6.18 TRANSMISSION SYSTEMS SAFETY AND NUISANCE

This section describes the existing electrical power transmission system at the Morro Bay Power Plant (MBPP) and assesses potential impacts of the Project on the transmission system. Since MBPP has been an operating power plant since the 1950s, and the existing transmission system will not be altered, impacts from the Project will be less than significant. This conclusion has been substantiated through a two-fold process that includes an interconnection study by Pacific Gas and Electric Company (PG&E), owner and operator of the existing Morro Bay Switchyard, and modeling of electric and magnetic fields from the transmission lines. The transmission lines are owned by PG&E and operated by the California Independent System Operator (ISO). Duke Energy is proposing to modernize and make improvements to MBPP in a manner that enables the existing PG&E transmission facilities to be utilized as is.

Beneficial aspects of the Project include:

- The existing PG&E Morro Bay switchyard and network of offsite transmission lines will carry the additional power generated by the Project, with no need for new transmission lines or major system modifications.
- The Project will not result in increases to the electric fields, or to radio and television interference levels, from the PG&E transmission lines connected to the PG&E switchyard.

6.18.1 EXISTING CONDITIONS

The MBPP is located 12 miles northwest of San Luis Obispo, California in San Luis Obispo County, within the City of Morro Bay. The plant is situated west of Highway 1 near Morro Bay Harbor, and east of Estero Bay. The area includes light industry, commercial operations, and marine, recreational and residential uses.

The MBPP generates power which is transmitted to the existing PG&E Morro Bay Switchyard. A series of transmission lines extend offsite from the PG&E switchyard to regional substations in various central California locations. These substations, which also receive electricity from other power plants in California, provide electrical service to communities situated in their general vicinity. The PG&E Morro Bay Switchyard also connects to a small local substation which provides electrical service to the Morro Bay and San Luis Obispo County areas. Figure 6.18-1 shows the PG&E switchyard location. Figure 6.18-2 shows the network of regional substations that receive power from MBPP.

6.18.1.1 Onsite PG&E Switchyard

As shown in Figure 6.18-1, the PG&E Morro Bay Switchyard is situated east of the main power plant structure. The four existing Morro Bay electricity generating units are connected to the PG&E switchyard by short generation tie lines. From there, power is directed to the offsite substations.

The PG&E switchyard itself is a power distribution center with switching equipment and a series of transformers to allow power to be directed to the various offsite transmission lines shown in Figure 6.18-2. The switchyard is composed of two different sections (or buses), which are 115 kilovolt (kV) and 230 kV. These sections are for intermediate transport of power over generally intermediate distances. The power generated is transferred into the ISO grid for distribution.

6.18.1.2 Existing Offsite Transmission Lines

As shown in Figure 6.18-2, the PG&E Morro Bay Switchyard is connected to several transmission lines that extend offsite to various regional substations. The transmission lines are typically supported by 100- to 150-foot towers (see Appendix 6.18-1). At the receiving substations, the power is transformed to lower voltages (115 kV and less) for distribution to various communities and businesses. The transmission lines that exit the PG&E Morro Bay Switchyard are as follows:

- Morro Bay - Gates 230-kV Lines 1 & 2: These lines help serve the Gates and Templeton substations shown in Figure 6.18-2. The Gates substation provides power to the greater Fresno and San Joaquin Valley areas. The Templeton substation in San Luis Obispo County provides power to the Paso Robles area.
- Morro Bay - Midway 230-kV Lines 1 & 2: These lines help serve the Midway substation shown in Figure 6.18-2. The Midway substation in Kern County provides power to the greater Bakersfield area.
- Morro Bay - Mesa 230-kV Line: This line helps serve the Mesa substation shown in Figure 6.18-2. The Mesa substation in San Luis Obispo County provides power to the greater Santa Maria area.
- Morro Bay - Diablo - Mesa 230-kV Line: This line is looped through the Diablo Power Plant and provides a backup equipment power source in the event systems are temporarily offline at Diablo. This line also helps serve the Mesa substation.
- Morro Bay Substation: This substation is located adjacent to the PG&E Morro Bay switchyard, as shown in Figure 6.18-1. Two 115-kV lines extending from this substation help provide power to the greater Morro Bay and San Luis Obispo area.

