6.0 ELECTRIC TRANSMISSION

The Tracy Peaker Project (TPP) would connect to PG&E's 115-kV system by looping the Tesla-Kasson 115-kV transmission line through the plant site. The existing Tesla-Kasson 115-kV line is directly adjacent to the TPP site. A PG&E switching station, to be named the Schulte Switching Station, would be constructed at the same time as the TPP and located within the TPP site. This interconnection is shown on Figure 6-1.

6.1 Transmission Line Engineering

6.1.1 Existing Facilities

An evaluation of the existing transmission facilities in the area of the TPP was made to identify transmission lines with adequate capacity to accommodate the output of the proposed plant. The existing transmission facilities in the area that are crossed or impacted by the TPP include:

- **PG&E's Tesla Substation** is four miles west of the TPP site. This switchyard is connected to PG&E's 500-kV, 230-kV, and 115-kV transmission systems. This substation is the end point for the Tesla-Kasson 115-kV transmission line. It is a major north-south focal point for power generation in California. Over a dozen transmission lines enter the Tesla Substation, but only those that are either crossed or impacted by the TPP are discussed below.

- **PG&E's 115-kV Tesla-Manteca transmission line** crosses the TPP site at the southeast corner. The line then runs to the Tesla Substation. This line is a single-circuit line utilizing lattice steel structures.

- **PG&E's 115-kV Tesla-Kasson transmission line** crosses TPP site at the southeast corner. The line then runs to the Tesla Substation. This line is a single-circuit line utilizing lattice steel structures that would be looped through the TPP in conjunction with the Schulte Switching Station, which would be constructed at the TPP site.

- **PG&E's 115-kV Tesla-Stockton Cogen transmission line** crosses the TPP site at the southeast corner. The line then runs to the Tesla Substation. This line is a single-circuit, bundled conductor line utilizing wood poles.

6.1.2 Proposed Facilities

6.1.2.1 Tracy Peaker Project Switchyards

The TPP would contain two onsite switchyards. One switchyard would be owned by GWF and would be called the "TPP switchyard." The other switchyard would be owned by PG&E and would be called the "Schulte Switching Station." The two switchyards would be connected by an onsite 340-foot tie-line, as shown in Figure 6-2.

The 115-kV TPP switchyard would be located on the south side of the TPP site. The switchyard would use a two-breaker radial bus configuration. The two breaker positions would be for the two 84.4-megawatt combustion turbine generators (one position for each unit).

The 115-kV PG&E Schulte Switching Station would be located on the east side of the TPP site. This station would utilize a three-position ring bus configuration. Two bus positions would be for the Tesla-Kasson 115-kV transmission line loop-through, and the remaining bus position would be for a station bypass used during maintenance actiities.

The TPP switchyard and Schulte Switching Station would be connected with an onsite 340-foot tie-line. The tie-line would utilize dead-end structures consisting of a steel pole and arms with polymer dead-end conductor insulators, as shown on Figure 6-3a. The dead-end structures would be supported by anchor-bolted foundations.

This tie-line would use a single 1,431 kcmil all aluminum conductor (AAC) "Carnation" per phase. This conductor has a normal current rating (ampacity) of 1,220 amperes. The normal conductor rating was determined from Alcoa's *T&D Conductors, Overhead Underground* handbook, based on a maximum conductor temperature rise of 40 degrees Celsius (ºC) above a 40ºC ambient temperature, a 2 feet per second (fps) crosswind, and an emissivity factor of 0.50 without sun.

The TPP switchyard and the Schulte Switching Station would be designed in accordance with applicable industry standards and would have the following ratings:

- Nominal voltage – 115 kV

- Basic impulse level – 550 kV
- Continuous current – 2,000 amperes
- Short-circuit current, included in PG&E's System Impact/Facility Study

The TPP switchyard would use a strain-bus design supported by galvanized-steel structures.

The Schulte Switching Station would use a conventional outdoor-air-insulated rigid-bus design supported on galvanized-steel structures.

Both switchyards would be fenced with a galvanized-steel, chain-link fabric of a typical height. All nongalvanized structures and equipment would be painted shades of ANSI gray. The control buildings would be a color similar to that of the TPP power generation facility.

A ground mat would be installed to provide safe step-and-touch potentials for the general public and switchyard operation and maintenance personnel. The grounding system would be designed in accordance with American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) 80.

