemically combine in the presence of the SCR catalyst to form nitrogen gas and water vapor. The ammonia injection rate is controlled based on the measured operating parameters of the combustion turbine and exhaust gases at the stack. Ammonia slip at the exhaust stack will be controlled to 5 ppmvd or less depending on the operation of the ammonia injection system, catalyst conditions and temperature of the exhaust gas. Additional information regarding aqueous ammonia usage and emissions rates at various operating conditions for each CTG and for the total plant is provided in Appendix 8-1.

The SCR design has not been finalized. It is expected that the final design will use a high activity catalyst on a metal, ceramic or zeolite extruded support structure. The SCR catalyst will be located within the HRSG in the optimum temperature range for effective NOx reduction.

CO reduction is accomplished by the inclusion in the Project of a carbon monoxide oxidation catalyst system, which will not have a material effect on the emissions. A complete analysis and discussion of the air quality impacts of the Project is provided in Section 6.2 - Air Quality.

8.3.2 WATER BALANCE

Water resources as they relate to the Project are described in detail in Section 6.5 - Water Resources. In summary, once-through seawater is used for cooling of the new MBPP similarly as the existing Units 1 through 4.

The existing seawater cooling facilities consist of:

- Dual inlet structures on the Morro Bay inner harbor (one inlet for Units 1 and 2 side by side with the inlet for Units 3 and 4) with stop logs, trash racks, traveling screens, and large capacity seawater pumps.
- Interconnecting piping.
- Three discharge tunnels (one discharge tunnel for Units 1 and 2, and one each for Units 3 and 4).
- An outfall structure with a short open channel adjacent to the north side of Morro Rock that discharges into Estero Bay.

The Units 1 through 4 intake structures were designed for an original capacity of 490,000 gpm. The pumps currently operate at 464,000 gpm. The structure on the harbor shoreline is organized into four parallel, communicating channels. Each channel contains guides for stop log isolation, a trash rack, a traveling screen and a pump bay with a pump. Seawater flows through one of four trash racks and one of four traveling screens to remove debris, then is drawn through one of the four pumps. Each pump discharges into a separate 650-foot-long, 54-inch-internal-diameter bell and spigot concrete pipe that passes under the Embarcadero connecting the pump discharge with the plant.

The existing Units 1 through 4 intake structures will be reused and modified to reduce impact on sea life. The flow through the intake structure will be reduced to 330,000 gpm from the currently permitted levels of 503,000 gpm, from the original design of 490,000 gpm and from the current operations of 464,000 gpm. The existing traveling screens will be refurbished or where necessary replaced in kind. The pump discharge lines will be reused between the pumps and a point inside MBPP where they will be intercepted by the new lines to the combined cycle units. The intent is to refurbish and possibly slip-line the existing lines that will be reused unless in detailed design it proves necessary to replace them entirely.

The new combined cycle units at peak loads requires 330,000 gpm of cooling water. The design of the new combined cycle units specify a 20° F maximum cooling water rise across the condenser. This is measured as the difference between the temperature in the discharge canal minus the temperature measured at the inlet structure. For the Project, the maximum temperature rise between the intake structure and the discharge canal will be less than the currently permitted 30° F. In any operating mode that is less than the new combined cycle units' rated capacity, the temperature rise will be proportionally less. The use of water resources for the Project is discussed in detail in Section 6.5 - Water Resources. Water balance diagrams are provided in Appendix 8-2, Water Balance Diagrams. A summary of cooling water system operating parameters from above is set forth below:

DESCRIPTION	UNITS 1 AND 2	UNITS 3 AND 4	COMBINED CYCLE UNIT
Gallons/Minute Cooling system at full load	184,000	280,000	330,000
Generating Capacity in Megawatts (Net)	326	676	1200
Discharge temperature differential (ΔT in °F) between intake and discharge canal	0 to 30°[1]	0 to 30°[1]	0 to 20°[1,2]
Permitted ΔT (°F)	30°	30°	Pending RWQCB decision on NPDES

(1) The intake seawater temperature varies between 2 to 15° F warmer than the open ocean depending on season and tidal movement of the bay from which the cooling water is withdrawn. The discharge temperatures reported are daily averages.

(2) Represents design discharge ΔT in °F.

The water usage figures presented in this AFC are based on a discharge temperature minus intake temperature differential of 20° F. The use of a 20° F differential will minimize the entrainment and impingement effects from the use of cooling water at the MBPP. Should the RWQCB determine that an adjustment is required to consider the warmer waters in Morro Bay compared to Estero Bay, then it will be necessary to increase the flows to allow full operation of the combined cycle units.

8.3.3 ENGINEERING DESIGN CRITERIA

The design criteria used for the various disciplines required to construct this facility are provided in Appendices 8-1 through 8-9.

8.4 TRANSMISSION SYSTEM DESIGN

As discussed in Chapter 2.0 - Project Description and Section 6.18 - Transmission System, this Project uses, and is compatible with, existing transmission facilities. The output from the new 1200-MW plant will feed into the existing 230-kilovolt (kV) PG&E switchyard adjacent to the units. The new plant will fill the switchyard bus positions currently occupied by the Units 1 through 4. Only minor modifications will be required to bypass switches in the PG&E switchyard to accommodate the new plant. Figures 8-3 and 8-6 provide a schematic and a single-line diagram, respectively, of the connection of the new combined cycle units to the existing 230-kv PG&E switchyard.

The generation tie-in lines that carry electrical energy from the new combined cycle units to the existing PG&E 230-kV switchyard are arranged into two sets of two conductors for a total of four conductors. Each set of conductors consists of one conductor which will carry the output of one steam turbine generator and the other conductor will carry the output of two gas turbine generators. The conductors run from the generation units take-off structure to the available bus positions in the PG&E 230-kV switchyard currently occupied by Units 1 through 4. The conductors are mounted on a few joint or individual structures. Electrical power load summaries and single-line drawings are provided in Appendix 8-9.

