SECTION 3.0

Transmission System Engineering

3.1 Introduction

Carlsbad Energy Center LLC proposes to develop the new Carlsbad Energy Center Project (CECP) on the existing Encina Power Station site. CECP will have two trains of generation, designated as Units 6 & 7. Each train includes one natural-gas-fired combustion turbine generator (CTG) and one steam turbine generator (STG). Each generator will have a generator step-up (GSU) transformer with the high voltage primary winding connected to a high voltage circuit breaker.

For Unit 6, the GSU transformer connected to CTG will step up the generation voltage from 16.5 kilovolts (kV) to 230 kV and the GSU transformer connected to STG will step up the generation voltage from 13.8 kV to 230 kV. 230-kV SF6 circuit breakers will be connected to the high side of the GSU transformers which will be then tied together and connect to a new 230-kV transmission line. This 230-kV transmission line, approximately 2,775 feet long, will interconnect Unit 6 to the existing San Diego Gas & Electric (SDG&E) 230-kV Encina switchyard.

For Unit 7, the GSU transformer connected to CTG will step up the generation voltage from 16.5 kV to 138 kV and the GSU transformer connected to STG will step up the generation voltage from 13.8 kV to 138 kV. 138-kV SF6 circuit breakers will be connected to the high-side of the GSU transformers which will be then tied together and connect to a new 138-kV transmission line. This 138-kV transmission line, approximately 1,250 feet long, will interconnect Unit 7 to the existing SDG&E 138-kV Encina switchyard.

The 230-kV and the 138-kV existing SDG&E Encina switchyards, the proposed Units 6 & 7 power plants, and the proposed interconnecting 138-kV and 230-kV transmission lines are all located within the existing Encina Power Station site. The transmission line interconnection to the California Independent System Operator (CAISO) grid is via the existing 230-kV and 138-kV transmission lines from the existing SDG&E Encina switchyards. The single-line representation of the electrical interconnection is depicted in Figure 3.1-1.

This section describes the interconnecting transmission lines and examines its impact on the existing electrical transmission grid. Additional discussions include potential electrical line nuisances (electrical, magnetic, audible noise, corona effects, and safety of the interconnection).

The CECP site was selected for this project, in part, because of the existing Encina Power Station site is already connected to SDG&E system via the existing 138-kV and 230-kV SDG&E Encina switchyards. Existing generation units 1, 2, and 3, currently connected to the existing 138-kV SDG&E Encina switchyard, will be retired and one of the vacated bus positions (Bay 1) will be used to connect the new 138-kV transmission lines from Unit 7. The 230-kV transmission line from Unit 6 will terminate to a new cable termination pole using

230-kV cable terminators. The cable termination pole will be located outside of the existing SDG&E 230-kV Encina switchyard near the northwest corner of the switchyard. From the cable termination pole, SDG&E will connect and routes 230-kV insulated cables through underground duct-banks and terminate the cables to a position in the ring bus of the 230-kV SDG&E Encina switchyard.

Figure 3.1-2 identifies the proposed CECP site layout and the proposed 138-kV and 230-kV transmission line routing within the existing Encina Power Station site.

3.2 Transmission Line Description, Design, and Operation

This section discusses the existing transmission facilities in the vicinity of the CECP, the interconnection to SDG&E system and the two Generator "Interconnection System Impact Studies" (ISIS) by SDG&E and CAISO. There are two separate ISIS processes, one for interconnection on the 230-kV system and one on the 138-kV system.

3.2.1 Existing Transmission Facilities

The CECP site is located just east of Carlsbad Boulevard in the City of Carlsbad and west of Interstate 5 (I-5) (Figure 3.2-1). The CECP is located within the site of the existing Encina Power Station that includes five operational generation units.

The existing 138-kV SDG&E switchyard is connected to the following:

- Existing generation Units 1, 2, and 3 (each 107 megawatts [MW], 104 MW and 110 MW respectively)
- Existing generation Unit 4 (306 MW)
- Existing simple cycle combustion turbine generator #EGT-1 (17 MW)
- Station auxiliary transformers and to the startup transformer
- Four existing 138-kV SDG&E transmission lines (TL 13801, TL 13804, TL 13806, and TL 13807). These transmission lines cross over I-5 heading in an east/southeast direction within SDG&E established transmission corridors that are then connected to SDG&E grid.

