C.9 PUBLIC SAFETY, HEALTH, AND NUISANCE

This chapter provides an update of information regarding electric and magnetic fields (EMF) and other issues surrounding public safety, health, and nuisance from that presented in the Final Environmental Impact Statement/Environmental Impact Report (FEIS/EIR) for the California-Oregon Transmission Project and the Los Banos-Gates Transmission Project (TANC/WAPA, 1988). This chapter discusses the increasing public awareness and concern regarding the potential health effects associated with electric power systems and other concerns related to power line fields including: corona and audible noise; radio, television, and electronic equipment interference; induced currents and shock hazards; effects on cardiac pacemakers; downed power lines due to wind or earthquake; nuisance (construction and operation noise); and safety concerns for aerial applicators. A revised discussion of potential impacts is presented, as well as four mitigation measures for the Proposed Project.

The environmental setting of the Proposed Project area has not significantly changed since the publication of the FEIS/EIR (TANC/WAPA, 1988) with respect to Electric and Magnetic Fields (EMF); however, the general understanding of EMFs has advanced. In 1993, the CPUC adopted a No Cost/Low Cost EMF policy, which applies to any regulated utility facilities. The methodology used for this analysis includes more established significance criteria than those used in the 1988 FEIS/EIR. There are three new impacts in this SEIR related to induced currents and shock hazards in joint use corridors and corona/audible noise; these result from additional research since the FEIS/EIR was published in 1988.

The discussion of impacts to aerial applicators was restricted to the Land Use section of the 1986 Draft EIS/EIR. However, in this SEIR, impacts to aerial applicators are presented in this chapter as the impacts relate to personnel safety, while impacts to aerial applications with respect to land use are presented in Section C.7, Land Use and Recreation. The impact conclusions of this section differ from the 1988 FEIS/EIR in that more impacts have now been identified for the Proposed Project. This SEIR also recommends a new mitigation measure that would require PG&E to notify aerial applicators of the new transmission lines.

The Proposed Project Corridor (Western Corridor) with the inclusion of Alternative Segment 6B would present the lowest risk to aerial applicators, primarily because the combination of the Proposed Project with Alternative Segment 6B would avoid productive agricultural lands to the greatest extent feasible. There is no substantial difference between alternatives with respect to EMF, corona, noise, or induced current.

C.9.1 ENVIRONMENTAL BASELINE AND REGULATORY SETTING

This section first presents a discussion of EMF (Section C.9.1.1), followed by a description of other concerns related to electric fields (corona, noise, electrical interference, induced currents, and cardiac pacemakers) in Section C.9.1.2. Section C.9.1.3 addresses other safety hazards, and Section C.9.1.4 addresses construction and operational noise.

C.9.1.1 Electric and Magnetic Fields (EMF)

The Proposed Project would be located in the western portion of the San Joaquin Valley. The Project area is mostly grassland and generally parallels the foothills of the Coast Range and Interstate 5 (I-5). In the developed areas, existing EMF will be more prevalent from the use of electronic appliances or equipment and existing electric transmission and distribution lines. In the undeveloped and natural areas, where most of the Proposed Project will be located, EMF are anticipated to be less common but still present in the vicinity of existing transmission line corridors.

Defining EMF

Electric and magnetic fields are separate phenomena and occur both naturally and as a result of human activity across a broad electrical spectrum. Naturally-occurring EMF are caused by the weather and the earth's geomagnetic field. These fields also occur from human activity, caused by technological application of the electromagnetic spectrum for uses such as communications, appliances, and the generation, transmission, and local distribution of electricity.

The EMF from power lines change their direction over time. The rate of this change in direction is referred to as a frequency, and represents the number of times the fields change direction each second. For power lines in the United States, the frequency of change is 60 times per second and is defined as 60 Hertz (Hz) power. In Europe and many other countries, the frequency of electric power is 50 Hz. Radio and communication waves operate at much higher frequencies: 500,000 Hz to 1,000,000,000 Hz. The information presented in this document is limited to the EMF from power lines at frequencies of 50 or 60 Hz.

Electric power flows across transmission systems from generating sources to serve electrical loads within the community. The transmission line's voltage and current determine the apparent power flowing over a transmission line. The higher the voltage level of the transmission line, the lower the amount of current needed to deliver the same amount of power. For example, a 115 kV transmission line with 200 amps of current will transmit approximately 40,000 kilowatts (kW), while a 230 kV transmission line requires only 100 amps of current to deliver the same 40,000 kW. A 500 kV transmission line requires 46 amps of current to deliver this amount.

Electric Fields

Electric fields from power lines are created whenever the lines are energized, with the strength of the field dependent directly on the voltage of the line creating it. Electric field strength is typically described in terms of kilovolts per meter (kV/m). Electric field strength attenuates rapidly as the distance from the source increases. Electric fields are shielded by most objects or materials such as trees or houses.

At reasonably close distances, electric fields of sufficient strength in the vicinity of power lines can cause the same phenomena as the static electricity experienced on a dry winter day, or with clothing just removed from a clothes dryer, and may result in electric discharges when touching long metal fences or large vehicles. An acknowledged potential impact to public health from electric transmission lines is the hazard of electric shock. Electric shocks from transmission lines are generally the result of accidental or unintentional contact by the public with the energized wires.

Magnetic Fields

Magnetic fields from power lines are created whenever current flows through power lines at any voltage. The strength of the field is directly dependent on the current in the line. Magnetic field strength is typically measured in milligauss (mG). Similar to electric fields, magnetic field strength attenuates rapidly with distance from the source. Unlike electric fields, magnetic fields are not easily shielded by objects or materials.

The nature of a magnetic field can be illustrated by considering a household appliance. When the appliance is energized by being plugged into an outlet but not turned on so no current would be flowing through it, an electric field will be generated around the cord and appliance, but no magnetic field will be present. If the appliance is switched on, the electric field will still be present and a magnetic field will be created. The electric field strength is directly related to the magnitude of the voltage from the outlet and the magnetic field strength is directly related to the magnitude of the current flowing in the cord and appliance.

EMF exists in the environment both naturally and as a result of human activities. The geomagnetic field of the earth ranges from 500 to 700 mG (Carstensen, 1987). In areas not immediately adjacent to transmission lines, EMF exists as a result of other electric power uses such as neighborhood distribution lines, household wiring, and electrical equipment or appliances. Public exposure to these fields is widespread and encompasses a very broad range of field intensities and durations. Research on ambient magnetic fields in homes and buildings in several western states found average magnetic field levels within rooms to be approximately 1 mG, while in the immediate area of appliances, the measured values ranged from 9 to 20 mG (Severson et al., 1988, Silva, 1988). Tables C.9-1 and C.9-2 indicate typical sources and levels of EMF exposure the general public experiences from appliances.

Table C.9-1 Typical Electric Field Values for Appliances, at 12 Inches

Appliance	Electric Field Strength (kV/m)
Electric Blanket	0.25*
Broiler	0.13
Stereo	0.09
Refrigerator	0.06
Iron	0.06
Hand Mixer	0.05
Phonographs	0.04
Coffee Pot	0.03

*1 to 10 kV/m next to blanket wires (Enertech, 1985).

Table C.9-2 Magnetic Field From Household Appliances

Appliance	Magnetic Field (mG)	
	12" Distant	Maximum
Electric Range	3 to 30	100 to 1,200
Electric Oven	2 to 25	10 to 50
Garbage Disposal	10 to 20	850 to 1,250
Refrigerator	0.3 to 3	4 to 15
Clothes Washer	2 to 30	10 to 400
Clothes Dryer	1 to 3	3 to 80
Coffee Maker	0.8 to 1	15 to 250
Toaster	0.6 to 8	70 to 150
Crock Pot	0.8 to 1	15 to 80
Iron	1 to 3	90 to 300
Can Opener	35 to 250	10,000 to 20,000
Mixer	6 to 100	500 to 7,000
Blender, Popper, Processor	6 to 20	250 to 1,050
Vacuum Cleaner	20 to 200	2,000 to 8,000
Portable Heater	1 to 40	100 to 1,100
Fans/blowers	0.4 to 40	20 to 300
Hair Dryer	1 to 70	60 to 20,000
Electric Shaver	1 to 100	150 to 15,000
Color TV	9 to 20	150 to 500
Fluorescent Fixture	2 to 40	140 to 2,000
Fluorescent Desk Lamp	6 to 20	400 to 3,500
Circular Saws	10 to 250	2,000 to 10,000
Electric Drill	25 to 35	4,000 to 8,000

Source: Gauger, 1985.