Duke energy and PG&E evaluated the existing systems and transmission lines and found them to have adequate capacity to accept the output from the new power generating units in most operating conditions (see Appendix 6.18-2). Once the Project is constructed and generating electricity, overload conditions will be precluded on the PG&E transmission lines or transformer banks by operational controls eliminating the need for any transmission system reinforcements.

8.4.1 ALTERNATING CURRENT (AC) AUXILIARY POWER DISTRIBUTION

Two auxiliary transformers will supply all 4,180-volt (V) power for each of the six generators that make up the Plant. The high side of the auxiliary transformer will be connected directly to the output of the steam turbine generator iso-phase bus at 18,000 V. The low side will be connected to the 4,180-V load center. The auxiliary transformers will be protected from phase-to-phase faults, ground faults, and sudden pressure faults. Electrical power from the 4,180-V load center will be distributed to the 480-V motor control load center, which is made up of metal clad switch gear and distributes the power to all loads at 480 V and below.

Power is supplied to the facility for startup and during outages by back feed through the STG step-up transformers. Two isolation transformers allow backfeed power to any one of the four GTGs.

8.4.2 DIRECT CURRENT (DC) POWER DISTRIBUTION SYSTEM

The 125-V DC power system for the combined cycle units consists of a station battery and battery chargers. The 125-V DC bus supplies critical DC motors in the plant, the unit control system, and uninterruptible power supply (UPS) and emergency lighting. Normally, the battery chargers supply power from the AC bus and maintain a float charge on the battery. During a loss of AC, the battery supplies power to critical loads.

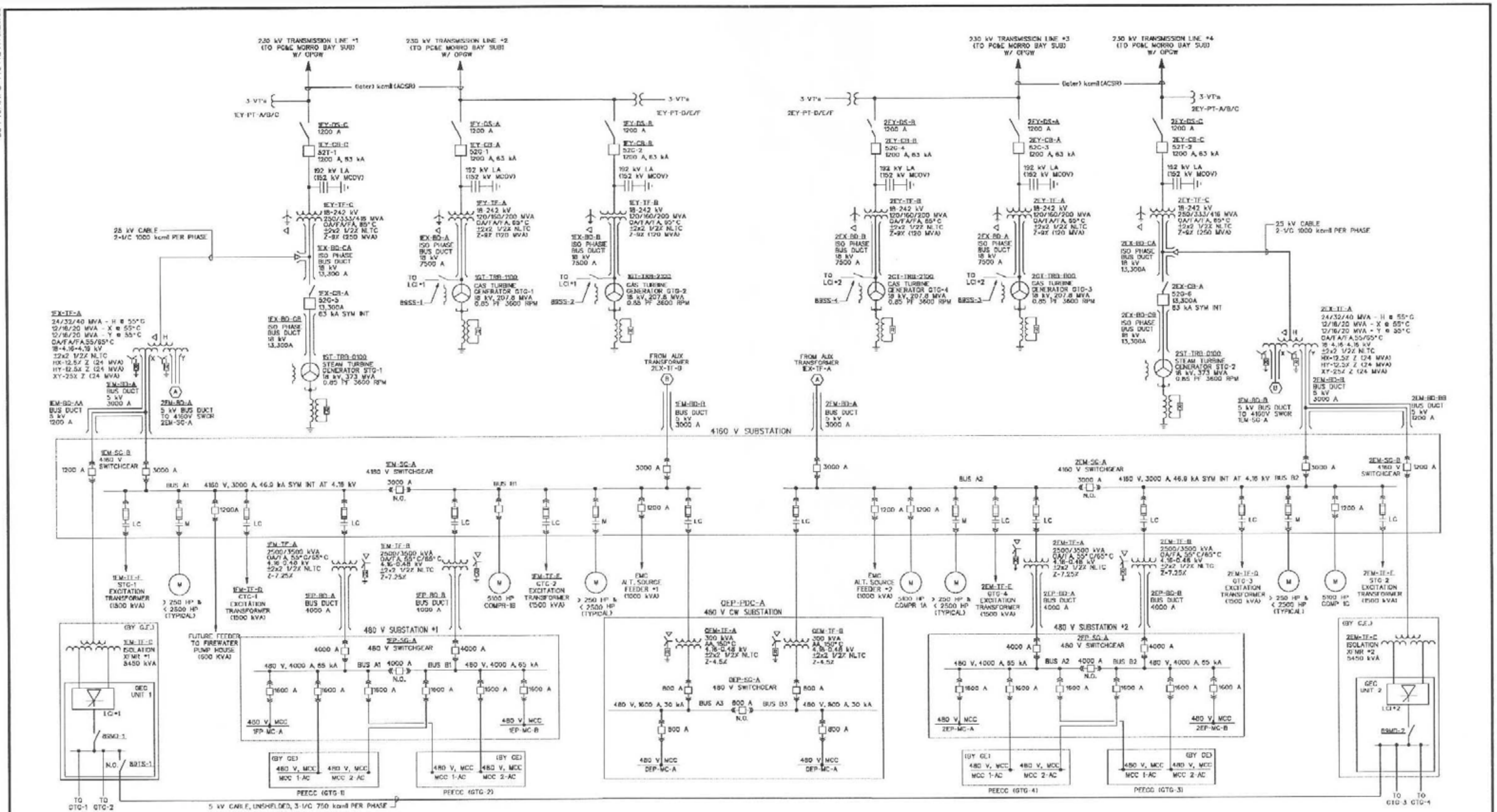
8.5 RELIABILITY

The fuel supply availability and reliability, and engineering design features included to create a reliable facility design are addressed in the following sections.