The switchyards alternating current (AC) supply would be derived from a redundant 480-volt AC feed from the TPP. The direct current (DC) supply for the TPP control and protection systems of the station would be derived from a 125-volt DC station battery. A one-line diagram for the TPP switchyards is shown on Figure 6-1. The configuration of the TPP switchyard and the Schulte Switching Station is shown on Figure 6-2. Photo-simulations of the proposed switchyards are shown in Section 8.11.

6.1.2.2 Tracy Peaker Project Tesla-Kasson 115-kV Interconnection

The Tesla-Kasson 115-kV transmission line would be cut directly adjacent to the TPP site and looped through the new onsite Schulte Switching Station. The transmission lines connecting the Tesla-Kasson line to the switching station would run under the existing Tesla-Manteca 115-kV transmission lines.

The dead-end structures for the proposed loop-through line would consist of a steel pole with polymer dead-end conductor insulators, as shown on Figure 6-3b. The dead-end structures would be supported by anchor-bolted foundations.

The proposed transmission line loop-through span is expected to be approximately 120 to 200 feet in length. The structure heights selected would provide a minimum ground clearance of 30 feet at 60 degrees Fahrenheit (°F) and 28.5 feet at 130°F, in accordance with the requirements of California Public Utilities Commission (CPUC) General Order No. 95 (GO-95).

The proposed loop-through line would use a single 477-kcmil steel-supported aluminum-conductor (SSAC) "Flicker" per phase. This conductor has a normal current rating (ampacity) of 1,205 amperes. The normal conductor rating was determined from Alcoa's *T&D Conductors, Overhead Underground* handbook, based on a maximum conductor temperature rise of 40 degrees Celsius (ºC) above a 40ºC ambient temperature, a 2 feet per second (fps) crosswind, and an emissivity factor of 0.50 without sun.

6.1.2.3 Other

Typical industry design, operation, or maintenance practices would be required for the proposed substation and transmission line facilities. Both substation sites and most transmission structure locations would be accessible from existing dirt, gravel, or paved roads. Short spur roads would be added and would not be graded unless necessary. An access plan would be prepared for construction to designate acceptable construction access routes. Construction access routes would be flagged in the field as required.

Temporary disturbance of land during construction, maintenance, and operation is considered negligible because the construction laydown, access, and stringing areas would be on either the TPP site or within existing PG&E transmission easements. The total permanent disturbance area is approximately 300 square feet.

The anticipated schedule for approval, materials and equipment procurement, and construction of the stations and transmission line is as follows:

- August 2001 – Submit application for Certification (AFC) to the California Energy Commission (CEC)
- October 2001 – Procure miscellaneous equipment and materials
- January 2002 – Start substation and transmission line construction
- May 2002 – Complete electrical interconnect construction

6.1.3 Applicable Regulations

The transmission line and switchyard associated with the TPP would generally be designed and constructed in conformance with CPUC GO-95 and the National Electrical Safety Code. A list of laws, ordinances, regulations, and standards (LORS) that may apply to the transmission line and switchyard design are presented in the following sections.

6.1.3.1 Design and Construction

Table 6-1 lists LORS applicable to the design and construction of the transmission line and switchyard.

6.1.3.2 Fire Hazard

Table 6-2 lists the LORS that govern fire hazard protection for the TPP.

6.1.3.3 Hazardous Shock

Table 6-3 lists the LORS regarding hazardous shock protection for the TPP.

6.1.3.4 Aviation Safety

Table 6-4 lists the applicable aviation safety LORS.

6.1.3.5 Communication Interference

Table 6-5 lists the applicable LORS regarding communications interference.

6.2 Transmission Line Electrical Effects

6.2.1 Project Characteristics

To integrate the TPP output into the PG&E 115-kV transmission system, GWF Energy LLC intends to loop PG&E's existing Tesla-Kasson 115-kV transmission line through PG&E's Schulte Switching Station at the TPP project site.

The following design criteria and assumptions were used to complete the initial design of the project's transmission line and calculate its electromagnetic field (EMF), audible noise, and radio/television interference effects.

6.2.1.1 Assumptions

The nominal transmission voltage would be 115 kV. For these calculations, the transmission line loading would be a nominal 169 MW. The loop-through line would be a single-circuit line composed of one 477-kcmil SSAC conductor per phase. The Tesla-Manteca and Tesla-Kasson 115-kV transmission lines are assumed to be 477 kcmil SSAC carrying 1,126 amps. The Tesla-Stockton Cogen 115-kV transmission line is assumed to be 795 kcmil ACSR (aluminum conductor steel reinforced) carrying 1,484 amps. The switchyard tie-line is assumed to be 1,431 kcmil AAC carrying 849 amps. Profile views of the transmission line corridor and switchyard tie-line are provided in Appendix A.