Public Health and EMF Studies

For more than 20 years, questions regarding the potential effects within the environment of EMF from power lines have been asked, and research has been conducted to provide some basis for response. Earlier studies focused primarily on interactions with the electric fields from power lines. In the late 1970s, the subject of magnetic field interactions began to receive additional public attention and research levels have increased.

A substantial amount of research investigating both electric and magnetic fields has been conducted over the past 15 years; however, much of the body of national and international research regarding EMF and public health risks remains contradictory or inconclusive.

Scientists have found that EMF can produce a number of biological effects (Carstenson, 1987). These range from slowed heart rates to changes in the rate at which the body produces various compounds. Some of these effects are apparently related to the electric field while others are thought to be due to the magnetic field. These effects have been difficult to determine and often are only detectable at field strengths well in excess of those to which the public is exposed from power lines or household wiring and appliances. Although it has been found that EMF causes biological effects, there is no scientific basis to conclude that any of these biological effects have negative implications for public health at the field levels associated with power lines.

Research related to EMF can be grouped into three general categories: cellular level studies, animal and human experiments, and epidemiological studies. These studies have provided mixed results; some studies show an apparent relationship between magnetic fields and health effects, while other similar studies do not.

Since 1979, public interest and concern specifically regarding magnetic fields from power lines has increased. This increase has generally been attributed to publication of the results of an epidemiological study (Wertheimer and Leeper, 1979), which observed an association between the wiring configuration of distribution power lines outside of homes in Denver and the incidence of childhood cancer. Following publication of the Wertheimer and Leeper study, more than 50 major epidemiological studies regarding EMF have been conducted.

Scientific Panel Reviews

Numerous panels of expert scientists have convened to review the data relevant to the question of whether exposure to power-frequency EMF is associated with adverse health effects. These evaluations have been conducted in order to advise governmental agencies or professional standard-setting groups. These panels of scientists first evaluate the available studies individually, not only to determine what specific information they can offer, but also in terms of their experimental design, methods of data collection, analysis, and suitability of the authors' conclusions to the nature and quality of the data presented. Subsequently, the individual studies, with their previously identified strengths and weaknesses, are evaluated collectively in an effort to identify whether there is a consistent pattern or trend in the data that would lead to a determination of possible or probable hazards to human health resulting from exposure to these fields.

These reviews include those prepared by international agencies such as the World Health Organization (WHO, 1984; 1987) and the international Non-Ionizing Radiation Committee of the International Radiation Protection Association (IRPA/INIRC, 1990), as well as governmental agencies of a number of countries, such as the U.S. Environmental Protection Agency (USEPA), the National Radiological Protection Board of the United Kingdom, and the French and Danish Ministries of Health.

All of these panels have concluded that the body of data, as large as it is, does not provide evidence to conclude that exposure to EMF of the magnitude expected during the operation of electric transmission lines causes cancer or otherwise constitutes a health hazard.

In May 1999, the National Institute of Environmental Health Sciences (NIEHS) submitted to Congress its report titled, *Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, containing mixed conclusions regarding EMF and health effects. The conclusions of this report state "using criteria developed by the International Agency for Research on Cancer, none of the Working Group considered the evidence strong enough to label ELF-EMF exposure as a known human carcinogen or probable human carcinogen. However, a majority of the members of this Working Group concluded that exposure to power-line frequency ELF-EMF is a possible carcinogen." Congress has not taken any action following issuance of this report and further research is being conducted since this Working Group was unable to determine that EMF does result in any health effects.

Policies, Standards, and Regulations Regarding EMF

A number of Counties, States, and local governments have adopted or considered regulations or policies related to EMF exposure. The reasons for these actions have been varied; in general, however, the actions can be attributed to addressing public reaction to and perception of EMF as opposed to responding to the findings of any specific scientific research. Following is a brief summary of activity in this area.

International Activity. The International Radiation Protection Association, in cooperation with the World Health Organization, has published recommended guidelines (INRC, 1998) for EMF exposures. For the general public, the limits are 4.2 kV/m for electric fields, and 830 mG for magnetic fields. Neither of these organizations has any governmental authority nor recognized jurisdiction to enforce these guidelines. However, because they were developed by a broad base of scientists, these guidelines have been given merit and are considered by utilities and regulators when reviewing EMF levels from electric power lines.

National Activity. Although the USEPA has conducted investigations into EMF related to power lines and health risks, no national standards have been established. The number of studies sponsored by the USEPA, the Electric Power Research Institute (EPRI), and other institutions has increased dramatically in the past few years. Several bills addressing EMF have been introduced at the congressional level and have provided funding for research; however, no bill has been enacted that would regulate EMF levels.

The 1999 NIEHS report to Congress suggested that the evidence supporting EMF exposure as a health hazard was insufficient to warrant aggressive regulatory actions. The report did suggest passive measures to educate the public and regulators on means aimed at reducing exposures. NIEHS also suggested that the power industry continue its practice of siting lines to reduce exposures and to explore ways to reduce the creation of magnetic fields around lines.

State Activity. Several states have adopted limits of electric field strength within transmission line ROWs. Florida and New York are the only states that currently limit the intensity of magnetic fields from transmission lines. These regulations include limits within the ROW as well as at the edge of the ROW and cover a broad range of values. Table C.9-3 lists the states regulating EMF and their respective limits. The magnetic field limits were based on an objective of preventing field levels from increasing beyond levels currently experienced by the public and are not based upon any link between scientific data and health risks (Morgan, 1991).

Elsewhere in the United States, several agencies and municipalities have taken action regarding EMF policies. These actions have been varied and include requirements that the fields be considered in the siting of new facilities. The manner in which EMF is considered has taken several forms. In a few instances, a concept referred to as "prudent avoidance" has been adopted. Prudent avoidance, a concept proposed by Dr. Granger Morgan of Carnegie-Mellon University, is defined as "…limiting exposures which can be avoided with small investments of money and effort" (Morgan, 1991). Some municipalities or regulating agencies have proposed limitations on field strength, requirements for siting of lines away from residences and schools, and, in some instances, moratoria on the construction of new transmission lines. The origin of these individual actions has been varied, with some initiated by regulators at the time of new transmission line proposals within their community, and some by public grassroots efforts.

Table C.9-3 EMF Regulated Limits (by State)

State	Electric Field (kV/m)	Magnetic Field (mG)	Location	Application
500 kV Lines Florida (codified)	10		in ROW	Single Circuit
	2	200	edge of ROW	Single Circuit
	2	250	edge of ROW	Double Circuit
230 kV Lines or less Florida (codified)	8		in ROW	
	2	150	edge of ROW	230 kV Lines or less
Minnesota	8		in ROW	> 200 kV
Montana (codified)	1		edge of ROW	> 69 kV
	7		in ROW	road crossings
New Jersey	3	under consideration	edge of ROW	Guideline for complaints
New York	1.6	200	edge of ROW	> 125 kV, > 1 mile
	7		in ROW	public roads
	11		in ROW	public roads
	11.8		in ROW	other terrain
North Dakota	9		in ROW	Informal
Oregon (codified)	9		in ROW	230 kV, 10 miles

Source: Public Utilities Commission of Texas.

In 1991, CPUC initiated an investigation into EMF associated with electric power facilities. This investigation explored the approach to potential mitigation measures for reducing public health impacts and possible development of policies, procedures, or regulations. Following input from interested parties, the CPUC did implement a decision (93-11-03), which requires the use of low-cost or no-cost mitigation measures for electric facilities requiring certification under General Order 131 (such as the subject of this SEIR). In response to this decision, PG&E implemented Transmission Line EMF Design Guidelines, which were submitted as a part of PG&E's application for this project. This decision also implemented a number of EMF measurement, research, and education programs. The CPUC did not adopt any specific limits or regulations on EMF levels related to electric power facilities.

California Research Programs. In coordination with the California Department of Health Services (DHS), the CPUC sponsors the California EMF Program, which conducts a wide range of research and advisory programs. This program and its components are described in detail on two Internet websites:

- http://www.dnai.com/ ~ emf/
- http://www.cpuc.ca.gov/divisions/energy/environmental/emf/emfopen.htm

The EMF Program under the CPUC and DHS is briefly described in the following sections.