8.5.1 FUEL AVAILABILITY

8.5.1.1 Source of Natural Gas Supply

Natural gas for the MBPP is supplied through the PG&E pipeline network. PG&E receives more than 90 percent of the natural gas for redelivery from the Southern California connection with



NOTE: THIS DRAWING IS CONCEPTUAL.
ACTUAL EQUIPMENT RATINGS WILL BE
DETERMINED DURING PROJECT DESIGN.

98-710RAFC-115 REV.10/20/00

ELECTRICAL OVERALL ONE LINE DIAGRAM COMBINED-CYCLE UNITS

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-6

El Paso Natural Gas near Topock, Arizona and from the Northern California connection with PG&E/Northwest near Malin, Oregon. Please refer to Figures 8-7, 8-8 and 8-9 for the following discussion.

As shown in Figure 8-7, the southern system consists of parallel 34-inch-diameter pipelines, Lines 300A and 300B, which connect the Topock Compressor Station in Southern California to the Milpitas Terminal near San Jose. One of the compressor stations on the southern system lines is the Kettleman Compressor Station. The Kettleman Compressor Station is one of three main line compressor stations on PG&E's 300A/B system that provide pressure support for the 300A/B pipelines. The Topock to Milpitas pipeline has the capacity to transport 1,180-million cubic feet of natural gas per day (MMcf/d). Natural gas from the El Paso supplier typically has a HHV in the range of 1,040 Btu per standard cubic foot (scf).

The northern system has two main trunk lines (see Figure 8-7). Line 400 is a 36-inch-diameter pipeline between Malin, Oregon and Antioch, California. Line 401 is a 42-inch-diameter pipeline between Malin, Oregon and an interconnection on Lines 300A/B in the southern system between Hollister Station and the Kettleman Compressor Station. The northern system has the capacity to import 1,800 MMcf/d of Canadian natural gas into the PG&E System. Natural gas from the Canadian suppliers typically has a HHV in the range of 1,020 Btu per scf.

The MBPP receives fuel from the Kettleman Compressor Station through PG&E pipeline 306 (see Figure 8-8). The Kettleman Compressor Station can act as a block valve on line 300A/B and can receive gas from both directions, if necessary. Therefore, the natural gas supply to Morro Bay has increased reliability from redundant sources of supply through the PG&E pipeline system.

PG&E line 306 was originally built to provide natural gas for Units 1 through 4 at the MBPP. Line 306, which is 20 inches in diameter, runs 70 miles from the Kettleman Compressor Station to Morro Bay. The first 40 miles of line 306, starting at the Kettleman Compressor Station, is designed to operate at a maximum pressure of 840 psig and normally is operated at 830 psig. A pressure limiting station (PLS) at mile 40 limits the downstream pressure to 630 psig although the line is designed for a maximum of 650 psig. The PLS limits the pressure of the downstream line to account for elevation changes and the thinner pipe wall thickness downstream.

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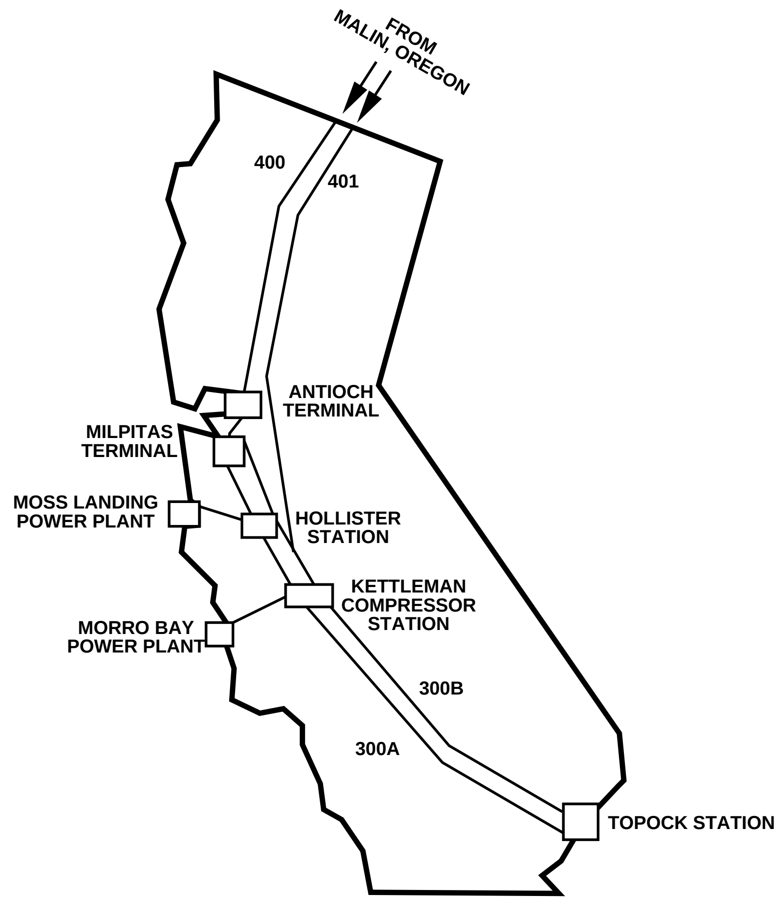

NOT TO SCALE

SOURCE: DUKE/FLUOR DANIEL, 2000.