The phase currents would be balanced (equal). The power factor used in the calculations would be 0.98 (leading or lagging). Continuous plant operation would not occur at this power factor, and variations in the actual power factor can be expected. This power factor represents a typical value for this area.

For the purposes of these calculations and to be conservative, the EMF, radio interference (RI), television interference (TVI), and audible noise calculations were performed at an assumed minimum conductor height above ground of 26 feet (mid-span). However, from a design perspective, the conductors would be a minimum of 30 feet above the ground (34 feet above railroad tracks).

The calculations were performed using the Bonneville Power Administration's (BPA) Corona and Field Effects Program.

6.2.1.2 Conductor Analysis

The selection of a phase conductor size and type for a new transmission line typically considers a number of factors. These factors include the following:

Thermal Capacity. The conductor size/type selected must have a thermal capacity greater than the initial and future capacity requirements of the project.

Economics. Economic evaluations typically consider the effects on conductor, structure, and foundation costs of various conductor sizes/types and bundle configurations (conductor diameters, sags, and tensions). The present worth of conductor losses is also typically considered.

Environmental. Electric and magnetic field strengths are largely dependent on the maximum line operating voltage, phase conductor currents, and the spatial arrangement (configuration) of the phase conductors, not the conductor size/type.

Standardization. Industry standard/typical conductor sizes/types and bundle configurations are given preference because of operation and maintenance, and in-service reliability considerations.

Minimum Size. A minimum allowable conductor size of 477 kcmil was selected for this project. This size selection was based on the existing conductor used on the Tesla-Kasson 115-kV transmission line.

For these calculations, the maximum anticipated loading on the Tesla-Kasson single-circuit transmission line is 190 MW. This loading would result in a maximum current in each phase of 954 amperes at 115 kV.

6.2.2 Aviation Safety

There is no major commercial aviation center in the general vicinity of the project. The Stockton airport is over 20 miles northeast of the TPP area. A smaller local airport in Tracy, the Tracy Municipal Airport, is within two miles of the project transmission line.

In accordance with Title 14, Part 77 of the Code of Federal Regulations (CFR), a Notice of Construction or Alteration must be filed with the Federal Aviation Administration (FAA) if there is any structure rising 200 feet (500 feet in uncongested areas) above the average ground level in the vicinity of the construction site. A notice is also required if any structure protrudes above an imaginary surface extending from the end of the nearest runway at a slope of 50:1 for 10,000 feet, if the longest runway length at the airport is 3,200 feet or less; or a slope of 100:1 for 20,000 feet, if the longest runway at the airport is longer than 3,200 feet.

The closest runway is less than two miles away, but the transmission line would not cut the extended imaginary surface of the airport runway. Therefore, a FAA Notice of Construction is not required for the transmission line.

Local crop dusting occurs in the project area. The Tesla-Kasson loop-through would be located within the existing transmission corridors and would not introduce a significant obstacle for crop-dusting activities.

6.2.3 Audible Noise and Radio/TV Interference

Audible noise is defined as any unwanted sound from a man-made source such as a transmission line, a transformer, an airport, vehicular traffic, etc. Audible noise is superimposed on the background or ambient noise that existed prior to the introduction of the audible noise source.

When an electric transmission line is energized, an electric field is generated in the air around the conductors. This electric field may cause corona (the breakdown of the air in the vicinity of the transmission line phase conductors). 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. This corona discharge produces energy, which can result in audible noise and/or radio interference and television interference. The corona effects from the line were calculated using the BPA CFE Program.

Corona-generated audible noise can be characterized as a hissing, crackling sound, which, under certain conditions, can be heard. The noise levels generated by the line are very low, and most of the time the audible noise would not be detectable, except in an area directly beneath the line on a quiet day. The audible noise calculation results for the Tesla-Kasson transmission line corridor are shown on Figure 6-4. The audible noise calculation results for the switchyard tie-line are shown on Figure 6-9.