Creation of the California EMF Program. CPUC Decision 93-11-013 (also described in Section C.9.2.1.1 following) created the California Electric and Magnetic Fields (EMF) Program to research and provide education and technical assistance on the possible health effects of exposure to EMF from power lines and other uses of electricity. In addition to funding research and policy analysis on this issue, the EMF Program provides education and technical assistance to government agencies, professional organizations, businesses, and members of the general public. Under the CPUC decision, this program is funded by money provided by the state's investor-owned utilities and is based in the DHS. The California EMF Program produces periodic reports to the CPUC, and its goal is to make the research, policy analysis, and educational products useful to the CPUC in future decision-making. This Program is currently scheduled to end by December 31, 2001.

As a part of this process, the CPUC mandated the DHS to explore the possible health risks of EMF as a result of power lines. A draft of that study, *An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) From Power Lines, Internal Wiring, Electrical Occupations, and Appliances*, was released in April 2001, but the conclusions are preliminary and may not be quoted. Comments on the draft report were due on September 10, 2001. At the time of release of this Draft SEIR, the Department of Health Services is compiling the comments received on that draft report.

Program Organization. The DHS has assigned Dr. Raymond Richard Neutra of the Division of Environmental and Occupational Disease Control to head the EMF Program. Funding for the EMF Program became available on January 1, 1994, and the Public Health Institute (PHI, formally the California Public Health Foundation) became the Program's nonprofit fiscal manager on April 30, 1994. PHI assists DHS by staffing the Stakeholders Advisory Consultants (SAC), overseeing the extramural research unit and its subcontracts, and handling the fiscal and administrative matters of the education unit. After the formation of the SAC and an international search, the research director joined the staff on February 1, 1995.

Stakeholders Advisory Consultants (SAC). The CPUC decision that created the California EMF Program states that the involvement of stakeholders and the public is very important to the development of effective EMF policies. This decision asks DHS to determine what form of stakeholder and public involvement best meets its needs. DHS decided that the most appropriate role for the SAC would be to advise the program on the development of the research projects and on budgetary matters, and to monitor its progress to ensure that the scientific and technical staff can exercise their responsibility and authority to carry out an effective program on behalf of the CPUC. The EMF Program assembled the SAC in 1994 and they have met several times a year since then.

One important function of the SAC is to serve as a forum where all citizens can ask questions and express their concerns about the possibility of health effects from exposure to EMF and express their opinions about EMF policy. All SAC meetings are open to the general public. Stakeholders' concerns about the research projects have surfaced through discussions that extended in some cases over several quarterly meetings. For some important issues, such as conflict of interest and property values research, consensus was not possible. In these cases, the Program tries to find solutions that are technically and scientifically sound while being responsive to the basic concerns of the various stakeholders.

Research Unit. The goal of the Research Unit is to help answer the following four questions that decision-makers face as they deal with the EMF issue:

- Is there a health problem? (risk research)
- Where is the problem? (exposure assessment and analysis)
- What can be done about it? (mitigation research)
- What should policymakers do, or what are the policy options and their pros and cons? (policy analysis)

In order to answer these questions, the Program's research priority areas are policy analysis, exposure assessment, epidemiology, and electrical engineering and mitigation.

Education and Technical Assistance Unit. The goals of the Education and Technical Assistance unit are to:

- Provide a trustworthy and balanced source information about potential EMF health risks and mitigation options
- Provide technical and consultative services to State and local officials, professional organizations, and the public about EMF exposures and health risks thought to be related to EMF
- Facilitate and maximize opportunities for public input into program projects and goals and provide support and training to enable stakeholders to use and remain informed about the research program results
- Coordinate actions within DHS, with other California State and local agencies, and with programs sponsored by the Federal government, other State governments, and investor-owned and municipal utilities
- Act as liaison between the Program's Stakeholders Advisory Consultants and staff by organizing and facilitating meetings and preparing and distributing meeting minutes
- Provide education and support for stakeholders and the public through the program newsletter, and prepare and distribute important program materials.

To accomplish these goals, Education and Technical Assistance staff write and distribute educational materials, organize meetings and workshops for stakeholders and the general public, produce a newsletter to keep stakeholders and interested parties informed of program activities, and respond by telephone, mail, and electronic mail to questions raised by members of the public.

Program Synthesis Projects. This is the final phase of the EMF Program, during which the research results will be reviewed and used as the basis for preparing reports and products to inform future discussions on this issue. As a result of SAC discussions, the DHS decided to pursue a program synthesis that includes four elements:

- An evaluation of the evidence of risk based on results of this Program as well as other research
- A policy integration document to help decision-makers use the policy analyses' results
- A well thought-out process for releasing the data collected in and results of the research projects
- Opportunities for potential end-users of the research effort to familiarize themselves with complex technical documents

The addition of this program synthesis required two applications to the CPUC for no-cost extensions of the EMF Program.

C.9.1.2 Other Field-Related Public Concerns

Other public concerns related to electric power facility projects include corona and audible noise; radio, television, and/or electronic equipment interference; induced currents and shock hazards; and potential effects on cardiac pacemakers.

C.9.1.2.1 *Corona and Audible Noise*

Corona is the breakdown of air very near conductors and occurs when the electric field is locally intensified by irregularities on the conductor surface such as scratches or water drops. Corona, as an issue for transmission lines, is more significant for extra-high voltage lines of 345 kV or above but will occur on lower voltage lines during rain or fog conditions. The physical manifestations of corona include a crackling or hissing noise and very small amounts of light. Besides the nuisance aspects of corona, it results in undesirable power loss over a transmission line. Therefore, the design of transmission lines incorporates sufficiently large conductor and smooth edged hardware, which limit or eliminate corona.

C.9.1.2.2 *Radio/Television/Electronic Equipment Interference*

Although corona can generate high frequency energy, which may interfere with broadcast signals or electronic equipment, this is generally not a problem for transmission lines. The Institute of Electrical and Electronic Engineers (IEEE) has published a design guide (Radio Noise Subcommittee, 1971) which is used to limit conductor surface gradients so as to avoid electronic interference.

Gap discharges or arcs can also be a source of high frequency energy. Gap discharges occur when an arc forms across a gap in loose or worn line hardware. It is estimated that over 90 percent of interference problems for electric transmission lines are due to gap discharges. Line hardware is designed to be problem-free, but wind motion, corrosion, and other factors can create a gap discharge condition. Gap discharges can be located and when they occur can be remedied by utilities.

Electric fields from power lines do not typically pose interference problems for electronic equipment in businesses since the equipment is shielded by buildings and walls. However, magnetic fields can penetrate buildings and walls thereby interacting with electronic equipment. Depending upon the sensitivity of equipment, the magnetic fields can interfere with equipment operation. Review of this phenomenon in regard to the sensitivity of electrical equipment identifies a number of thresholds for magnetic field interference. Interference with typical computer monitors can be detected at magnetic field levels of 10 milligauss (mG) and above, while large screen or high-resolution monitors can be susceptible to interference at levels as low as 5 mG. Other specialized equipment, such as medical equipment or testing equipment, can be sensitive at levels below 5 mG.

The most common electronic equipment that can be susceptible to magnetic field interference is probably personal computer monitors. Magnetic field interference results in disturbances to the image displayed on the monitor, often described as screen distortion, "jitter," or other visual defects. In most cases it is annoying, and at its worst, it can prevent use of the monitor. This type of interference is a recognized problem in the video monitor industry. As a result, there are manufacturers who specialize in monitor interference solutions and shielding equipment. Possible solutions to this problem include: relocation of the monitor, use of magnetic shield enclosures, software programs, and replacement of cathode ray tube monitors with liquid crystal displays that are not susceptible to magnetic field interference. Equipment that may be susceptible to very low magnetic field strengths are typically installed in specialized and controlled environments since even building wiring, lights, and other equipment can generate magnetic fields of 5 mG or higher.

C.9.1.2.3 *Induced Currents and Shock Hazards*

Power line fields can induce voltages and currents on conductive objects, such as metal roofs or buildings, fences, and vehicles. When a person or animal comes in contact with a conductive object, a perceptible current or small secondary shock may occur. Secondary shocks cause no physiological harm; however, they may present a nuisance.