PG&E GAS SYSTEM

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-7

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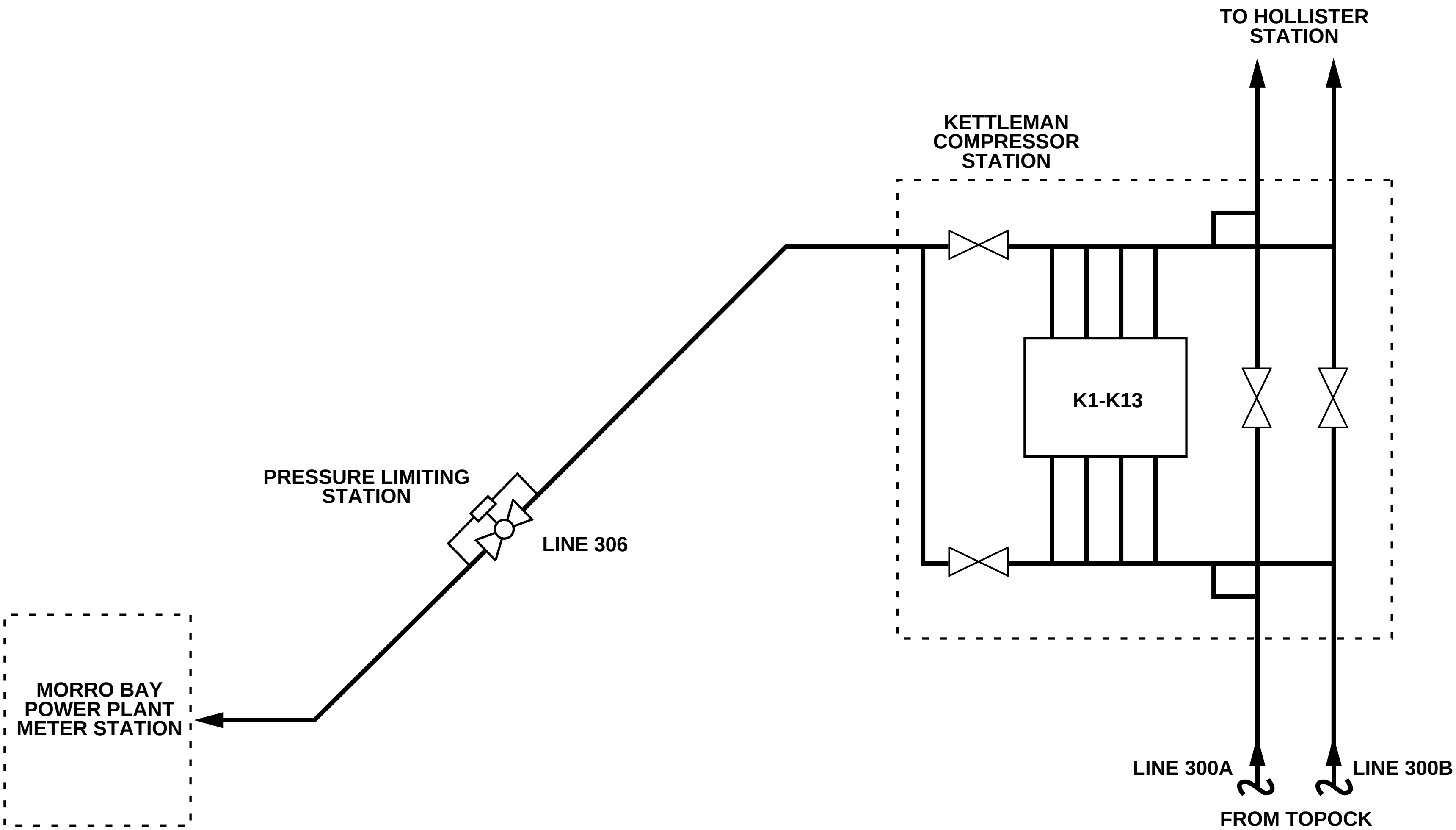

SOURCE: DUKE/FLUOR DANIEL, 2000.

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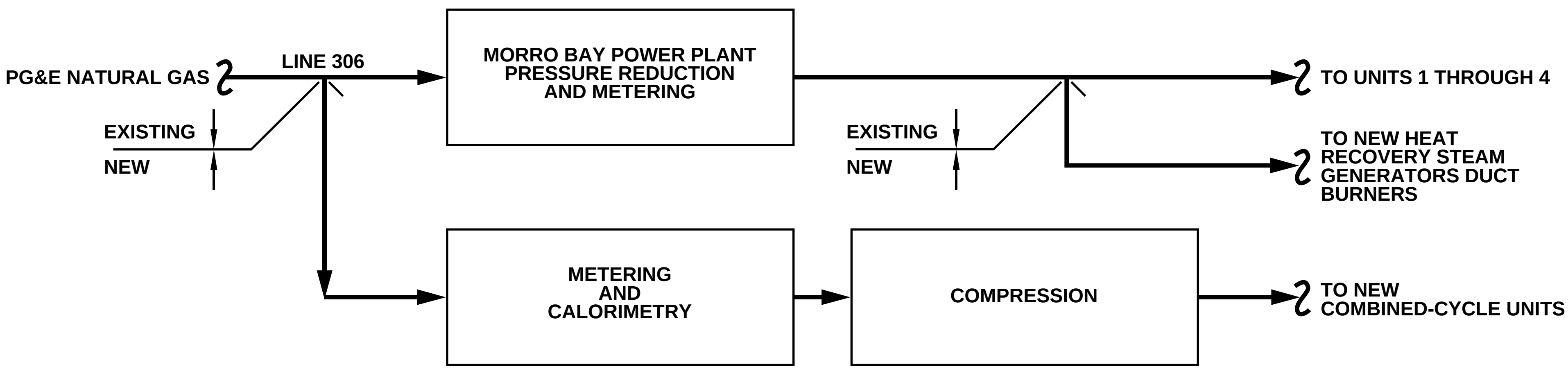
PG&E MORRO BAY POWER PLANT PIPELINE

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-8



SOURCE: DUKE/FLUOR DANIEL, 2000.

NOT TO SCALE

NATURAL GAS DISTRIBUTION
MORRO BAY POWER PLANT

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-9

The existing Units 1 and 2 at MBPP consume 42-million standard cubic feet per day (MMscf/d) each for a total of 84 MMscf/d at full load. Units 3 and 4 consume 77 and 80 MMscf/d at full load respectively. The new combined cycle units at MBPP will consume approximately 205 MMscf/d at the highest demand condition. The existing natural gas pipeline will have adequate capacity because MBPP Units 1 through 4 will be retired prior to the startup of the new combined cycle units. The 36 MMscf/d increase can easily be provided by the existing system.