Corona on transmission line conductors can also generate electromagnetic noise in the frequency bands used for radio and television signals. This phenomenon is generally referred to as RI and TVI. These terms are commonly applied to any disturbance within the radio frequency band. RI and TVI consist of two distinct types: gap-type noise and noise due to corona. Gap-type noise is the result of sparking or arcing between two pieces of hardware. This arcing occurs when hardware is loose (not tight-fitting), or at sharp burrs or edges on the hardware. This type of noise occurs at discrete points along the line and is often associated with undermaintained lines. Such interference can be easily identified and corrected with proper maintenance. The second type of noise is caused by corona on the conductors. This corona noise emanates from the entire length of conductor and is typically referred to as RI and TVI.

Corona-related interference with radio and television reception is typically associated with transmission line voltages of 345 kV or greater, although it may occur at lower voltages. It is a direct function of the strength of the received radio/television signal and the level of the noise present. The signal to noise ratio (S/N) is defined as the ratio of the average signal power to the average noise power. The higher the S/N ratio, the better the reception quality. A high S/N ratio indicates a high signal level and a low noise level. Consider the analogy of a person talking in a room with low background noise and a person talking in a room with high background noise. If the person’s voice (signal level) remains constant, the person would be heard much more easily in a room with low background noise than the person in a room with high background noise. This concept also applies to radio and television signals in the presence of background noise.

It is difficult to determine whether a particular level of RI or TVI would cause unacceptable radio or television reception. Studies have been conducted, however, to determine acceptable signal to noise ratios. For radio reception, a S/N ratio above 20 is generally considered to provide acceptable reception. For television reception, an S/N ratio of 30 to 40 typically provides acceptable reception. It is anticipated that for receivers proximate to the Tesla-Kasson transmission line right-of-way, there would be little, if any, degradation of radio or Television reception. The exception, if there is one, would be for very remote, poorly received stations. In addition, RI typically interferes with amplitude modulated (AM) stations only. Frequency modulated (FM) stations are generally immune to RI because of the inherent characteristics of the modulation scheme. Therefore, the probability for RI complaints is reduced, as a major band of the radio broadcast spectrum is generally unaffected by the phenomenon. The calculated RI and TVI for the Tesla-Kasson transmission line are shown on Figures 6-5 and 6-6, respectively. The RI and TVI for the switchyard tie-line are shown on Figures 6-10 and 6-11, respectfully. These levels of interference are not expected to be noticeable, except for remote stations. The TVI at the edge of the right-of-way would be noticeable only for weak (remote) stations.

The Tesla-Kasson line would be maintained as part of a regular maintenance program. Therefore, it is unlikely any gap-type noise would result. If any is reported or discovered, it would be quickly mitigated. In addition, it is anticipated that few if any RI/TVI complaints would occur, because of the low magnitude of calculated corona noise. If complaints do occur, they would be addressed, investigated, and mitigated if needed, on a case-by-case basis.

6.2.4 Electric and Magnetic Fields

Electricity is a phenomenon resulting from the existence and interaction of charges. When a charge is stationary or static, it produces forces on objects in regions where it is present. When a charge is in motion, it produces magnetic effects. Whenever electricity is used or transmitted, electric and magnetic fields are created. Transmission lines, distribution lines, house wiring, and appliances produce electric fields in their vicinity due to the electric charges associated with the appliances/conductors. Electric field strengths are typically expressed in units of volts per meter (V/m) or kilovolts (thousands of volts) per meter (kV/m).

Electric charges in motion (currents) produce magnetic fields. The strength of a magnetic field is proportional to the current through the conductor (circuit) producing the field. Magnetic fields can be characterized by the force they exert on a moving charge or on an electric current. Electric currents are sources of magnetic fields. Magnetic field strengths are measured in milligauss (mG).

An example of electric and magnetic fields in a home is a lamp plugged into an electrical outlet. If the lamp is turned off, an electric field exists in the vicinity of the cord of the lamp because of the voltage on the cord. When the lamp is turned on, current flows through the cord and a magnetic field also exists around the cord because of the current flow.

The strength of an electric field depends on the potential (voltage) of the source of the field, and distance from that source to the point of measurement of the field strength. Electric fields decrease rapidly as the distance (r) from the source increases. If an energized conductor (source) is placed inside a grounded conducting enclosure, the electric field outside the enclosure would approach zero (limited by ambient electric field level), and the source is said to be shielded.

Transmission-line-related magnetic fields decrease at a rate of $1/r^2$ if currents are balanced and conductors are closely spaced. Magnetic fields associated with unbalanced phase currents decrease at a rate inversely proportional to the distance from the source (conductor), at a rate of 1/r. Transmission lines typically are operated with balanced phase currents.