C.9.1.2.4 *Effects on Cardiac Pacemakers*

An area of concern related to electric fields from transmission lines has been the possibility of interference with cardiac pacemakers. There are two general types of pacemakers: asynchronous and synchronous. The asynchronous pacemaker pulses at a predetermined rate. It is practically immune to interference because it has no sensing circuitry and is not exceptionally complex. The synchronous pacemaker, however, pulses only when its sensing circuitry determines that pacing is necessary. Interference from transmission line electric field may cause a spurious signal on the pacemaker's sensing circuitry. However, when these pacemakers detect a spurious signal, such as a 60 Hz signal, they are programmed to revert to an asynchronous or fixed pacing mode of operation, returning to synchronous operation within a specified time after the signal is no longer detected. Cardiovascular specialists do not consider prolonged asynchronous pacing a problem. As mentioned before, some pacemakers are designed to operate that way. Periods of operation in this mode are commonly induced by cardiologists to check pacemaker performance. So, while transmission line electric fields may interfere with the normal operation of some of the older model pacemakers, the result of the interference is generally not harmful, and is of short duration (EPRI, 1985; 1979).

C.9.1.3 Other Safety Hazards

C.9.1.3.1 *Wind, Earthquake, and Fire Hazards*

Transmission line structures used to support overhead transmission lines must meet the requirements of the CPUC General Order No. 95, Rules for Overhead Electric Line Construction. This design code and the National Electrical Safety Code include loading requirements related to wind conditions. Transmission support structures are designed to withstand different combinations of loading conditions, including extreme winds. These design requirements include use of safety factors that consider the type of loading as well as the type of material used (e.g., wood, steel, or concrete). Failures of transmission line support structures in wind or earthquakes are extremely rare and are typically the result of anomalous loading conditions such as tornadoes or ice storms.

Overhead transmission lines consist of a system of support structures and interconnecting wire that is inherently flexible. Industry experience has demonstrated that under earthquake conditions structure and member vibrations generally do not occur or cause design problems. Overhead transmission lines are designed for dynamic loading under variable wind conditions that generally exceed earthquake loads.

Potential fire hazards are addressed in Section C.8, Socioeconomics and Public Services.

C.9.1.3.2 *Safety Concerns Related to Agricultural Aerial Applicators*

In agricultural areas, aerial spraying (crop dusting) is used to control insects, weeds, and diseases (Schleicher, 2000). Where transmission lines exist in an agricultural area, pilots fly over, beside, and even under transmission lines to spray agricultural land with various products (usually pesticides). Aerial applicators fly at low levels, sometimes at speeds in excess of 100 miles per hour. High numbers of fatalities associated with aerial applicators can partly be attributed to flying at these low altitudes and speeds with the additional possibility of crashing into power lines, trees, towers, and sometimes buildings and mountainsides within the flight area (Suarezi, 2000). Many aerial applicator accidents are not reported unless they resulted in an injury or fatality. Of the crashes reported between 1992 and 1998, 33 percent were as a result of having struck a power line, tree, or tower (Suarezi, 2000). Transmission line towers present a substantial obstacle to avoid, and therefore require additional attention from the pilots (TANC/WAPA, 1986).

Table C.9-4 lists the agricultural setting for each segment in the Western and Eastern Corridors in terms of the percent of land in the segment that is cultivated for orchards, seasonal crops, and/or hay. The presence of agricultural fields within the corridors was based on field observations made in August and September 2001 (refer to Figures C.7-1a through C.7-1e in Section C.7).

Table C.9-4 Percentage of Agricultural Land in Corridors

Proposed Project (Western Corridor)	% Total Ag	Western Corridor Alternative Segments	% Total Ag	Eastern Corridor Alternative	% Total Ag
Segment 1	0.0%			Segment 1	43.5%
Segment 2	0.0%	Segment 2A	0.0%	Segment 2	8.0%
Segment 3	0.0%			Segment 3	0.0%
Segment 4	0.0%	Segment 4A	0.0%	Segment 4	87%
Segment 5	9.5%		0.0%	Segment 5	86.7%
Segment 6	31.4%	Segment 6A	86.0%	Segment 6	81.5%
Segment 7	85.8%	Segment 6B	0.0%		
Total for Western Corridor	12.9%			Total for Eastern Corridor Alternative	70.9%

C.9.1.4 Construction and Operation Noise (Nuisance)

To describe noise environments and to assess impacts on noise sensitive areas, a measurement scale that simulates human perception is customarily used. It has been found that *A-weighting* of sound intensities best reflects the human ear's reduced sensitivity to low frequencies and correlates well with human perceptions of the annoying aspects of noise. The A-weighted decibel scale (dBA) is cited in most noise criteria. Decibels are logarithmic units that conveniently compare the wide range of sound intensities to which the human ear is sensitive.

Noise environments and consequences of human activities are usually well represented by an equivalent A-weighted sound level over a given time period (L_{eq})[1], or by the average day-night noise levels (L_{dn})[2]. Noise levels are generally considered low when ambient levels are below 45 dBA, moderate in the 45 to 60 dBA range, and high above 60 dBA. Outdoor L_{dn} levels can vary by over 50 dBA depending on the specific type of land use. In wilderness areas, the L_{dn} noise levels average approximately 35 dBA, 50 dBA in small towns or wooded residential areas, 75 dBA in major metropolitan areas (e.g., San Francisco), and 85 dBA near major freeways and airports. Although people often accept the higher levels associated with very noisy urban residential and residential-commercial zones, they nevertheless are considered to be adverse levels of noise to public health.

Various environments can be characterized by noise levels that are generally considered acceptable or unacceptable. Lower levels are expected in rural or suburban areas than what would be expected for commercial or industrial zones. Nighttime ambient levels in urban environments are about seven decibels lower than the corresponding average daytime levels. The day-to-night difference in rural areas away from roads and other human activity can be considerably less. Areas with full-time human occupation that are subject to nighttime noise and are the same as daytime levels are often considered objectionable relative to noise disturbance. Noise levels above 45 dBA at night begin to cause sleep interference and at 70 dBA, sleep interference effects become considerable (USEPA, 1971).

Policies, Standards, and Regulations Regarding Noise

There are no federal noise standards that directly regulate environmental noise from construction or operation of a transmission line project. However, it should be noted that the U.S. EPA has developed guidelines on recommended maximum noise levels to protect public health and welfare (USEPA, 1974). Table C.9-5 provides a summary of noise levels identified as requisite to protect public health and welfare with an adequate margin of safety. With regard to noise exposure and workers, the occupational safety and health administration (OSHA) regulations safeguard the hearing of workers exposed to occupational noise. Refer to 29 CFR Section 1910.95 (Code of Federal Regulations) for a list of permissible noise exposures.

1 The Equivalent Sound Level (L_{eq}) is a single value of sound level for any desired duration, which includes all of the time-varying sound energy in the measurement period.

2 Day-night average sound level that is equal to the 24 hour A-weighted equivalent sound level with a 10 decibel penalty applied to nighttime levels.

Table C.9-5 Examples Of Protective Noise Levels Recommended by U.S. EPA

Effect	Level	Area
Hearing Loss	Leq(24)<70 dB	All areas
Outdoor Activity Interference and Annoyance	Ldn<55 dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	Leq (24)<55 dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor Activity Interference and Annoyance	Ldn<45 dB	Indoor residential areas
	Leq(24)<45 dB	Other indoor areas with human activities such as schools, etc.

Source: U.S. EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974.
Note: Leq (24) = Represents the sound energy averaged over a 24-hour period.
Ldn = Represents the Leq with a 10 dB nighttime weighting.

California encourages each local government entity to perform noise studies and implement a noise element as part of their general plan. Most counties adopt normally acceptable noise level guidelines based on land use categories to require new projects to meet acceptable exterior noise level standards. The local jurisdictions with regulatory authority over project noise levels are Merced County and Fresno County. Refer to Table C.9-6 for acceptable noise levels per land use category in Merced and Fresno Counties.

Table C.9-6 Normally Acceptable Noise Levels Per Land Use Category

Land Use Category	Normally Acceptable[a] Levels – Ldn	
	Merced County	Fresno County
Residential	60 - 65	50 – 60
Parks/Playgrounds	70	50 – 70
Commercial	70	50 – 70
Industrial/utility/agricultural	75	50 – 75

Sources: Fresno County, 1999 and Merced County, 2001.
[a] Specified decibel level is satisfactory within the specified land use category.

In Merced County, daily construction hour limits are decided on a case-by-case basis and included in the Conditional Use Permit issued by the County (Merced County, 2001).