A natural gas booster compressor will be required at the MBPP to supply natural gas to the combined cycle units at the pressure required by the combustion turbines (see Figure 8-9).

The new combined cycle units at the MBPP will not adversely impact the present ability of PG&E Line 306 to supply natural gas to current users at current levels of consumption. PG&E Line 306 primarily provides fuel for the MBPP. Line 306 does not support any other distribution systems with significant demand. The natural gas supply to the Morro Bay community is unaffected because the community is in a territory serviced by the Southern California Gas Company system which is independent of the PG&E system.

8.5.1.2 Availability of Gas

As stated in the California Energy Commission's (Commission) 1995 natural gas market outlook, California has a total natural gas resource base of 1,056 trillion cubic feet (tcf) from surrounding basins in the Rocky Mountains, southwestern United States and Canada. 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 and expanded pipelines have increased the supply diversity into the region through new and expanded 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.

8.5.2 GENERAL PLANT

8.5.2.1 Plant Availability

The combined-cycle portion of the Project will be designed for an operating life of a minimum of 30 years. Availability projections are based on this projected operating life.

To provide high plant reliability and availability, two measures will generally be taken. First, the redundancy of the auxiliary systems serving the individual turbine generators and the plant (see Table 8-2), will provide standby capability on an auxiliary component failure. Second, planned outages for each of the CTGs would normally be scheduled during times when regional electric demand is low and low cost surplus capacity would be available.

TABLE 8-2

MORRO BAY POWER PLANT
COMBINED-CYCLE UNITS
MAJOR EQUIPMENT LIST

EQUIPMENT/SYSTEM	QUANTITY	SIZE/CAPACITY	REMARKS
Combustion Turbine Generator	4	172 MW each	DLN combustion control
Heat Recovery Steam Generator	4		Three pressure with reheat No duct firing
Aqueous Ammonia Storage Tank	2	33,000 gal	For NO_X control
Ammonia Injection Blower	8		Two per HRSG
High Pressure/Intermediate Pressure (HP/IP) Feedwater	8	1,660/250 gpm	HP feed with interstage bleed
Desalination Evaporator	1	100 gpm	50% recovery vapor compression
Oily Water Separator	1	100 gpm	CPI separator package
Air Compressors	2	500 scfm	Service and instrument air
Steam Turbine Generator	2	285 MW	Reheat/condensing
Steam Surface Condenser	2	1,530 mmBtu/hr	Seawater
Condensate Pumps	4	3,450 gpm	Vertical turbine
Circulating Water Pumps	8	41,300 gpm	--
Fuel Gas Filter/Separator	4	83,000 lb/hr	For natural gas fuel
Demineralized Water Package	1	100 gpm	Two "trains"
Demineralized Water Pumps	2	500 gpm	HRSG makeup water and CTG water wash
Demineralized Water Tank	1	500,000 gal	For cycle makeup and CTG water wash
Continuous Emissions Monitoring System	4	--	--

Source: Duke-Fluor Daniel, 2000.

CTG inspections and overhauls will dictate the length and frequency of major scheduled outages. CTG inspections of the combustors and rotating sections will require a 1- to 2-week scheduled outage each year. Major CTG overhauls will be required approximately every 3 to 5 years. Scheduled outages for major overhauls will last from 3 to 12 weeks for each CTG, depending on the scope of work and availability of spare parts. Major hot section overhauls will be required at approximately 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 include actual operating hours plus a factor for number of starts. Experience with similar large frame type CTGs indicates that the first major overhaul will be required during the third year of operation for the combined-cycle configurations. The expected power plant maturation period is 1 year from start of operation.

Plant operations and maintenance staff during normal operation will perform preventative maintenance. Duke Energy will utilize a maintenance program designed to minimize unplanned maintenance and forced outages. This program will incorporate preventative and predictive maintenance in a maintenance management system and will also provide for rapid and effective response to unplanned maintenance events requiring corrective maintenance action. The program will utilize plant personnel as well as outside contract services. An outline of the maintenance program is shown in Table 8-3. Qualitative evaluations of program effectiveness and continuous improvement will be utilized to maintain optimum levels of reliability and availability.

8.5.2.2 Capacity Factors

8.5.2.2.1 Combined Cycle Units

Depending on the market price, a combined cycle unit could effectively operate for up to 95 percent of the year, although permitted usage will be 8,400 hours per year. The combined cycle units are better suited for base load operation, but can operate efficiently at part loads with CTG load reduction down to 50 percent load and still meet the emission requirements. The forecast is that local loads and market forces will act to create a consistent usage level.

8.5.2.2.2 Equipment Redundancy

In general, the Project will be designed so that no single rotating machinery component failure in the balance-of-plant and no single-point failure in the plant Control System will cause a combustion turbine HRSG "train" to go offline. Likewise, no single switchyard circuit breaker or main step-up transformer failure will isolate the plant from the utility. The multiple combustion turbine trains add a significant degree of redundancy to the plant.

TABLE 8-3

MAINTENANCE PROGRAM OUTLINE
MORRO BAY POWER PROJECT

1. Minor Maintenance (Planned and Unplanned)
    - 1.1 Plant Personnel
        - 1.1.1 Preventative
            - 1.1.1.1 Planning
                - 1.1.1.1.1 Experience
                - 1.1.1.1.2 COS Operations and Maintenance (O&M) Procedures
                - 1.1.1.1.3 Manufacturer's Guidelines
                - 1.1.1.1.4 Regulations
            - 1.1.1.2 Maintenance Management System
                - 1.1.1.2.1 Minor Inspections
                - 1.1.1.2.2 Equipment Surveys
                - 1.1.1.2.3 Lubrication
                - 1.1.1.2.4 Component Replacement
        - 1.1.2 Emergency
            - 1.1.2.1 Minor Troubleshooting and Repair
    - 1.2 Contract Services
        - 1.2.1 Preventative
            - 1.2.1.1 Minor Inspections
            - 1.2.1.2 Component Replacement
        - 1.2.2 Emergency
            - 1.2.2.1 Minor Troubleshooting and Repair

2. Major Maintenance (Planned and Unplanned)
    - 2.1 Contract Services
        - 2.1.1 Scheduled Overhauls
        - 2.1.2 Major Repair

Source: Duke-Fluor Daniel, 2000.