The electric field created by a high-voltage transmission line extends from the energized conductors to other nearby conducting objects such as the ground, structures, 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 characterize electric fields under transmission lines.

The transmission line parameters that have the greatest effect on electric and magnetic field levels in the vicinity of a transmission line are maximum operating voltage, line current, conductor height, and electrical phasing. The maximum ground level electric and magnetic fields typically occur near the centerline of a line and at mid-span where the conductors are closest to the ground. For purposes of these estimates, the minimum mid-span conductor height is assumed to be 26 feet.

The electric and magnetic fields from the Tesla-Kasson 115-kV transmission line and the switchyard tie-line were calculated using the BPA Corona and Field Effects Program. The strengths of the electric and magnetic fields were calculated for a sensor height of 1 meter above ground. Calculations were performed based on the minimum 26-foot ground clearance and extend to at least 120 feet on each side of the centerline. The calculated magnetic fields produced by the Tesla-Kasson 115-kV line operating at peak loading conditions are shown on Figure 6-7.

Note that for maximum current flow, the magnetic field at the outside edge of the Tesla-Kasson transmission line corridor would be approximately 59 mG. The magnetic field levels are directly proportional to the current flowing through the transmission line. When current flow is increased or reduced so does the magnetic field level.

The route of the Tesla-Kasson 115-kV transmission line is through sparsely populated area of San Joaquin County. The closest house to the Tesla-Kasson transmission line is approximately 350 feet away. At this distance, the contribution of the magnetic field of the transmission line to the overall magnetic field level is negligible. The electric field levels produced by the Tesla-Kasson transmission line are shown on Figure 6-8. Note that at the outside edge of the transmission line corridor, the electric field level is approximately 0.6 kV/m.

The magnetic field for the switchyard tie-line at the maximum current flow of 954 amps would be 37.7 mG forty feet from the centerline, as shown in Figure 6-12. The electric field would be 0.04 kV/m forty feet from the centerline, as shown in Figure 6-13. The tie-line is on GWF or PG&E property for its entire length; therefore, there should be little or no change in EMF levels to the general public.

Given the concerns about human exposure to electric and magnetic fields and possible adverse health affects, several states have adopted standards limiting electric and magnetic field levels within or at the edge of transmission line rights-of-way (see Table 6-6). California is not one of these states. However, while California does not have regulatory requirements for transmission line magnetic fields, the calculated magnetic fields for the Tesla-Kasson transmission line (refer to Figures 6-7 and 6-12) are much lower than the requirements for those states with existing limitations.

California does not regulate the level of transmission line electric fields. However, calculated values for the Tesla-Kasson line (refer to Figures 6-8 and 6-13) are also substantially below the levels established by those states that do have limits.

6.2.4.1 Transmission Line Electromagnetic Field Reduction

Although the State of California does not limit electric and magnetic field levels, the CPUC mandates EMF reduction as a practicable design criterion for new and upgraded electrical facilities. From this mandate, the regulated electric utilities, including PG&E, have developed their own design guidelines to reduce EMF at each new facility. The CEC requires independent power producers to follow the guidelines that have already been established by the local electric utility or transmission-system owner.

In keeping with the goal of EMF reduction, the TPP interconnection would be generally designed and constructed using the principles outlined in the PG&E publication, Transmission Line *EMF Guidelines*. These guidelines incorporate the directives of the CPUC by developing design procedures that comply with Decision 93-11-013 and GO-95, 128, and 131-D. In other words, when the towers, conductors, and rights-of-way are designed and routed according to the PG&E guidelines, the transmission line is consistent with the CPUC mandate.

From the PG&E guidelines, the primary techniques for reducing EMF anywhere along the line are the following:

- Increase the distance from the line conductors
- Reduce the spacing between the line conductors

- Minimize the current on the line
- Optimize the configuration of the phases (A, B, C)

To increase the distance from the line conductors, the line would be routed along an existing utility corridor, thereby avoiding proximity to residential and public-use areas. The nearest residence is approximately 350 feet away. Additionally, along the route of the overhead line, the adjacent land is a mix of industrial, agricultural, and vacant land.

Reducing the spacing between the conductors can reduce magnetic fields. Also, for the double-circuit case, the circuits on one side would be reverse-phased from the circuits on the other side to further reduce resulting magnetic fields.