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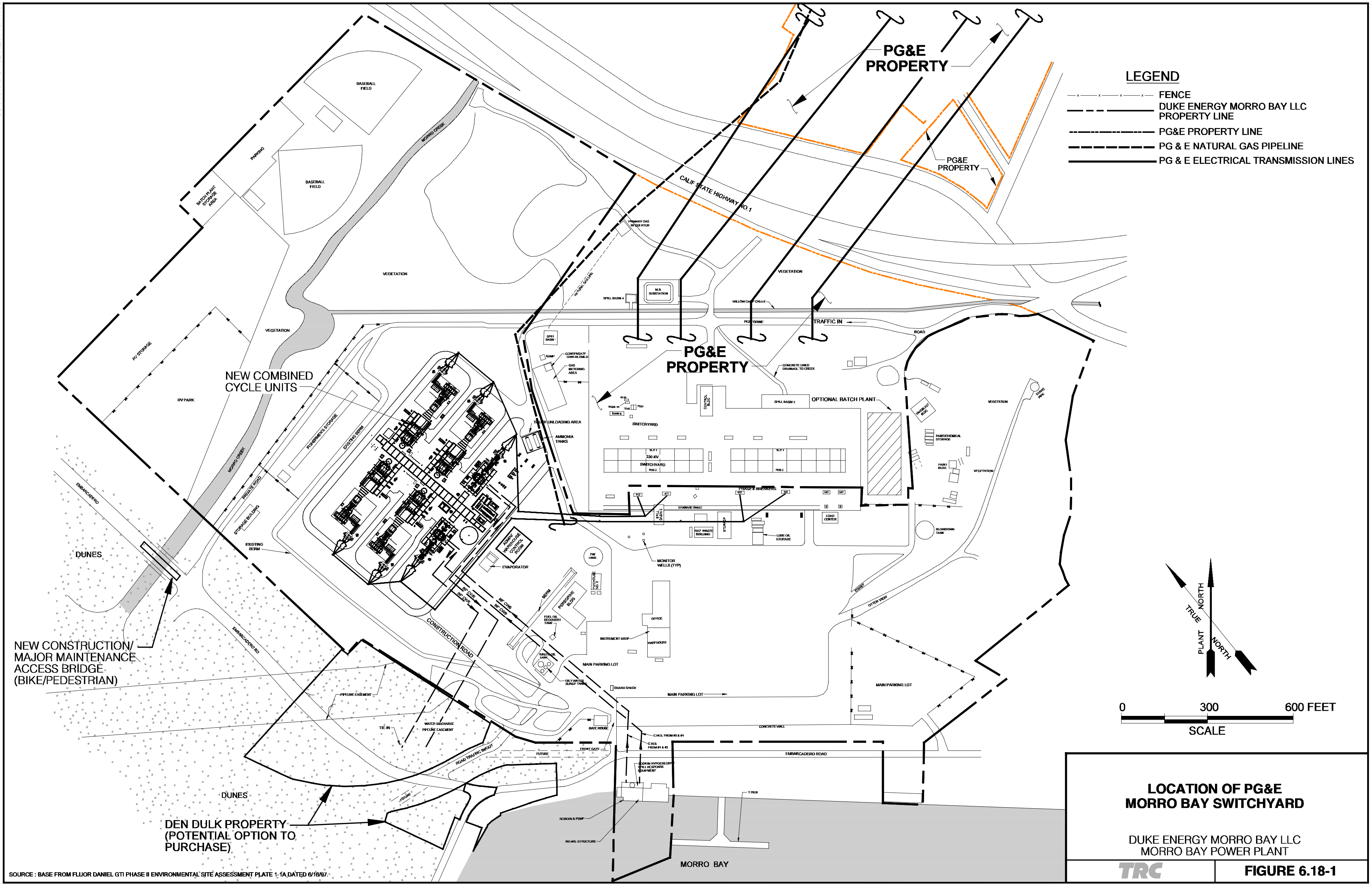