Prime equipment for each train (i.e., combustion turbine, heat recovery steam generator, and steam turbines) will not have redundant equipment. Each support system will include redundant equipment to be evaluated on a system by system basis during the engineering and procurement phase.

In addition to hardware redundancy in the plant design and construction, there will be administrative and operational considerations, which enhance plant 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 operator 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 onsite to minimize duration of unplanned outages further enhancing plant operating reliability.

8.5.2.2.3 Equipment Reliability

Duke Energy will be operating in a competitive market where profitability will depend on the units operating reliably without requiring excessive maintenance time or expenditures. The first step in achieving high equipment reliability will be through a careful process of technical and commercial specification, qualification of suppliers, final selection of equipment, and a formal quality assurance and control program instituted throughout the design, fabrication, installation and startup process. After the new units begin commercial operations, continued reliability will be achieved through performance and condition monitoring and through a formal maintenance program designed to provide optimum long-term equipment reliability and unit availability. Inherent design-related and recurring equipment problems will be tracked and trended. Investigation and development of corrective action will be aggressively pursued, with manufacturer participation included in most cases.

Other measures Duke Energy will take include:

- Monitor manufacturers' advisories and equipment upgrade offerings.
- Participate in user group organizations.
- Stay abreast of opportunities for capital improvements and upgrades.
- Attend manufacturer-sponsored seminars and technical conferences to keep current with industry experience with equipment similar to that of the Project.

The current reliability of the "F" class gas turbines manufactured by General Electric are among the highest of all gas turbines commercially available today. More than 100 of the GE 7FA combustion turbines are currently in operation and have collectively logged millions of hours of operation.

The development of combustion turbine technology is still dynamic. New features developed for the advanced design turbines are often incorporated or even retrofitted into current generation designs. Currently, gas turbine development is directed primarily at achieving increased efficiency, reduced emissions and improved reliability. Recent advancements include increasing compressor efficiency, improving the dry low-NO_x combustor design, and increasing reliability by improving equipment condition monitoring with advanced gas turbine control systems.

Manufacturers have been generally successful in achieving these multiple objectives because they rely on incremental development and improvement rather than radical redesign. The "F" class combustion turbines have been commercially available for about 10 years and are becoming commercially mature. Many of the fundamental design features, materials and manufacturing techniques used in these machines are the same as those used in earlier generation models of 15 to 20 years ago. Improvements developed for the advanced design "F" class machines are being incorporated into the older design models, so that a "mature" design often includes many of the newest design, material and manufacturing features. The "F" class combustion turbines are proven designs that include improvements over previous generation machines in terms of reliability, efficiency and emissions.

Other major equipment, including HRSGs, steam turbines and condensers will be specified and procured from a select group of manufacturers with extensive and proven experience and capabilities. The required size of this equipment and the flows, pressures and temperatures under which they must operate are equivalent to power plants that have been in operation for 40 to 50 years. They represent design conditions that have been achievable for over 60 years. Standard manufacturers' warranties and performance guarantees will be required as a condition of procurement. Reliability guarantees may also be available from some manufacturers. These guarantees are generally provided in the form of insurance or liquidated damages and should not be assumed, for the purposes of this section, to directly alter the performance of a specific piece of machinery. Rather, they should be considered indicative of how well the manufacturers expect their equipment will actually perform.

8.5.2.2.4 Water Availability

Seawater will be used for all power cycle requirements, including makeup to the seawater desalination evaporator which supplies fresh feed water (FW) makeup to each HRSG. Demineralized HRSG blow down provides about one third of the total FW makeup requirement. The total FW makeup requirement for the combined cycle units averages 32 gpm.

Potable water will be produced by the fresh water wells located northeast of the Project and will be used for fire water, safety showers, change room showers and sanitary facilities as is currently done. Drinking water will be provided from bottled water.

8.5.2.2.5 Project Quality

This section summarizes the Project Quality Control Program that will be applied to the MBPP combined-cycle Project. The objective of the Project Quality Control 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. Selective controls will be applied to various project activities, such as checking and reviewing engineering design work. Appropriate quality control measures for manufacturing and construction include inspections, surveillance and testing.

Project Stages

For purposes of the Project Quality Control Program, activities are 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.
- **Detail Design -** Typical activities include preparation of specifications, drawings, lists and other technical data needed to describe, illustrate or define systems, structures or components of the plant. This phase of the work will be accomplished by a turnkey Engineering, Procurement and Construction (EPC) contractor through a formal competitive procurement process administered by Duke Energy. The owner's engineering staff will review selected document packages for conformance with the Project requirements.