While the EMF levels have been calculated for the TPP Generator Tie-line as designed, the CEC requires actual measurement of EMF for comparison of “before” (background) with “after” (transmission line and background together) EMF levels. These verification measurements would be made consistent with Institute of Electrical and Electronics Engineers guidelines and would provide sampled readings of edge of right-of-way EMF. Additional measurements would be made upon request for areas of particular concern.

6.2.4.2 Conclusion on Electromagnetic Fields

Electromagnetic field reduction would be an integral consideration during the design and routing of the interconnection between the TPP and the offsite transmission lines. Since the PG&E *Transmission Line EMF Guidelines* embody the CPUC directives for EMF reduction, the guidelines are the primary criteria for EMF considerations in this project.

The route of the Tesla-Kasson 115-kV transmission line is not near any areas of public concern, including schools and day care centers. Mitigation measures, such as locating the line away from sensitive facilities or increasing the aboveground height of the conductor when a sensitive facility is close to the edge of the right-of-way, would not be required.

6.2.5 Induced Current and Voltages

A conducting object, such as a vehicle or person, in an electric field would experience induced voltages and currents. The magnitude of the induced current would depend upon the electric field strength, the size and shape of the object, and object-to-ground resistance. The measured induced current for a person in a 1-kV/m electric field is 0.016 milliamps (mA); for a large school bus, 0.41 mA; and for a large trailer truck, 0.63 mA.

When a conducting object in an electric field is isolated from ground, and a grounded person touches the object, a perceptible current or shock may occur. The magnitude of the current depends upon the field strength, the size (or length for fences, pipelines, and railroad tracks) of the object, and the grounding resistance of the object and person. Shocks are classified as below perception, above perception, secondary, and primary. The mean perception level is 1.0 mA for a 180-pound man and 0.7 mA for a 120-pound woman. Secondary shocks cause no direct physiological harm but may annoy a person and cause involuntary muscle contraction. The lower average secondary-shock level for an average-sized man is about 2 mA. Primary shocks can be harmful; their lower level is described as the current at which 99.5 percent of subjects can still voluntarily “let go” of the shocking electrode. For the 180-pound man this is 9 mA, for the 120-pound woman, 6 mA, and for children, 5 mA.

The National Electric Safety Code specifies 5 mA as the maximum allowable short-circuit current to ground from vehicles, trucks, and equipment near transmission lines.

The mitigation for hazardous and nuisance shocks is to ensure that metallic objects on or near the right-of-way are grounded, and that sufficient clearances are provided at roadways and parking lots to keep electric-field-induced voltages at these locations sufficiently low to prevent vehicle short-circuit currents resulting from vehicle contact by persons below 5 mA.

Magnetic fields can also induce voltages and currents in conducting objects. Typically, this requires a long metallic object such as a fence, pipeline, or railroad that is grounded at only one location. A person who touches the object, at a location remote from the grounded point, would experience a shock similar to that described above for an ungrounded object. Installing multiple grounds on fences or pipelines parallel to the transmission line can mitigate this problem.

The proposed 115-kV Tesla-Kasson loop-through would be constructed in conformance with GO-95 and Title 8 CCR, Section 2700 requirements. Therefore, hazardous shocks are unlikely to occur as a result of the TPP construction or operation.

6.2.6 Nuisance Shocks

Normal grounding practices effectively mitigate the possibility of nuisance shocks resulting from induced currents from stationary objects near the line, such as fences and buildings. Since the electric field extends beyond the right-of-way, grounding requirements extend beyond the right-of-way for very large metal objects or very long fences. Electric fences require a special grounding technique because they can operate only if they are insulated. Application of the grounding policy during and after construction would effectively mitigate the potential for shocks from stationary objects near the Tesla-Kasson line.

6.2.7 Fire Hazards

The transmission line and switchyards would be constructed in conformance with CPUC GO-95 and National Electric Safety Code standards. Title 14 CCR, Section 1250, Article 4 (from CPUC GO-95) establishes fire prevention standards for electric utilities. The TPP would comply with these standards.

6.2.8 Cumulative Impacts

The Tesla-Kasson transmission line would operate proximate to existing transmission lines along the right-of-way. Interaction with the electric and magnetic fields of other existing lines would depend on the phase arrangements and relative positions of the conductors of the new line compared to the existing lines. An evaluation of these interactions would require detailed construction data on the existing transmission lines that are not currently available. Corona noise for the Tesla-Kasson line is projected to be small and is not expected to significantly increase the ambient noise near the existing lines.