LOCATION OF PG&E MORRO BAY SWITCHYARD

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 6.18-1

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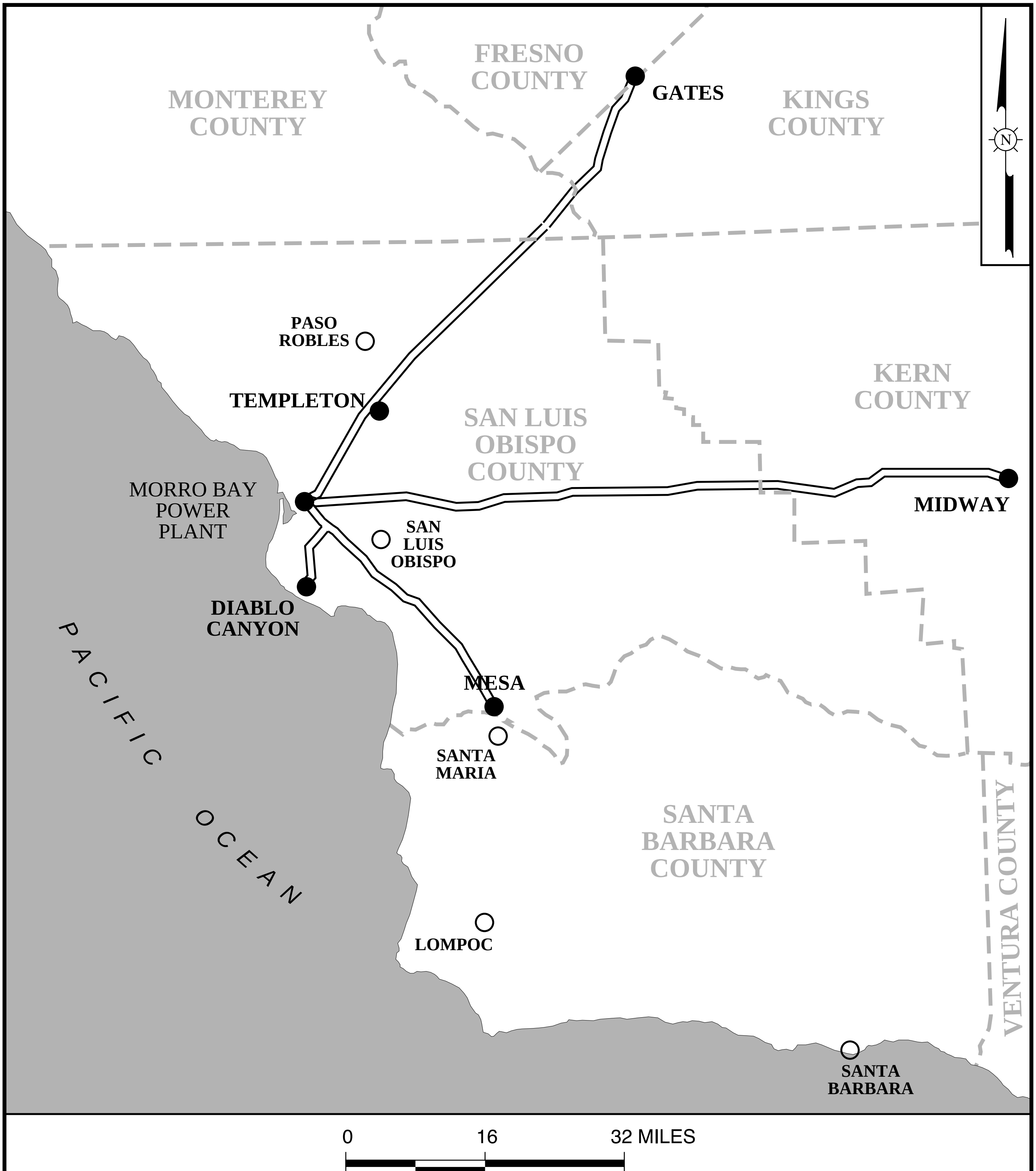


LEGEND

- ELECTRICAL SUBSTATION
- 230 KV LINES

REGIONAL ELECTRICAL SUBSTATIONS FED BY MORRO BAY POWER PLANT

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 6.18-2

6.18.1.3 Transmission Line Safety

As described above, the PG&E Morro Bay Switchyard is able to direct power to at least five separate regional substations that help provide electricity to several million homes throughout central California. Power travels from the PG&E switchyard to the regional substations through 230-kV transmission lines. These lines are owned and maintained by PG&E and operated by the ISO.