- **Procurement Specification Preparation -** This work will also be performed by the EPC Contractor. Typical work includes preparing and issuing formal, documented "packages" for suppliers of equipment or services. The supplier proposals are formally evaluated 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(s) for equipment or contract(s) for services, to assure that the products or services conform to the requirements of the purchase order or contract.
- **Supplier Data Review -** These activities, to be performed by the EPC Contractor, include reviewing selected supplier drawings, data, instruction, procedures, plans and other documents to monitor conformance to the requirements of the EPC Contractor's purchase order or contract. EPC Contractor visits to supplier shops will be included as appropriate, as well as Owner visits when required.
- **Shipping and Receipt Inspections -** These activities, also to be performed by the EPC Contractor, include inspections and review of products at the time of shipment and delivery to the construction site. Surveillance of this process may be performed by the Owner's engineering staff if required.
- **Construction/Installation -** These activities include inspection and review of the EPC Contractor's storage, installation, cleaning and initial testing of systems and components at the plant site. Where appropriate, the Owner will survey the EPC Contractor's inspection systems.
- **System/Component/Plant Testing -** These activities are performed by the EPC Contractor and witnessed by the owner's engineering staff. They require that the plant be commissioned, started up and tested in a documented and controlled manner to confirm that the performance of systems and components conforms to the EPC Contract requirements and guarantees.

8.5.2.2.6 Quality Control Records

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

- Approved Environmental and Building Permits
- Project Procedures and Instruction Manual
- Design Calculations and Equipment Specifications
- Project Design Basis
- Quality Assurance Audit Reports
- Piping and Instrument Diagrams
- One-Line and Three-Line Diagrams

- Conformance to Construction Records Drawings
- Procurement Specifications (Contract Issue and Charge Orders)
- Purchase Orders and Change Orders
- Supplier's Quality Assurance and Quality Control Records
- Correspondence and Conference Memoranda

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

During construction, commissioning and plant testing, field activities are accomplished by the EPC Contractor including receipt inspection, construction and installation, and system/component/plant testing. The EPC Contractor will be responsible for performing the work in accordance with the quality requirements specified by the EPC Contract.

Subcontractor quality compliance will be monitored through EPC Contractor inspections and audits, supplemented when necessary by the Owner and/or Owner's representatives.

8.6 EFFICIENCY

8.6.1 COMBINED CYCLE UNIT

See Appendix 8-1 for heat balance diagrams covering the range of ambients, for fired, unfired and part loads.

Annual fuel consumption for the two combined cycle units based on average ambient temperature at full load for 8,000 hours per year (hrs/yr.) (half of which is with supplementary firing) is 62,800,000 million British thermal units per year (MM Btu/yr.) higher heating value (56,600,000 MMBtu/yr. lower heat value). The annual net electrical output based on average ambient temperature at full load for 8,000 hrs/yr. (half of which is with supplementary firing) is 8,920,000 megawatts hours per year (MW hr/yr.).

A comprehensive discussion of alternative generating technologies available for the Project is provided in Chapter 5.0 - Alternatives Analysis. Included is the projected efficiency of each alternative generating technology and the rationale for selecting combined-cycle technology over the alternative technologies.

8.7 PROJECT CONSTRUCTION

8.7.1 POWER PLANT FACILITY

Design engineering for the Project will require a minimum of 6 months. Construction and startup of the combined-cycle units from the start of site mobilization to commercial operation is expected to take approximately 21 months (see Figure 8-10). The overall sequence of construction and startup includes: design engineering; major equipment delivery for the gas turbine generators; steam turbine generators; and the heat recovery steam generators; construction activities including site preparation and piling; foundations construction; installation of the gas turbine generators, STGs and HRSGs; and startup testing. Demolition of the existing power building and three 450-foot-tall stacks for Units 1 through 4 will take approximately 48 months.

The construction and startup schedule is based on a two shift, 6 x 10 hours per day work week basis. Figure 8-11 indicates the projected total construction craft manpower by month for the Project. As shown in Figure 8-11, an estimated peak of approximately 700 craft and professional personnel is anticipated in month 16. Overtime may be used to maintain or enhance the construction schedule.

8.8 DEMONSTRATION

This Project uses well-developed combined-cycle generating plant technologies and is not a demonstration facility.

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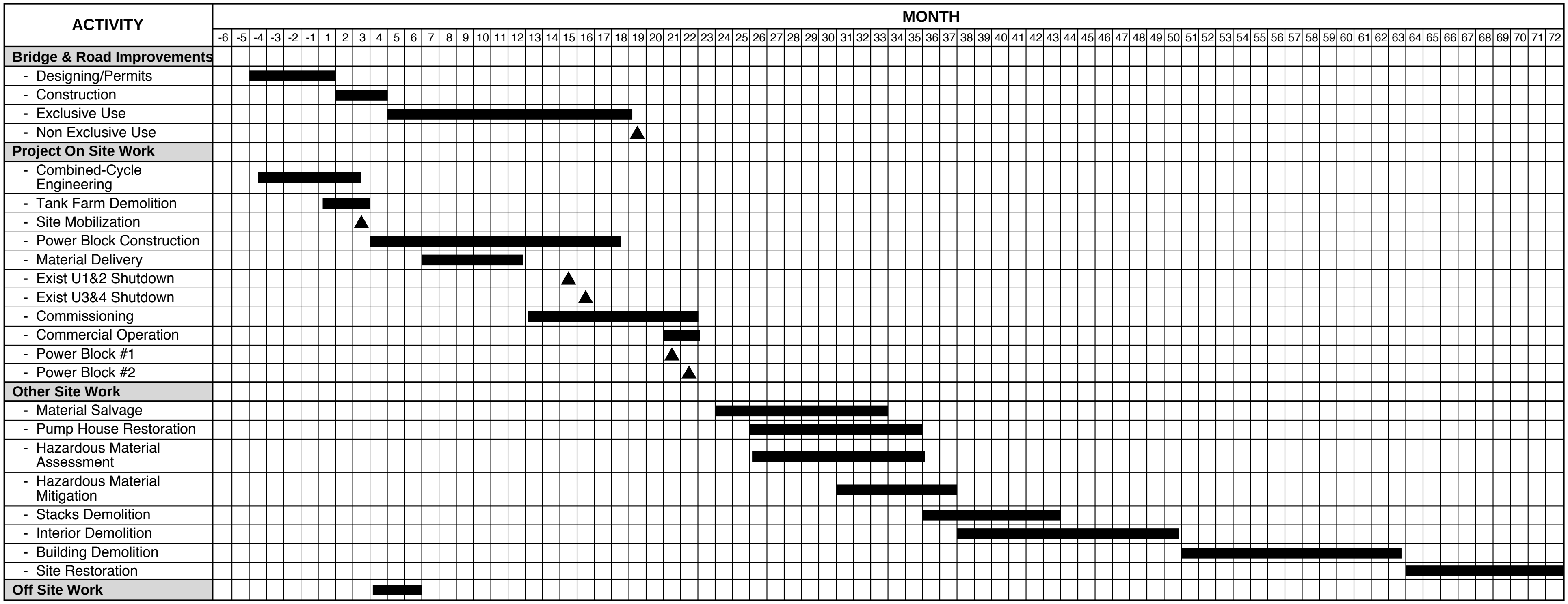