6.3 Transmission System Evaluation

6.3.1 Description of Transmission Alternatives

Several interconnection alternatives were reviewed to determine options for integrating the nominal 169-MW plant output into the California transmission system grid. The alternative interconnections are described in Section 5.0 (Alternatives).

6.3.2 Applicant's Interconnection Study

GWF commissioned Navigant to perform a load flow and transient system impact analysis on PG&E's behalf. In addition, PG&E completed a fault current study for the project. The results of these analyses are included in Appendix A. No significant impacts were identified that would require additional facilities or other mitigation measures.

6.3.3 PG&E System Impact/Facility Study

GWF Energy LLC requested that PG&E prepare a System Impact/Facility Study for the electrical interconnection of the proposed TPP. The draft study would be circulated to the Independent System Operator (ISO) for review in October 2001. The final (ISO-approved) study would be available in October 2001. The study would evaluate the potential impacts of adding 169 MW (at 0.85 power factor) of generation to the PG&E system. The scope of work for the study is included in Appendix A.

6.4 Jurisdiction

Table 6-7 identifies agencies with jurisdiction to issue permits and approvals, and/or enforce laws and regulations.

6.5 Agency Contacts

Local contacts for the TPP transmission line and the switchyard are shown in Table 6-8.

TABLES

Table 6-1
Design and Construction LORS

LORS	Applicability	Reference
GO-95 CPUC, Rules for Overhead Electric Line Construction	CPUC rule covers required clearances, grounding techniques, and maintenance and inspection requirements.	Section 6.1.2.2 Section 6.1.2.3
Title 8 California Code of Regulations (CCR), Section 2700 et seq., High Voltage Electrical Safety Orders	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical installation and equipment to provide practical safety and freedom from danger.	Section 6.1.2
GO-128 CPUC, Rules for Construction of Underground Electric Supply and Communications Systems	Establishes requirements and minimum standards to be used for the station AC power and communications circuits.	Section 6.1.2.1 Section 6.1.2.3
GO-52 CPUC, Construction and Operation of Power and Communications Line	Applies to the design of facilities to prevent or mitigate inductive interference.	Section 6.1.2.2 Section 6.1.2.3
ANSI/IEEE 693, IEEE Recommended Practices for Seismic Design of Substations	Provides recommended seismic design and construction practices.	Section 6.1.2.1 Section 6.1.2.3
IEEE 1119, IEEE Guide for Fence Safety Clearances in Electric-Supply Stations	Provides recommended clearance practices for substation fences.	Section 6.1.2.1 Section 6.1.2.3
ANSI/IEEE 605, IEEE Guide for Design of Substation Rigid Bus Structures	Provides recommended design and construction practices for substation rigid bus systems.	Section 6.1.2.1 Section 6.1.2.3
NFPA 70-1996, National Electrical Code	Establishes requirements and minimum standards for low-voltage AC systems.	Section 6.1.2

Table 6-2
Fire Hazard LORS

LORS	Applicability	Reference
Title 14 CCR, Sections 1250–1258, Fire Prevention Standards for Electric Utilities	Provides specific exemptions from electric pole and tower firebreak and electric conductor clearance standards, and specifies when and where standards apply.	Section 6.1.2.2 Section 6.1.2.3
ANSI/IEEE 979, IEEE Guide for Substation Fire Protection	Provides guidance for fire protection practices that should be used in designing control and relay buildings.	Section 6.1.2.1 Section 6.1.2.3
GO-95 CPUC, Section 35, Rules for Overhead Electric Line Construction	CPUC rule covers tree trimming criteria to mitigate fire hazard.	Section 6.1.2.2 Section 6.1.2.3

Table 6-3
Hazardous Shock LORS

LORS	Applicability	Reference
Title 8 CCR, Section 2700 et seq., High Voltage Electrical Safety Orders	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical equipment to provide practical safety and freedom from danger.	Section 6.1.2
ANSI/IEEE 80, IEEE Guide for Safety in AC Substation Grounding	Presents guidelines for assuring safety through proper grounding in AC outdoor substations.	Section 6.1.2.1 Section 6.1.2.3
National Electrical Safety Code, ANSI C2, Section 9 Article 92, Paragraph E Article 93, Paragraph C	Covers grounding methods for electrical supply and communications facilities.	Section 6.1.2.1 Section 6.1.2.3