The existing transmission lines have been present for up to 45 years in some areas. The following sections address special safety considerations associated with transmission lines.

6.18.1.4 Audible Noise and Radio/Television Interference

When a transmission line is in operation, an electric field is generated in the air surrounding the conductor. Corona is the partial electrical breakdown of the insulating properties of the air in the vicinity of the conductors of a transmission line. When the intensity of the electric field at the conductor surface exceeds the breakdown strength of the surrounding air, a corona discharge occurs at the conductor surface. Energy and heat are dissipated in small volumes near the surface of the conductors. Part of this energy is in the form of small local pressure changes that result in audible noise, or in a discharge that results in radio/television (TV) interference.

Corona-generated audible noise can be characterized as a hissing, cracking sound which, under certain conditions, is accompanied by a 120-hertz (Hz) hum. Corona-generated audible noise is of concern primarily for contemporary lines at voltages of 345 kV and higher during inclimate weather. The conductors of high voltage transmission lines are designed to be corona-free under ideal conditions. However, slight variations and irregularities in the conductor surface cause higher electric fields near the conductor surface, and the occurrence of corona. The most common source of enhanced electric fields at the conductor surface is water droplets on, or dripping from, the conductors. Therefore, audible noise from transmission lines is generally associated with wet weather (i.e., wet conductor) phenomenon. Wet conductors can occur during periods of rain, fog, snow or icing. These conditions are expected to occur infrequently (less than 5 percent of the time). During fair weather, insects and dust on the conductor also can serve as sources of corona.

Corona on transmission line conductors can also generate electromagnetic noise in the frequency bands used for radio and TV signals. Radio and TV interference, known as gap-type noise, is caused by an oxidized film on the surface of two hardware pieces in contact. The film acts as an insulator between the surfaces and small electric arcs, which produce noise and interference.

Interference with electromagnetic signals by corona-generated noise is generally associated with lines operating at voltages of 345 kV or higher, or undermaintained lines. This is especially true of interference with TV signals.

It is not possible to say that a particular level of radio or TV noise will or will not cause unacceptable reception. This is because what is perceived to be "acceptable" reception is affected by ambient noise levels and the strength of the radio or TV signal received. One measure of acceptability of radio or TV noise can be explained in terms of the signal-to-noise ratio, defined as the ratio of the average signal power to the average noise power. A signal-to-noise ratio above 20 is generally considered to provide acceptable radio reception. For TV reception, a signal-to-noise ratio of 30 to 40 provides acceptable reception.

The 230-kV transmission lines extending from the PG&E Morro Bay Switchyard are currently maintained by well-trained transmission line maintenance crews. If complaints of noise and radio or TV interference are received, they are logged, investigated and corrected by PG&E.

6.18.1.5 Induced Currents and Hazardous/Nuisance Shocks

Induced current or spark discharge shocks can occur under certain conditions, in fields associated with 230-kV or higher voltage transmission lines, when a person comes into contact with an object in an electric field. These resulting short-term or long-term effects are the possible nuisances from electric fields. Studies indicate it is unlikely that electric fields produce long-term health effects. There have been no reports of induced current and nuisance voltage shocks from objects within the MBPP vicinity. The grounding of nearby metal objects reduces the potential for these effects.

6.18.1.6 Electric and Magnetic Fields

Whenever electricity is used or transmitted, electric and magnetic fields (EMFs) are created by the electric charges. An electric field is said to exist in a region of space if a charge, at rest in that space, experiences a force of electrical origin (i.e., electric fields cause free charges to move). The electric field is a vector quantity; that is, it has both magnitude and direction. The direction corresponds to the direction a positive charge would move in the field. Sources of electric fields are unbalanced electrical charges (positive or negative) and time-varying magnetic fields. Transmission lines, distribution lines, house wiring and appliances all generate electric fields in their vicinity because of unbalanced electrical charge on unshielded energized conductors. Electric fields are expressed in units of volts per meter (V/m) or kilovolts (thousands of volts) per meter (kV/m). Electric fields are easily shielded by most objects, including trees, fences and buildings.