C.9.2 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES FOR THE PROPOSED PROJECT

This section focuses on the environmental impacts of the safety, health, and nuisance effects of the proposed Los Banos-Gates 500 kV Transmission Project.

C.9.2.1 Definition and Use of Significance Criteria

Generally, the basis for determining the significance of impacts with respect to EMF and other public and safety concerns is by comparison with existing standards or regulations. In the absence of regulations, significance determinations are based on existing conditions in the project area from similar facilities in place today and the standards of significance established in Appendix G of the CEQA Guidelines. Impacts of the Proposed Project or Alternatives to public safety and health would be considered significant based on the criteria discussed below.

EMF Significance Criteria. As discussed in Section C.9.1, there is no scientific conclusion that there are negative public health impacts due to EMF at the levels expected from electric power facilities. Further, there are no Federal or State standards limiting human exposure to EMF from transmission lines or substation facilities in California. In other states, the standards or limits that have been adopted were based on an objective of keeping the field levels from new power lines similar to the field levels from existing lines. In Decision No. 93-11-03, the CPUC addressed mitigation of EMF for regulated utility facilities and implemented the following recommendations:

- No-cost and low-cost steps to reduce EMF levels
- Workshops to develop EMF design guidelines
- Uniform residential and workplace programs
- Stakeholder and public involvement
- A four-year education program
- A four-year non-experimental and administrative research program
- An authorization of Federal experimental research conducted under the National Energy Policy Act of 1992.

The no/low-cost mitigation was to be applied to new and reconstructed facilities and is applicable to the Los Banos-Gates 500 kV Transmission Project. PG&E established Transmission Line and EMF Design Guidelines in response to Decision 93-11-03 and has submitted these guidelines as a part of their application. The decision included considerable discussion as to the meaning of "low-cost," and stated the following:

> "From Edison's analysis and DRA's few percentage points criteria, it is logical to define low cost to be in the range of 4 percent of the total cost of a budgeted project. We direct the utilities to use 4 percent as a benchmark in developing their EMF mitigation guidelines. We will not establish 4 percent as an absolute cap at this time because we do not want to arbitrarily eliminate a potential measure that might be available but cost more than the 4 percent figure. Conversely, the utilities are encouraged to use effective measures that cost less than 4 percent. Given the evolving body of research on EMF measures, we feel that 4 percent provides the utilities with sufficient guidance without hindering their ability to seek out or develop innovative measures and to reduce the cost to implement known measures.We further endorse the concept put forward by [Pacific Gas & Electric Co.] and [San Diego Gas & Electric] that a mitigation measure should achieve some noticeable reduction. PG&E and SDG&E define significant EMF reduction as 15 percent and 20 percent, respectively. Again we decline to adopt specific numbers because there is not sufficient scientific evidence upon which to base such findings."

Corona. There are no standards or regulations pertaining to corona levels on electric power facilities. The USEPA has conducted extensive studies to identify the effects of certain sound levels on public health and welfare and has developed noise guidelines. These guidelines typically form the basis for community zoning requirements related to noise levels. For residential areas, the EPA guidelines indicate noise should not exceed 55 decibels (dBA) between 7 a.m. and 10 p.m. or 45 dBA between 10 p.m. and 7 a.m.

Electrical Interference. There are no local, State, or Federal regulations with specific limits on high frequency emissions from electric power facilities. Federal Communication Commission (FCC) regulations require that transmission lines be operated so that no harmful interference is produced (FCC regulations, Section 15.25).

Induced Current. The National Electrical Safety Code (NESC) specifies that transmission lines be designed to limit short circuit current from vehicles or large objects near the line to no more than 5 milliampere (mA). CPUC General Order 95 and the NESC also address shock hazards to the public by providing guidelines on minimum clearances to be maintained for practical safeguarding of persons during the installation, operation, or maintenance of overhead transmission lines and their associated equipment.

Pacemaker Effects. It has been reported that synchronous pacemakers can be affected by electric fields between 2 kV/m and 9 kV/m (EPRI, 1985; 1979). When a synchronous pacemaker is in a field in this range, a few older model pacemakers may revert to an asynchronous mode.

Safety Effects on Aerial Applicators. There are no local, State, or Federal regulations with specific limits on placement of transmission line towers in farmlands. Based on research of hazards associated with aerial applicators and transmission line towers and the standards of significance derived from Appendix G of the CEQA guidelines, impact significance is based on the percentage of lands in agricultural production.

Noise from Construction or Operation. These effects would be significant if:

- Adopted local standards, noise elements, or ordinances would be exceeded in noise level, timing, or duration
- The project would increase the ambient noise level above ordinance-specified limits for the land use zoning
- Permanent increases of 5 dB would also be significant
- Long term noise would conflict with State or local guidelines, interior noise levels, and 24-hour averages, and specifically, noise levels exceeding a day-night average sound pressure level L_{dn} of 60 dBA at the nearest noise sensitive receptor (California Office of Noise Control)

C.9.2.2 Impacts and Mitigation Measures from 1988 FEIS/EIR

Table C.9-7 presents the public safety, health, and nuisance impacts identified in the 1988 FEIS/EIR, and then compares the impacts to those identified in this SEIR. Impacts and mitigation measures are described in detail in Section C.9.2.3.

Table C.9-8 lists the impacts to aerial applicators based on percentage of farmland from the 1986 Draft EIS/EIR and the updated land use data and significance levels. In addition to those identified in the EIS/EIR, two additional segments have been identified in this SEIR to have significant impacts to aerial applicators. Based on the significance criteria in this SEIR, it is concluded that the presence of agricultural land (regardless of the percentage) within a segment would have the potential for safety impacts to aerial applicators.

Table C.9-7 Summary of Impacts: 1988 FEIS/EIR* and SEIR

Final EIS/EIR Impact	Significance	SEIR Impact	Significance
Electric and Magnetic Fields	Less than significant	**Impact 9-1:** Electric and Magnetic Fields (EMF)	Less than significant
Corona	Less than significant	**Impact 9-2:** Corona and Audible Noise	Less than significant
Radio and television interference	Less than significant with mitigation	**Impact 9-3:** Radio/Television/Electronic Equipment Interference	Less than significant with mitigation
Induced Current and Shock Hazard	Less than significant	**Impact 9-4:** Induced Currents and Shock Hazards in Joint Use Corridors	Less than significant with mitigation
Effects on Cardiac Pacemakers	Less than significant	**Impact 9-5:** Effects on Cardiac Pacemakers	Less than significant
Impacts on aerial application	Significant	**Impact 9-6:** Transmission lines in agricultural areas present a safety hazard to aerial applicators	Significant (see Table C.9-8)
Construction Noise	Not Specified	**Impact 9-7:** Intermittent and continuous noise levels during transmission line and substation upgrade construction	Less than significant
Operation Noise	None	**Impact 9-8:** Operational noise	Less than significant

* Impacts from Final EIS/EIR are from Table 2-B, Summary of Significant Environmental Impacts, Applicable Mitigation Measures, and Mitigation Effectiveness for Los Banos-Gates

Table C.9-8 Summary of Aerial Applicator Safety Impacts per Segment: 1986 Draft EIS/EIR* and SEIR

Draft EIS/EIR Segment	Significance	SEIR Segment	Significance
West-1 (Segment 1)	Low - Insignificant	Segment 1	Insignificant
West-2 (Segment 2)	None – Insignificant	Segment 2	Insignificant
West-3 (Alternative Segment 2A)	None – Insignificant	Alternative Segment 2A	Insignificant
West-4 (Segment 4)	None – Insignificant	Segment 4	Insignificant
West-5 (Alternative Segment 4A)	None – Insignificant	Alternative Segment 4A	Insignificant
West-6 (Segment 5)	None – Insignificant	Segment 5	Significant
West-7 (Segment 6)	Low – Insignificant	Segment 6	Significant
West-8 (Alternative Segment 6A)	High – Significant	Alternative Segment 6A	Significant
West-10 (Alternative Segment 6B)	Low – Insignificant	Alternative Segment 6B	Insignificant
West-11 (Segment 7)	High - Significant	Segment 7	Significant
Eastern Corridor Alternative	High - Significant	Eastern Corridor Alternative**	Significant

* Impacts from Draft EIS/EIR are from Table 4.6-14, Impacts on Aerial Applicators.

** All segments would have significant safety impacts to aerial applicators except Segment 3, which has no agricultural fields.