The existing 230-kV SDG&E Encina switchyard is connected to the following:

- Existing generation Unit 5 (345 MW)
- Three existing 230-kV transmission lines (TL 23003, TL 23011, and TL 23012). These transmission lines connect to the grid after crossing over I-5 heading in an east/southeast direction within the existing SDG&E transmission corridors.

3.2.2 Proposed Transmission Interconnection

The CECP is located within the existing Encina Power Station site and the new generation will interconnect to the SDG&E system via the existing 138-kV and 230-kV SDG&E Encina switchyards.

3.2.2.1 Proposed Transmission Interconnection at 230 kV

The CECP will run approximately 2,775 feet of overhead transmission line from two 230-kV SF6 circuit breakers and disconnect switches of Unit 6 to a cable termination pole, to be located outside the SDG&E existing 230-kV switchyard.

The Interconnection Facilities that are needed to interconnect the CECP to the SDG&E system at 230 kV are as follows:

- SDG&E will connect the 230-kV overhead line to the cable termination poles with 230-kV insulated cables and route them through underground duct-banks and terminate the cables to a position in the ring bus in the 230-kV existing SDG&E Encina switchyard.

3.2.2.2 Proposed Transmission Interconnection at 138 kV

The CECP will run approximately 1,250 feet of overhead transmission line from the two 138-kV SF6 circuit breakers and disconnect switches of Unit 7 to Bay 1 dead-end structure in the 138-kV existing SDG&E Encina switchyard. CECP will retire the existing Encina Units 1, 2, and 3.

The Interconnection Facilities that are needed to interconnect the CECP to SDG&E system at 138 kV are as follow:

- In the existing 138-kV SDG&E Encina switchyard, SDG&E will disconnect the existing incoming 138-kV lines from the existing Encina Power Station Units 1, 2, and 3 GSU transformers and perform bus rearrangements necessary to accommodate the CECP 138-kV transmission line.
- From the last CECP 138-kV transmission line dead-end pole, SDG&E will connect the CECP 138-kV transmission line to the vacated position in Bay 1, at the north end of the 138-kV Encina switchyard. This transmission line from Unit 7 will carry less power than the removed generation from the retired Encina Power Station Units 1, 2, and 3. Therefore, new generation will not impact the ratings of the existing 138-kV Encina switchyard or the existing 138-kV transmission lines from the Encina switchyard that connect to the grid.

3.2.3 Transmission Interconnection System Impact Studies

SDG&E/CAISO issued Generator ISIS, dated June 5, 2007. This ISIS considered a net increase of 288 MW of new generation interconnecting to 230-kV SDG&E existing Encina switchyard. SDG&E/CAISO held several meetings with Carlsbad Energy Center LLC afterwards to review the ISIS. Carlsbad Energy Center LLC requested SDG&E/CAISO update the ISIS based the current CECP needs as described in Section 3 of this report. SDG&E/CAISO plans to issue an updated ISIS with updated estimated cost of the impact associated with the CECP. The current ISIS study agreements/workplans with SDG&E and CAISO are included in Appendix 3A. Proof of payment for the revised ISIS is also included in Appendix 3A.

The CECP will have a maximum net output of 280 MW from Unit 6 for interconnection to SDG&E 230-kV Encina switchyard. This reduction in generation capacity of 8 MW compared to the 288 MW capacity used in the June 5, 2007 ISIS analysis, will result in a reduced impact on the 230-kV system.

The CECP will have a maximum net output of 280 MW from Unit 7 for interconnection to SDG&E 138-kV Encina switchyard. This 280 MW Unit 7 generation addition will replace the generation capacity from the retired Encina Power Station Unit 1, 2, and 3 with 330 MW with a net generation reduction of 50 MW. This reduction will not impact the capacities of outgoing transmission lines from SDG&E Encina 138-kV switchyard and therefore, it is expected to have negligible impact on SDG&E system. An ISIS agreement with SDG&E to conduct a system impact analysis for the 138-kV connection was executed on June 1, 2007. As noted above, the signed ISIS agreements and proof of payments are provided in Appendix 3A.

CECP will retire Encina Power Station Units 1, 2, and 3 prior to placing CECP Units 6 and 7 in commercial service. Unit 1 will be retired prior to bringing Unit 6 on line. The retirement of Encina Power Station Units 2 and 3 will precede operation of CECP Unit 7.