Once electric fields 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. Magnetic field is a vector quantity that is characterized by both magnitude and direction. Electric currents are sources of magnetic fields. Magnetic fields are expressed as exposure per unit area in units of milligauss (mG). Magnetic fields are not shielded by most materials.

The spatial uniformity of an electric field depends on the source of the field and on the distance from that source. On the ground under a transmission line, the electric field is nearly constant in magnitude and direction over distances of a few meters. In proximity to transmission or distribution line conductors, however, the field decreases rapidly as distance (r) 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 (source) is inside a grounded conducting enclosure, then the electric field outside the enclosure is zero, and the source is said to be shielded.

Transmission line-related fields decrease at a rate of $1/r^2$, if currents are balanced and conductors are closed spaced. Magnetic fields associated with unbalanced phase circuits will fall off inversely from distance to the source (conductor), at a rate of 1/r. Therefore, if the distance is doubled from the source and the transmission line current is balanced in all three phases, the magnetic field would drop off by a factor of 4. However, if the phase current is unbalanced and distance from the source is doubled, the field decreases by only one-half of its original intensity.

The electric field created by a high voltage transmission line extends from the energized conductors to other conducting objects such as the ground, towers, vegetation, buildings, vehicles and people. The strength of the vertical component of the electric field at a height of 1 meter (3.28 feet) is frequently used to describe the electric field under transmission lines. Magnetic fields from high voltage transmission lines are produced only when current flows, and they have a magnitude that is dependent on the amount of current, not the applied voltage.

The most important parameters of a transmission line in determining EMF at a 1-meter height are conductor height above ground and line voltage. The maximum, or peak, EMF occur in areas near the centerline and at midspan, where conductors are at their lowest point.

6.18.1.7 Electric and Magnetic Fields Modeling

The Bonneville Power Administration Corona and Field Effects Program (BPA Program) model was used to calculate the electric and magnetic fields for the major transmission line right-of-way (ROW) cross section configurations at MBPP. The BPA Program is used to predict values of electric and magnetic fields that have been confirmed by field measurements by numerous utilities. To estimate the maximum EMF, calculations are performed at mid-span where the conductor is at its lowest point between structures, and at a height of 1 meter above ground. The calculations and methodology are included in Appendix 6.18-1.

The Morro Bay - Mesa and Morro Bay - Mesa - Diablo 230-kV lines and associated 115-kV lines were not included in the EMF analysis because these lines are either radial or are not substantially affected by the Project's generation additions. Radial lines are transmission lines that have an unchanging load and are not part of the interconnected system. The lines that are affected by the increased generation, and therefore change in load, have been modeled to evaluate EMF.

The following two different transmission line ROW cross section configurations were analyzed. These configurations were based on a review of PG&E maps of the surrounding area. Each configuration represents the actual physical transmission line tower, the geometry of the tower, and placement of the tower relative to other towers. The percent coincidence describes the percent of the line's length that shares a common ROW with another line. A high noncoincidence percentage means the line traverses its own ROW for most of its length.

- Diablo - Gates 500 kV Line (DB-GAT 500) on a common ROW with the Morro Bay - Gates 230 kV Lines (MB-GAT 230), based on an 85 percent coincidence.
- Morro Bay - Midway 230 kV (MB-MID 230) on a separate ROW, based on a 75 percent noncoincidence.

The calculated electric field strengths, at the left and right edges of the existing ROWs, and the maximum value within the ROWs, are presented in Table 6.18-1. For the existing case, the field strengths range from 0.10 kV/m to 1.18 kV/m at the ROW edges. While California does not have a regulatory level, these values are within levels established by those 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 ROW, depending on line voltage. The California Energy Commission (Commission) does not presently specify limits on electric fields (Commission, 1992).