Table C.9-9 lists the mitigation measures that were proposed in the FEIS/EIR (TANC/WAPA, 1988) in the area of Public Safety, Health, and Nuisance for the reduction of impacts from the Proposed Project, and shows how those measures are addressed in this document. These mitigation measures have been updated to today's standards and compliance tracking information has been added.

Table C.9-9 Mitigation Measures from 1988 FEIS/EIR

Impact	Text of Mitigation Measure	Disposition in this SEIR
Corona-induced radio and television interference	Appropriate selection of design parameters (i.e., conductor surface gradient, conductor diameter, and conductor configuration) and proper location of the transmission line corridor to avoid critical locations will reduce corona-induced radio and television interference to acceptable levels.	Incorporated into Mitigation Measure **PS-3**
AM radio and television interference	PG&E will resolve AM radio and television interference complaints and make every reasonable effort to promptly correct the cause of the interference when it has been established that this interference is from PG&E facilities.	Incorporated into Mitigation Measure **PS-3**
Radio and television interference	To provide a basis for evaluating and correcting any adverse effects caused by the transmission line, radio and TV field strength measurements will be made after the selection of the final transmission line alignment, prior to construction and operation of the transmission line. If complaints are received after operation of the line, PG&E will be able to take corrective measures to provide satisfactory service.	Incorporated into Mitigation Measure **PS-3**
Construction and Operation Noise	An ambient noise survey will be conducted at selected, sensitive sites along the corridor prior to construction and operation of the line. These measurements will then be available if complaints are received after the line is placed in operation.	Incorporated into Mitigation Measure **PS-5**
Impacts on aerial applications	Avoid diagonal orientations of transmission lines across cultivated fields.	Incorporated into Mitigation Measure **L-13***
Impacts on aerial applications	When locating towers in row crops is unavoidable, if possible, preference should be given to fields with rows that would be parallel, rather than perpendicular, to the transmission line.	Incorporated into Mitigation Measure **L-13***
Impacts on aerial applications	Place transmission lines and towers toward the center of the field where possible. Avoid placing towers at the edge of fields where canals or irrigation ditches are located.	Incorporated into Mitigation Measure **L-14***
Impacts on aerial applications	Avoid angular joining of transmission line alignments.	Incorporated into Mitigation Measure **L-16***

* Mitigation measures for impacts to aerial applications, as presented in Section C.7, Land Use and Recreation, also apply for the safety impacts to aerial applicators.

C.9.2.3 General Impacts and Mitigation Measures

Impact 9-1: Electric and Magnetic Fields (EMF)

EMF levels in the project area would not change during construction of the Proposed Project, since the lines would not be energized during construction. When the transmission lines are energized, there would be some long-term impacts to the surrounding environment due to EMF. For overhead transmission lines, these impacts are anticipated to be very localized. Using an optimized phase arrangement for the proposed transmission line, the magnetic field calculated by PG&E will vary from approximately 160 mG within the right-of-way to 42 mG at the edge of the right-of-way (100 feet), diminishing to 5 mG at 300 feet from the line (TANC/WAPA, 1986, Vol. 2B, Figure 4.9-2).

Methods to Reduce EMF

EMF levels from transmission lines can be reduced in three primary ways: shielding, field cancellation, or increasing the distance from the source. Shielding, which primarily reduces exposure to electric fields, can be actively accomplished by placing trees or other physical barriers along the transmission line right-of-way (ROW). Shielding also results from existing structures the public may use or occupy along the line. Since most materials can block electric fields, shielding is effective for the electric fields but is of limited effectiveness for magnetic fields.

Field cancellation is achieved in two ways. First, when the configuration places the conductors closer together, the interference, or cancellation, of the fields from each wire is enhanced. This technique has practical limitations because of the potential for short circuits if the wires are placed too close together. There are also worker safety issues to consider if spacing is reduced. Second, in instances where more than three phase wires are used, such as in the Proposed Project, cancellation can be accomplished by arranging different phase wires from different circuits near to each other.

The distance between the source of fields and the public can be increased by either placing the wires higher aboveground or by increasing the width of the ROW. For transmission lines, this method can prove effective in reducing fields because the reduction of the field strength drops rapidly with distance.

In accordance with CPUC Decision 93-11-013 (see Section C.9.2.1), PG&E must incorporate "no-cost" and "low-cost" magnetic field reduction steps in the proposed transmission line and substation facilities. PG&E's Transmission and Substation EMF Design Guidelines (developed in response to the CPUC's order) include the following measures that may be available to reduce the magnetic field strength levels from electric power facilities:

- Increase distance from conductors and equipment
- Reduce conductor spacing
- Minimize current
- Optimize phase configuration

As prescribed by G.0.131-D, the EMF Management Plans provided by PG&E include the following project information:

- A description of the project (cost, design, length, location, etc.)
- A description of the surrounding land uses using priority criteria classifications
- No-cost options to be implemented
- Priority areas where low-cost measures are to be applied
- Measures considered for magnetic field reduction and cost reduction
- A conclusion that states which options were selected and how areas were treated equivalently or why low-cost measures cannot be applied to this project

Based upon magnetic field analysis furnished by PG&E, incorporation of an optimized phase configuration as a low-cost field reduction measure will result in a reduction of the magnetic field at the edge of the ROW. Increasing the distance from conductors as a field reduction measure has a more pronounced effect immediately beneath overhead lines but is less effective when considering field levels at the edge of the ROW. Increasing the height of the transmission line may greatly increase the cost of the project resulting in only minimal field reduction when remaining within the low cost threshold identified by the CPUC. For example, the increase in structure height necessary to accomplish a pronounced field reduction may significantly increase visual impacts for the project.

While there is continuing public concern about the health effects of EMF, the conclusion of completed research supports the conclusion that EMF from power lines is an adverse, but less than significant impact of the Proposed Project (**Class III**). At final project design and construction stages, PG&E will incorporate mitigation measures consistent with the CPUC No-Cost/Low-Cost EMF Mitigation Policy. No further mitigation measures are recommended.

Impact 9-2: Corona and Audible Noise

There may be some periodic impacts due to corona and audible noise during rain and fog conditions. The Draft EIS/EIR states that corona noise at the edge of the right-of-way of a 500 kV transmission line would range from 45 to 50 dBA. This low level hissing or crackling, although adverse, would only be noticeable in wet weather conditions in close proximity to the line and is considered to be less than significant (**Class III**). No mitigation measures are recommended.

Impact 9-3: Radio/Television/Electronic Equipment Interference

Corona or gap discharges related to high frequency radio and television interference impacts are dependent upon several factors including the strength of broadcast signals and is anticipated to be very localized if it occurs. Individual sources of adverse radio/television interference impacts can be located and corrected on the power lines. Conversely, magnetic field interference with electronic equipment such as computer monitors can be corrected through the use of software, shielding, or changes at the monitor location. The following mitigation measures are recommended to reduce the potential impacts of interference to less than significant levels (**Class II**).

Mitigation Measures for Impact 9-3, Radio/Television/Electronic Equipment Interference

PS-1 As part of the design and construction process, PG&E shall limit the conductor surface electric gradient in accordance with the IEEE Radio Noise Design Guide. PG&E shall provide the CPUC with documentation of compliance prior to energizing the line.

PS-2 After energizing the transmission line, PG&E shall respond to and document all radio/ television/equipment interference complaints received and the responsive action taken. These records shall be made available to the CPUC for review upon request. All unresolved disputes shall be referred by PG&E, within 90 days, to the CPUC's Energy Division for Resolution.

Impact 9-4: Induced Currents and Shock Hazards in Joint Use Corridors

Induced currents and voltages on conducting objects near the proposed transmission lines represent a potential significant impact that can be mitigated. These impacts do not pose a threat in the environment if the conducting objects are properly grounded, and the following mitigation measure is recommended to reduce the potential impacts of induced currents to less than significant levels (**Class II**).

Mitigation Measure for Impact 9-4, Induced Currents and Shock Hazards in Joint Use Corridors

PS-3 As part of the siting and construction process, PG&E shall identify objects (such as fences, conductors, and pipelines) that have the potential for induced voltages and work with the affected parties to determine proper grounding procedures (CPUC G.0.95 and the NESC do not have specific requirements for grounding). PG&E shall install all necessary grounding measures prior to energizing the line. Thirty days prior to energizing the line, PG&E shall notify in writing, subject to the review and approval of the CPUC Energy Division, all property owners within and adjacent to the Proposed Project ROW of the date the line is to be energized. The written notice shall provide a contact person and telephone number for answering questions regarding the line and guidelines on what activities should be limited or restricted within the ROW. PG&E shall respond to and document all complaints received and the responsive action taken. These records shall be made available to the CPUC for review upon request. All unresolved disputes shall be deferred by PG&E to the Lead Agencies for resolution.