3.3 Transmission System Safety and Nuisances

This section discusses safety and nuisance issues associated with the electrical interconnection of the CECP into the existing electrical grid.

3.3.1 Electrical Clearances

High-voltage overhead transmission lines consist of bare conductors, support structures, polymer or porcelain insulators, and connecting hardware. Transmission lines are designed and constructed so that they provide sufficient clearances to protect the public and the utility workers. Minimum clearances are established by National Electric Safety Code, California Public Utility Commission (CPUC) General Order 95 (GO-95), Electric utilities, state regulators, and local ordinances. Typically, clearances are specified for:

- Distance between the energized conductors themselves
- Distance between the energized conductors and the supporting structure
- Distance between the energized conductors and other power or communication lines on the same supporting structure.
- Distance from the energized conductors to the ground and features such as roadways, railroads, driveways, parking lots, navigable waterways, airports, etc.
- Distance from the energized conductors to buildings and signs
- Distance from the energized conductors to other parallel power or communications lines

The CECP transmission interconnection will be designed to meet all federal, state, and local code clearance requirements. Since the design must take into consideration many different situations, the generalized dimensions provided in the figures of this section should be regarded as conceptual. The location of the McClellan Palomar Airport nearby requires that the height of the transmission line poles be limited and CPUC GO-95 requires that the minimum clearance for 230-kV transmission line be 30 feet above thoroughfare.

The final design will comply with CPUC GO-95, SDG&E and SCE guidelines for the electric and magnetic field (EMF) reduction.

3.3.2 Electrical Effects

The electrical effects of high-voltage transmission lines fall into two broad categories: corona effects and field effects. Corona is the ionization of the air that occurs at the surface of the energized conductor and suspension hardware due to very high electric field strength at the surface of the metal during certain conditions. Corona may result in radio and television reception interference, audible noise, light, and production of ozone. Corona is a function of the voltage of the line, the diameter of the conductor (or bundle of conductors), and the condition of the conductor and hardware. Field effects are the voltages and currents that may be induced in nearby conducting objects. Transmission line's 60-hertz (Hz) electric and magnetic fields cause these effects.

3.3.2.1 Electric and Magnetic Fields

Operating power lines, like the energized components of electrical motors, home wiring, lighting, and electrical appliances, produce electric and magnetic fields, commonly referred to as EMF. The EMF produced by the alternating current electrical power system in the United States has a frequency of 60 Hz.

The 60-Hz power line fields are considered to be extremely low frequency. Electric and magnetic fields of power transmission lines at 60-Hz frequency have very low energy that does not cause heating or ionization. The 60-Hz fields do not radiate, unlike radio-frequency fields.

Electric fields around transmission lines are produced by electrical charges on the energized conductor. Electric field strength is directly proportional to the line's voltage; that is, increased voltage produces a stronger electric field. The electric field is inversely proportional to the distance from the conductors, so that the electric field strength declines as the distance from the conductor increases. The strength of the electric field is measured in units of kilovolts per meter (kV/m). The electric field around a transmission line remains practically constant and is not affected by the common daily and seasonal fluctuations in usage of electricity by customers.

Magnetic fields around transmission lines are produced by the level of current flow, measured in units of amperes, through the conductors. The magnetic field strength is also directly proportional to the current; that is, increased amperes produce a stronger magnetic field. The magnetic field is inversely proportional to the distance from the conductors. Thus, like the electric field, the magnetic field strength declines as the distance from the conductor increases. Magnetic fields are expressed in units of milligauss. The flow of current fluctuates daily and seasonally as the electricity usage and so does the magnetic field around transmission lines.

Considerable research has been conducted over the last 30 years on the possible biological effects and human health effects from EMF. This research has produced various studies that offer no uniform conclusions about whether long-term exposure to EMF is harmful or not. In the absence of conclusive or evocative evidence, some states, California in particular, have chosen not to specify maximum acceptable levels of EMF. Instead, these states mandate a program of prudent avoidance whereby EMF exposure to the public is minimized by encouraging electric utilities to use low-cost techniques to reduce the levels of EMF.