TABLE 6.18-1

ELECTRIC FIELD VALUES (KILOVOLTS/METER)

LINE(S)	LOCATION	EXISTING FIELD	CASE 1[1] FIELD	FIGURE IN APPENDIX 6.18-1
DB-GAT 500 kV MB-GAT 230 kV	L ROW Edge Maximum R ROW Edge	0.10 7.06 1.18	0.10 7.06 1.18	6.18-1
MB-MID 230 kV	L ROW Edge Maximum R ROW Edge	1.07 2.05 1.07	1.07 2.05 1.07	6.18-2

(1) Case 1 is the addition of the 540-MWs to the existing system.

The calculated magnetic fields strengths, at the left and right edges of the existing ROWs, and the maximum value within the ROWs, are presented in Table 6.18-2. For the existing case, the field strengths range from 4.8 mG to 43.8 mG at the ROW edges. The maximum value within the ROWs is 126.9 mG. While California does not have a regulatory level, these values are well below the levels established by those states that do have regulatory limits. States with regulations have ranges from 150 mG to 250 mG at the edge of the ROW, depending on line voltage. The Commission does not presently specify limits on magnetic fields, but does require measurement and reporting of levels along ROWs for lines licensed by the Commission (Commission, 1992).

TABLE 6.18-2

MAGNETIC FIELD VALUES (MILLIGAUSS)

LINE(S)	LOCATION	EXISTING FIELD	CASE 1[1] FIELD	FIGURE IN APPENDIX 6.18-1
DB-GAT 500 kV MB-GAT 230 kV	L ROW Edge Maximum R ROW Edge	4.8 126.9 43.8	4.9 127.2 51.8	6.18-1
MB-MID 230 kV	L ROW Edge Maximum R ROW Edge	22.6 50.6 22.6	29.4 66.1 29.4	6.18-2

(1) Case 1 is the addition of the 540-MWs to the existing system.

6.18.1.8 EMF Consensus Group Finding

In January 1991, the California Public Utilities Commission (CPUC) issued an Order Instituting Investigation (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 from 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 EMFs" on March 20, 1992 (California EMF Consensus Group, 1992). Regarding the relevant policy consensus recommendation title "Facility Siting," the group stated the CPUC should recommend that utilities take public concern about EMFs into account when sighting new electric facilities. This group could not conclude that there is a relationship between EMF and human health effects; therefore, they recommended the CPUC authorize further research.

6.18.2 IMPACTS

Significance criteria were determined based on California Environmental Quality Act (CEQA) Guidelines, Appendix G, Environmental Checklist Form (approved January 1, 1999) and on performance standards or thresholds adopted by responsible agencies. An impact may be considered significant if the Project results in:

- Increased levels of audible noise and radio/TV interference.
- Significant changes to the existing electric and magnetic fields.
- Changes to the configuration or operation of the transmission system, such that new transmission lines or switchyards would be required to be constructed.

The MBPP Project proposes to remove existing Units 1 through 4 and replace them with two 600-megawatts (MW) net combined-cycle units. The maximum power exiting the MBPP over existing transmission lines will be 1,200 MW.

A previously proposed MBPP project would have replaced Units 1 and 2 (340-MW) with a nominal 530-MW combined-cycle generating unit. This new combined-cycle unit plus existing Units 3 and 4 (690 MW) would have resulted in a maximum of 1,230 MW of power exiting the MBPP over existing transmission lines. The following studies and analyses are based on the previously proposed MBPP project which would have transmitted a maximum of 1,230 MW over existing transmission lines. Since the studies and analyses are based on 1,230 MW which is greater than the 1,200 MW that will be generated by this MBPP Project, they are not only valid in their conclusion but conservative. Figure 6.18-3 depicts the short onsite generation tie-in lines that will connect the new combined-cycle units to the existing PG&E Morro Bay switchyard.

An assessment of the ability of the PG&E switchyard and transmission system to accommodate the added power generation has been completed (Jones, 1998). The analysis concluded that the existing and planned PG&E transmission system will not require the construction of new switchyards or transmission lines. Some nominal upgrading of the existing PG&E-operated switchyard will likely be necessary. Short generation ties within the Project site will be required to connect the new generation units to the switchyard (see Figure 6.18-3).