SOURCE: DUKE ENERGY, 2000.

PROJECT SCHEDULE OF ACTIVITIES

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-10

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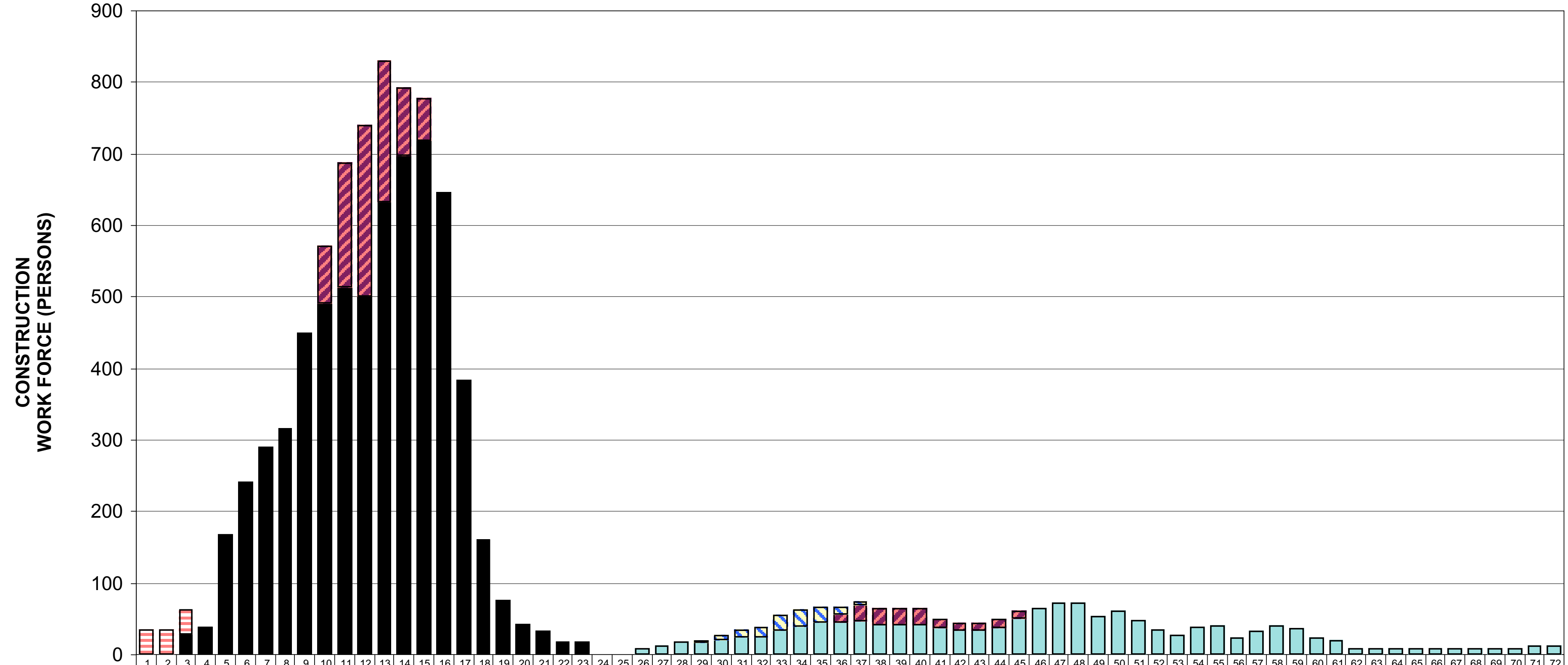

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Onsite Tank Farm Demolition	35	35	35																					
New CC Units 2nd Shift										80	175	240	200	95	60									
New CC Units 1st Shift			29	39	169	242	291	317	450	491	513	501	631	698	718	647	385	161	77	44	34	19	19	0
Pump House																								
Stack Removal Units 1-4																								
Existing Power Building Demolition																								

	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Onsite Tank Farm Demolition																								
New CC Units 2nd Shift																								
New CC Units 1st Shift	0																							
Pump House					4	8	12	16	24	24	24	12	4											
Stack Removal Units 1-4												12	24	24	24	24	12	12	12	12	12			
Existing Power Building Demolition		9	13	18	18	22	26	26	35	42	46	46	48	44	44	44	40	35	35	40	52	66	73	73

	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
Onsite Tank Farm Demolition																								
New CC Units 2nd Shift																								
New CC Units 1st Shift																								
Pump House																								
Stack Removal Units 1-4																								
Existing Power Building Demolition	55	62	48	35	29	40	42	24	33	42	37	24	20	9	9	9	9	9	9	9	9	9	13	13

LEGEND

- Onsite Tank Farm Demolition
- New CC Units 2nd Shift
- New CC Units 1st Shift
- Pump House
- Stack Removal Units 1-4
- Existing Power Building Demolition

SOURCE: DUKE ENERGY AND DUKE/FLUOR DANIEL, 2000.

WORK FORCE LOADING
PROJECT CONSTRUCTION

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 8-11