Table 6-4
Aviation Safety LORS

LORS	Applicability	Reference
Title 14 CFR, Part 77, Objects Affecting Navigable Airspace	Describes the criteria used to determine whether a Notice of Proposed Construction or Alteration (NPCA, FAA Form 7460-1) is required for potential obstruction hazards.	Section 6.2.2
FAA Advisory Circular No. 70/7460-1G, Obstruction Marking and Lighting	Describes the FAA standards for marking and lighting of obstructions as identified by Federal Aviation Regulations Part 77.	Section 6.2.2
FAA Advisory Circular No. 70/7460-2H, Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace	Informs individuals proposing to erect or alter an object that may affect the navigable airspace, regarding the need to notify the FAA prior to such construction.	Section 6.2.2
Public Utilities Code (PUC), Sections 21656–21660	Discusses the permit requirement for construction of possible obstructions in the vicinity of aircraft landing areas, to navigable airspace, and near the boundary of airports.	Section 6.2.2

Table 6-5
Communication Interference LORS

LORS	Applicability	Reference
Title 47 CFR, Section 15.25, Operating Requirements, Incidental Radiation	Prohibits operation of any device emitting incidental radiation that causes interference to communications. The regulation also requires mitigation for any device which causes interference.	Section 6.2.3
General Order 52 (GO-52), CPUC	Governs the Construction and Operation of Power and Communications Lines and specifically applies to the prevention or mitigation of inductive interference.	Section 6.2.3 Section 6.2.4
CEC staff, RI-TVI Criteria (Kern River Cogeneration Project 82-AFC-2, Final Decision, Compliance Plan 13-7)	Prescribes the CEC's RI-TVI mitigation requirements, developed and adopted by the CEC in past siting cases.	Section 6.2.3

Table 6-6
State Regulatory Requirements on Electric and Magnetic Fields

	Electric Field		Magnetic ROW
	On ROW	**Edge of ROW**	**Edge of ROW**
Florida	8 kV/m[1]	2 kV/m	150 mG[1] (max load)
	10 kV/m[2]	--	200 mG[2] (max load)
	--	--	250 mG[3] (max load)
Minnesota	8 kV/m	--	--
Montana	7 kV/m[4]	1 kV/m	
New Jersey	--	3 kV/m	--
New York	11.8 kV/m	1.6 kV/m	200 mG (max load)
	11.0 kV/m[5]	--	
	7 kV/m[4]	--	
North Dakota	9 kV/m[6]	--	--
Oregon	9 kV/m[7]	--	--
Rhode Island	8 kV/m[8]	--	--

[1] For lines of 69 kV–230 kV
[2] For 500-kV lines
[3] For double-circuit, 500-kV lines
[4] Maximum for highway crossings
[5] Maximum for private road crossings
[6] For 230-kV lines and above
[7] For 230-kV lines and above
[8] For all new lines

Table 6-7
Jurisdiction

Agency or Jurisdiction	Responsibility
California Energy Commission (CEC) Project Manager 1516 9th Street, MS-15 Sacramento, CA 95814-5512	Jurisdiction over new transmission lines associated with thermal power plants that are 50 megawatts or more (Public Resources Code [PRC] 25500); jurisdiction of lines out of a thermal power plant to the interconnection point to the utility grid (PRC 25107); jurisdiction over modifications of existing facilities that increase peak operating voltage or peak kilowatt capacity by 25 percent (PRC 25123).
California Public Utilities Commission (CPUC) Mr. Julian Ajello Supervisor, North California Safety Section 505 Van Ness Avenue San Francisco, CA 94102 (415) 703-1327	Regulates construction and operation of overhead transmission lines (General Order No. 95); regulates construction and operation of underground transmission and distribution lines (General Order No. 128); regulates construction and operation of power and communications lines for the prevention of inductive interference (General Order No. 52).
San Joaquin County Electrical Inspector Department of Public Works Sacramento, CA	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity (NFPA 70).
Western Systems Coordinating Council (WSCC) Mr. Dennis E. Eyre Executive Director 615 Arapeen Drive, Suite 210 Salt Lake City, UT 84108 (801) 582-0353	Establishes power supply design criteria to improve reliability of the power system.

Table 6-8
Agency and Utility Contacts

Agency	Contact/Title	Telephone Number
California Independent System Operator	Armando Perez Director, Grid Planning	(916) 331-4444
Pacific Gas & Electric Company	Crispin M. Sullivan Project Manager	(415) 257-3317

FIGURES