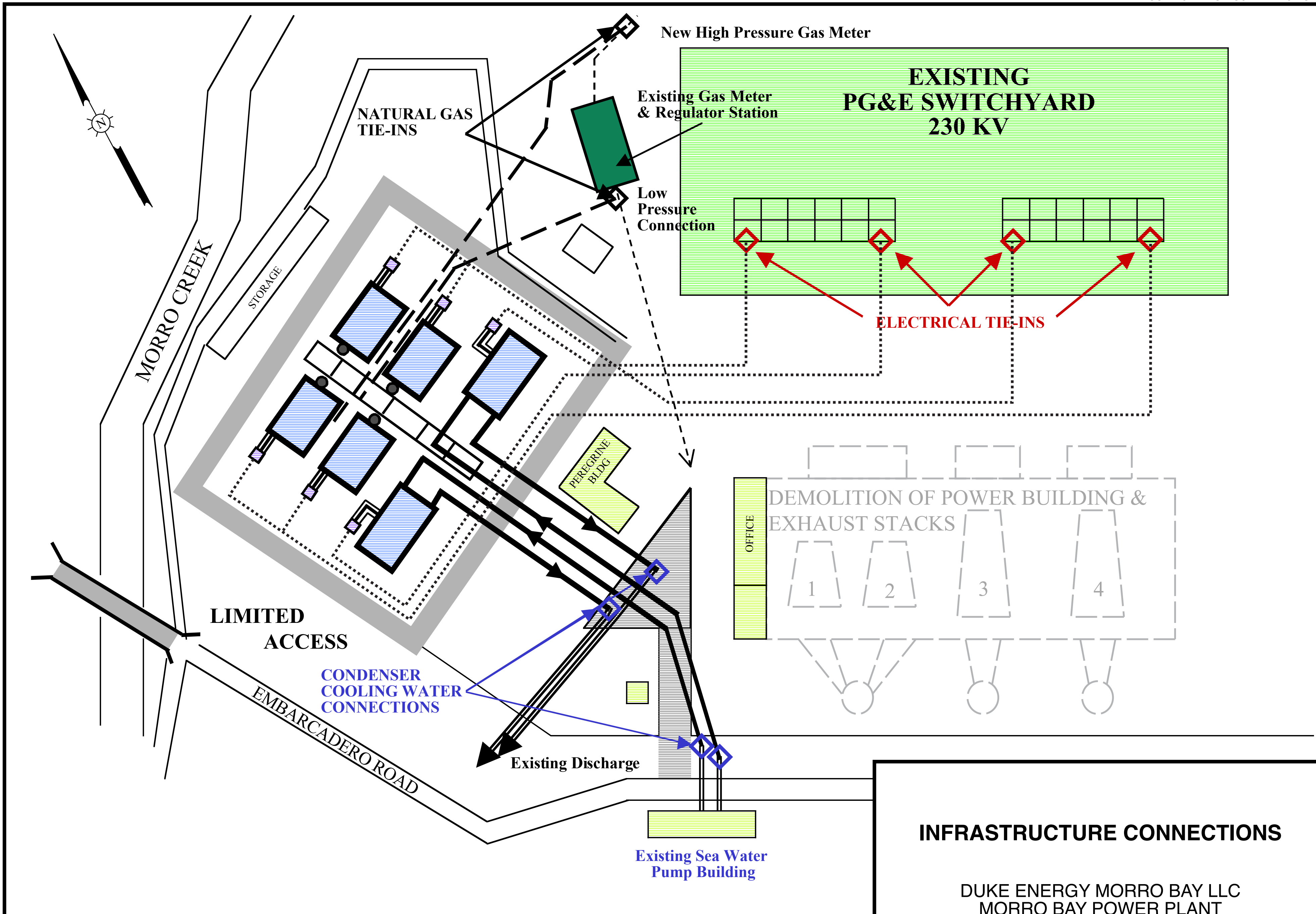
A Preliminary Interconnection Study has been prepared by PG&E to examine transmission capacity availability and system reinforcements needed for the Project (Appendix 6.18-2). Recommendations for protection and upgrades will be included in the Project plan and incorporated into the Project, as necessary. The study concludes that no normal transmission line overloads will be created by the Project.