The written notice shall describe the nature and operation of the line, and PG&E's responsibilities with respect to grounding all conducting objects. In addition, the notice shall describe the property owner's responsibilities with respect to notification for any new objects, which may require grounding, and guidelines for maintaining the safety of the ROW.

Impact 9-5: Effects on Cardiac Pacemakers

The electric fields associated with the Proposed Project and Alternative transmission lines may be of sufficient magnitude to impact operation of a few older model pacemakers, resulting in them reverting to an asynchronous pacing. Cardiovascular specialists do not consider prolonged asynchronous pacing to be a problem; periods of operation in this mode are commonly induced by cardiologists to check pacemaker performance. Therefore, while the transmission line's electric field may impact operation of some older model pacemakers, the result of the interference is of short duration and is not considered significant or harmful (**Class III**). No mitigation measures are required or recommended.

Impact 9-6: Transmission Lines in Agricultural Areas Present a Safety Hazard to Aerial Applicators

The primary reason that transmission lines and towers are a safety hazard for aerial applicators is that they present an additional obstacle for pilots to avoid. The following discussion describes the specific circumstances that present a safety hazard to aerial applicators (Hanson, 2001; Taylor, 2001; TANC/WAPA, 1986). Transmission lines are especially hazardous when:

- Lines are diagonally oriented, relative to field boundaries
- Multiple lines exist side-by-side
- Change in direction (angle) is created along the corridor
- New transmission lines and towers are installed
- Towers and lines are not clearly visible.

According to an aerial applicator who works throughout the San Joaquin Valley (Taylor, 2001), pilots may periodically fly over fields that they haven't been to in six months or longer. In those cases, pilots most likely have no previous knowledge that new transmission lines and towers may have been constructed during their absence, which creates an increased danger for pilots. To ensure pilot notification of the approved corridor, the following measure should be implemented.

Mitigation Measure for Impact 9-6, Transmission Lines in Agricultural Areas Present a Safety Hazard to Aerial Applicators

PS-4 PG&E shall consult with landowners to determine which aerial applicators cover agricultural parcels within 1 mile of the approved transmission line corridor. PG&E shall provide written notification to all aerial applicators and to the CPUC stating when the new transmission lines and towers will be erected. PG&E shall also provide all aerial applicators and the CPUC with recent aerial photos or topographic maps clearly showing the new lines and towers, as well as all existing PG&E lines and towers within 10 miles of the approved corridor.

Mitigation Measure **PS-4** requires notification to aerial applicators of the new lines, and Mitigation Measures **L-13**, **L-14**, and **L-16** (Section C.7, Land Use and Recreation) address the safety hazards associated with the orientation of the transmission line(s) along and within the agricultural fields. However, while these measures would reduce the level of impact, if implementation is feasible, the safety hazard to aerial applicators would remain significant (**Class I**).

Impact 9-7: Intermittent and Continuous Noise Levels During Project Construction

Noise impacts could result from construction of the proposed 500 kV transmission line. Construction impacts are generally short-term in nature. Approximate noise levels from construction of the Proposed Project were estimated based on the construction equipment characteristics information provided in Table C.9-10. Maximum estimated noise levels from on-site and off-site construction activities were determined and then compared to the significance criteria as described in Section C.9.2.1.

Table C.9-10 Noise Characteristics of Construction Equipment

Equipment	Range of Noise Level (dBA) at 50 feet	Equipment	Range of Noise Level (dBA) at 50 feet
Front loaders	72-84	Forklifts	76-82
Backhoes	72-93	Pumps	69-71
Tractors, dozers	76-96	Generators	71-82
Scrapers, graders	80-93	Compressors	74-86
Trucks	82-94	Pneumatic tools	83-88
Concrete mixers	75-88	Jack hammers and rock drills	81-98
Concrete pumps	81-83	Pavers	86-88
Cranes (movable)	75-86	Compactors	84-90
Cranes (derrick)	86-88	Drill rigs	70-85

Source: PG&E, 1999.

Construction noise can be created from on-site and off-site sources. On-site noise sources would primarily consist of the operation of heavy duty diesel- and gasoline-powered construction equipment. Off-site noise sources would include vehicles commuting to and from the job site, as well as from trucks transporting material and equipment to the staging areas or construction right-of-way (ROW). These sources are described further in the following paragraphs.

On-site Noise Sources. On-site construction noise would occur primarily from heavy-duty construction equipment (e.g., dozers, backhoes, pile driver). Table C.9-10 presents a list of typical equipment that would be used to construct the transmission line and substations, as well as the noise intensity level at 50 feet from the noise source. Noise levels from these individual pieces of construction equipment range from 70 dBA to 98 dBA at a distance of approximately 50 feet (see Table C.9-10). It should be noted that noise levels are calculated based on the assumption that noise from a localized source is reduced by approximately 6 dBA with each doubling of distance from the source of noise.

In addition to the construction equipment listed in Table C.8-10, helicopters may be used in some areas to transport construction materials and to string the conductors. Short-term helicopter noise can range from 92 to 95 dBA at 150 feet from the helicopter (PG&E, 1999).

Two types of noise are associated with on-site construction activities: intermittent and continuous. The projected maximum intermittent noise level associated with the construction of transmission line structures would range from approximately 82 to 92 dBA at 50 feet and 76 to 86 dBA at 100 feet. Intermittent construction noise could be annoying to sensitive receptors within 1,000 feet of the construction activity. It is estimated that continuous noise levels from the transmission line construction activities at 50 feet would range from 70 to 77 dBA. At 100 feet, noise levels would be approximately 63 to 71 dBA.

Most of the Proposed Western Corridor is remote with a limited number of noise receptors in the area. However, several residences are adjacent to the Proposed Western Corridor and Alternative Segments. Construction noise levels near these receptors could adversely affect residents. It is anticipated that on-site construction noise would be short-term, lasting no longer than a few days at any one given location. Short-term on-site construction noise levels are expected to generate adverse, but less than significant impacts (**Class III**). Although no significant impacts have been identified, Mitigation Measure **L-7** (Section C.7, Land Use and Recreation) would further reduce the impacts by proving advanced notice to property owners, residents, and tenants with 1,000 feet of the proposed construction areas. This measure also requires PG&E to avoid nighttime construction near sensitive land uses (e.g., residences and campers at residential areas).

Off-site Noise Sources. Off-site noise during construction would occur primarily from commuting workers and from various truck trips to and from the construction sites. As described in Section B.3.5 (Proposed Project Construction), the construction workforce for the project would average approximately 110 workers over an estimated 27-month period. It is anticipated that most workers would be meeting at one of the staging areas (at the existing substations) and would travel to the construction site in commuter vans or buses. It is also assumed that truck trips would be required to haul structures, conductor line, and other materials to the construction sites. The peak noise levels (approximately 70 to 75 dBA at 50 feet) associated with passing trucks and commuting worker vehicles would be short-term in duration and would generate adverse, but less than significant impacts (**Class III**). Off-site noise impacts would be essentially the same for the Proposed Western Corridor and Alternative Segments and for the Eastern Corridor Alternative.

Impact 9-8: Operational Noise

Other than corona noise (see Impact 9-2), noise sources associated with operations of the proposed transmission line would be inspection and maintenance of the transmission line, instrumentation and control, and support systems. PG&E would inspect all of the structures from the surface annually for corrosion, misalignment, and excavations. Ground inspection would occur on selected lines to check the condition of hardware, insulators, and conductors. Noise generated by periodic maintenance and inspection activities occurring at various times are considered to be adverse, but less than significant short-term impacts **(Class III)**. Operation and maintenance impacts would be essentially the same from alternative to alternative, so they will not be discussed further under the Western Corridor Alternative Segments.

C.9.2.4 Proposed 500 kV Transmission Line Corridor (Western Corridor)

Impacts 9-1 through 9-5 are general impacts and mitigation measures discussed in Section C.9.2.3. These impacts apply to all areas of the Proposed Project.