6.18.2.1 Audible Noise and Radio/Television Interference

The intensity of noise levels and potential for radio and TV interference from transmission lines is related to the corona performance of the lines. Corona performance can be predicted using empirical equations that have been developed from measurements on several high-voltage lines. The BPA Program utilizes an empirical equivalent method to analyze corona performance that agrees with long-term data. Outputs of the program are maximum conductor surface voltage gradient, fair and foul weather audible noise and radio interference levels at the ROW edges, and TV interference levels. These outputs are indices of corona performance.

The BPA Program was used to assess the two predominant transmission line ROW configurations at MBPP under two scenarios: the existing "base" case and Case 1. Base case consists of existing Units 1 through 4 for a total of 1,030 MW exiting the MBPP over existing transmission lines. Case 1 assumes that Units 1 and 2 are removed, Units 3 and 4 (690 MW) continue to operate and a new 540-MW combined-cycle unit is added for a total of 1,230 MW exiting the MBPP over existing transmission lines.(1) The model output results are in Appendix 6.18-1.

(1) To be conservative, the model was run using 540 MW even though the combined-cycle unit that will be installed under the Project is a 530-MW unit.



INFRASTRUCTURE CONNECTIONS

DUKE ENERGY MORRO BAY LLC
MORRO BAY POWER PLANT

TRC

FIGURE 6.18-3

SOURCE: DUKE ENERGY, 2000.

Noise is measured on a logarithmic scale, expressed in decibels (dB). The predicted fair weather audible noise levels from the two line configurations range from 26.8 decibels on the A-weighted scale (dBA) to 44.6 dBA at the ROW edges (see Appendix 6.18-1), comparable to the noise level in a suburban area living room. The A-weighted scale is the most widely used scale for describing noise levels since it correlates with human response to sound. There are generally few complaints about transmission line noise for levels below 50 dBA (Electric Power Research Institute, 1987).

The addition of the generating unit does not change the values of the corona performance indices for both of the transmission line configurations modeled in this analysis (see Appendix 6.18-1). Therefore, there are no predicted impacts to current audible noise and radio and TV interference levels due to the Project.

6.18.2.2 Electric and Magnetic Fields

The potential impacts of the Project on existing EMFs were modeled using the BPA Program, as described in Appendix 6.18-1. Tables 6.18-1 and 6.18-2 show the change in EMFs due to the addition of the generating unit (Case 1). As shown in Table 6.18-1, the electric field strength values do not change from existing levels, since electric field strengths are independent of the conductor current. Therefore, there is no predicted change in electric fields from the existing transmission line configurations as a result of the Project.

Table 6.18-2 shows the predicted magnetic field strengths for Case 1. These magnetic field strengths generally increase for both transmission line configurations. The maximum field strength values range from 4.9 mG to 51.8 mG at the edge of the ROWs, and from 66.1 mG to 127.2 mG within the ROWs. These values are still below the average levels established by states that have regulatory limits, which are 150 mG to 250 mG at the edge of the ROW.

6.18.2.3 Cumulative Impacts

None of the offsite cumulative projects (see Table 6.1-1) will alter transmission line voltage. Consequently, there are no cumulative transmission system impacts associated with the Project.

6.18.2.4 Project Design Features

Based on the impacts analysis, there are no significant impacts. Therefore, there are no Project design features required for the transmission system.

6.18.3 MITIGATION MEASURES

There are no potential impacts or cumulative impacts due to the Project. As a result, no mitigation measures are required.

6.18.4 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

There are no significant unavoidable adverse impacts associated with the Project.

6.18.5 LAWS, ORDINANCES, REGULATIONS AND STANDARDS (LORS) COMPLIANCE

The existing transmission lines have been in operation for over 45 years in some areas, and have been designed, operated and maintained in accordance with applicable guidelines. The MBPP Project will not require construction of new transmission lines or facilities, or change the design and maintenance of existing PG&E transmission lines. The only change to the transmission system will be indirect, through the addition of generating capacity and the resulting change in load on the lines. As discussed in Section 6.18.2, there are no significant audible noise, radio and TV interference, or EMF impacts due to the Project. Thus, the transmission lines will remain in compliance with existing LORS, as identified in Section 7.4.3 and Table 7-1.

6.18.6 REFERENCES

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