Impacts to aerial applicators (Impact 9-6) would be a significant and unmitigable impact (**Class I**) in Segments 5, 6, and 7 due to the presence of agricultural land. As listed in Table C.9-4, Segments 5, 6, and 7 have 9.5%, 31.4%, and 85.8% of land, respectively, that has been identified to be cultivated for agricultural purposes. While implementation of Mitigation Measures **PS-4**, **L-13**, **L-14**, and **L-16** would reduce the safety risk to pilots, the impacts would remain significant. There would be no safety impacts related to aerial applicators in Segments 1, 2, 3, and 4.

Two residences are located within the proposed corridor at Milepost (MP) 68 and MP 80 and a mobile home residence is located at MP 68 (PG&E, 1986). These receptors could experience adverse, but less than significant construction noise impacts (Impact 9-7, **Class III**) as identified above. Although significant impacts have not been identified, implementation of Mitigation Measure **L-4** would further reduce the noise impact.

C.9.2.5 Proposed Substation Modifications

The proposed modifications to the Los Banos and Gates Substations would be within the existing substation footprints. Therefore, there would be no impacts to public health, safety or nuisance.

With regard to operational noise at the Gates and Los Banos Substations, the existing transformers that could operate at higher energy levels after project completion, and the additional equipment that would be needed to be installed ~~at the existing Gates and Los Banos Substations that~~ could generate noise levels above existing conditions. However, there are no sensitive noise receptors in the immediate vicinity of either of the substations. Therefore, operational noise levels at the Gates and Los Banos Substations would result in less than significant impacts (**Class III**).

C.9.2.6 Gates Loop

The proposed changes in the area of the Gates Substation include the removal of seven transmission line towers and construction of 6 new replacement towers at another location. Although the changes would be within the existing PG&E property boundaries, part of this land is currently leased for agricultural purposes. The new transmission towers would be constructed in different locations on the leased land. Therefore, impacts to aerial applicators would be significant (**Class I**). Implementation of Mitigation Measure **PS-4** would require notification of these changes to aerial applicators.

C.9.2.7 Reconductoring South of Gates Substation

Because the reconductoring that may be required on the Gates-Arco-Midway 230 kV transmission line would not require placement of new transmission towers, there would be no new public health, safety or nuisance impacts.

C.9.3 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES FOR THE WESTERN CORRIDOR ALTERNATIVES SEGMENTS

Impacts 9-1 through 9-5 are general impacts and mitigation measures discussed in Section C.9.2.3. These impacts apply to all Western Corridor Alternative Segments.

Impacts to aerial applicators (Impact 9-6) would be a significant and unmitigable impact (**Class I**) in Segment 6A due to the presence of agricultural land. As listed in Table C.9-4, 86.0 percent of the land in Segment 6A has been identified to be cultivated for agricultural purposes. However, implementation of Mitigation Measures **PS-4**, **L-13**, **L-14**, and **L-16** would reduce the safety risk to pilots. There would be no safety impacts related to aerial applicators in Western Corridor Alternative Segments 2A, 4A, and 6B.

No noise sensitive receptors have been identified along any of the Western Corridor Alternative Segments. Therefore, there would be no noise related impacts associated with these alternative segments.

C.9.4 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES FOR THE EASTERN CORRIDOR ALTERNATIVE

Impacts 9-1 through 9-5 are general impacts; relevant mitigation measures are discussed in Section C.9.2.3. These impacts apply to all areas of the Eastern Corridor Alternative.

Impacts to aerial applicators (Impact 9-6) would be a significant and unmitigable impact (**Class I**) in all segments of the Eastern Corridor Alternative except for Segment 3 (refer to Table C.9-4) due to the presence of agricultural land. However, implementation of Mitigation Measures **PS-4**, **L-13**, **L-14**, and **L-16** would reduce the safety risk to pilots.

A residence is located at AMP 10, three residences in a Farm Labor Camp are near AMP 37, and a ranch house is adjacent to AMP 65 (PG&E, 1986). These receptors could experience adverse, but less than significant construction noise impacts (Impact 9-7, **Class III**) as identified above. Although significant impacts have not been identified, implementation of Mitigation Measure **L-4** would further reduce noise impacts.

C.9.5 MITIGATION MONITORING PROGRAM

Table C.9-11 presents a summary of impacts of the Proposed Project and the Mitigation Monitoring Program recommended for mitigating public safety, health, and nuisance impacts. This program outlines the location, responsible party, required monitoring activities, effectiveness criteria, and timing of each monitoring activity.

Table C.9-11 Mitigation Monitoring Program

Impact	Mitigation Measure	Location	Monitoring/Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
Proposed Project and Alternative Corridors						
Radio and Television Interference (**Class II**).	**PS-1** As part of the design and construction process, PG&E shall limit the conductor surface electric gradient in accordance with the IEEE Radio Noise Design Guide. PG&E shall provide the CPUC with documentation of compliance prior to energizing the line.	All overhead transmission line segments.	Submit engineering report for selected conductor and analysis of surface gradient to the CPUC.	Engineering report shall present analysis of surface gradient and demonstrate compliance to IEEE Radio Noise Guide.	CPUC	Prior to construction.
Radio and Television Interference (**Class II**).	**PS-2** After energizing the transmission line, PG&E shall respond to and document all radio/ television/equipment interference complaints received and the responsive action taken. These records shall be made available to the CPUC for review upon request. All unresolved disputes shall be referred by PG&E, within 90 days, to the CPUC's Energy Division for Resolution.	All overhead transmission line segments.	Document complaints and action taken. Submit summary to CPUC each year for first two years of operation. Unresolved complaints submitted to CPUC.	Complaint summary demonstrates a lack of interference complaints or remedies utilized to resolve interference.	CPUC	First two years of operation.
Induced Currents and Shock Hazards (**Class II**).	**PS-3** As part of the siting and construction process, PG&E shall identify objects (such as fences, conductors, and pipelines) that have the potential for induced voltages and work with the affected parties to determine proper grounding procedures (CPUC G.0.95 and the NESC do not have specific requirements for grounding). PG&E shall install all necessary grounding measures prior to energizing the line. Thirty days prior to energizing the line, PG&E shall notify in writing, subject to the review and approval of the CPUC Energy Division, all property owners within and adjacent to the Proposed Project ROW of the date the line is to be energized. The written notice shall provide a contact person and telephone number for answering questions regarding the line and guidelines on what activities should be limited or restricted within the ROW. PG&E shall respond to and document all complaints received and the responsive action taken. These records shall be made available to the CPUC for review upon request. All unresolved disputes shall be deferred by PG&E to the Lead Agencies for resolution.	All overhead transmission line segments.	Document criteria for installing grounding and tabulate locations where grounding installed shall be submitted to the CPUC.	Design prevents electric shocks to public.	CPUC	Prior to energizing transmission line.

Impact	Mitigation Measure	Location	Monitoring/Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
	The written notice shall describe the nature and operation of the line, and PG&E's responsibilities with respect to grounding all conducting objects. In addition, the notice shall describe the property owner's responsibilities with respect to notification for any new objects, which may require grounding, and guidelines for maintaining the safety of the ROW.					
Transmission Lines in Agricultural Areas Present a Safety Hazard to Aerial Applicators (**Class I**).	**PS-4** PG&E shall consult with landowners to determine which aerial applicators cover agricultural parcels within 1 mile of the approved transmission line corridor. PG&E shall provide written notification to all aerial applicators and to the CPUC stating when the new transmission lines and towers will be erected. PG&E shall also provide all aerial applicators and the CPUC with recent aerial photos or topographic maps clearly showing the new lines and towers, as well as all existing PG&E lines and towers within 10 miles of the approved corridor. **L-13, L-14, and L-16** (See Section C.7).	All segments that cross agricultural land.	Notification to aerial applicators and the CPUC. Consultation with landowners prior to construction.	Reduce the level of impact but the safety hazard will remain significant.	CPUC	Prior to construction.
Electric and Magnetic Fields (**Class III**).	No-cost, low-cost field reduction measures determined by PG&E	Entire transmission line corridor.	Document no-cost, low-cost measures incorporated in line design shall be provided to the CPUC.	Report documents amount of field reduction obtained through mitigation measures.	CPUC	Prior to construction.
Construction Noise Could Disturb Sensitive Receptors (**Class III**).	**L-7** (See Section C.7)	All lands within 1,000 feet of ROW, substation, or access road	Review and approve copies of mailed notices, bulletins, and published notices	Timely and detailed notices, bulletins, and published notices.	CPUC	At least one month before construction

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