3.3.2.2 Audible Noise

Audible noise on transmission lines and structures is due to the effects of corona. Corona is a function of transmission line voltage, conductor diameter and condition of the conductor, and the suspension hardware. The electric field gradient is the rate at which the electric field changes and is directly related to the line voltage. The electric field gradient is greatest at the surface of the conductor. Large-diameter conductors have lower electric field gradients at the conductor surface and, hence, lower corona than smaller conductors, everything else being equal. Irregularities (such as nicks and scrapes on the conductor surface) or sharp edges on suspension hardware concentrate the electric field at these locations and, thus, increase corona at these spots. Similarly, contamination on the conductor surface, such as dust or insects, can cause irregularities that are a source for corona. Raindrops, snow, fog, and condensation are also sources of irregularities. Corona typically becomes a design concern for transmission lines at 345 kV voltage and above.

3.3.2.3 EMF Assumptions

It is important that any discussion of EMF include the assumptions used to analyze the effect of EMF, and consider that the EMF in the vicinity of the power lines vary with regard to line design, line loading, distance from the line, and other factors. The electric field depends upon the line voltage, which remains nearly constant for a transmission line during normal operation. A worst-case voltage of 242 kV (230 kV + 5 percent) will be used in the calculations for the 230-kV lines and a worst-case voltage of 145 kV (138 kV + 5 percent) will be used in the calculations for the 138-kV lines.

The magnetic field is proportional to line loading (amperes), which varies as power plant generation is changed by the system operators to meet increases or decreases in electrical demand. Line loading values used for the EMF calculations are based on the nominal output rating of the connected generators.

The CECP will produce a maximum of 280 MW from Unit 6 for interconnection to SDG&E 230-kV Encina switchyard. This reduction in generation capacity of 8 MW compared to the 288 MW capacity used in the June 5, 2007 ISIS analysis, will result in a reduced impact on the 230-kV system. The transmission line connecting Unit 6 generation to the SDG&E 230-kV Encina switchyard will be routed entirely inside the Encina Power Station. The site is not accessible to the public and, therefore, the public will not be exposed to any EMF level from this transmission line. At the Unit 6 area, the line is closest to the site property line (about 260 feet from the east property line). At the 230-kV switchyard area the line is about 800 feet from the nearest residence. There are three existing SDG&E 230-kV transmission lines connected to SDG&E 230-kV switchyard. Power flows in all directions on these transmission lines which depend on imports, internal generation, transmission lines that may be out of service and the system demand load. No change on the existing transmission lines conductor size is expected. The existing line EMF is based upon the capacity rating of the transmission lines and therefore, the EMF levels for these lines will not change.

The CECP will produce a maximum of 280 MW from Unit 7 for interconnection to SDG&E 138-kV Encina switchyard. The transmission line connecting Unit 7 generation to the SDG&E 138-kV Encina switchyard will be routed entirely inside the Encina Power Station. The site is not accessible to the public and as such, EMF exposure from this transmission line by the public will not be an issue. At the Unit 7 area, the line is closest to the site property line (about 260 feet from the east property line). At the 138-kV switchyard area the line is about 1,300 feet from the nearest residence. This 280 MW Unit 7 generation addition will replace the generation capacity from retiring Encina Unit 1, 2, and 3 with 330 MW with a net generation reduction of 50 MW. This reduction will not impact the capacities of the outgoing 138-kV transmission lines from SDG&E Encina Power Station 138-kV switchyard and therefore the EMF levels for these lines will not change.

The following figures illustrate the plan view of the interconnection between Units 6 and 7 and SDG&E 230-kV and 138-kV switchyards. Other figures show the cross sections of the transmission line poles at different locations.

- Figure 3.1-2 illustrates the plan view of the interconnection alignments.
- Figure 3.3-1 shows a cross section of the 230-kV dead-end pole before the transmission line drops down to another dead-end pole next to Unit 6.
- Figure 3.3-2 shows a cross section of the 230-kV tangent pole with phase configuration change from the previous pole.
- Figure 3.3-3 shows a cross section of the double-circuit 138/230-kV dead-end angle pole before the lines cross the existing railroad track at approximately perpendicular to the track. A minimum of 34 feet of clearance above the railroad track will be maintained.
- Figure 3.3-4 shows a cross section of the double-circuit 138/230-kV dead-end pole before the 138-kV transmission line is routed to a separate pole before entering the 138-kV SDG&E Encina switchyard.
- Figure 3.3-5 shows a cross section of the 138-kV dead-end pole before the 138-kV transmission line is routed to the 138-kV SDG&E Encina switchyard.

3.3.2.3.1 Transmission Line EMF Reduction

While the State of California does not set a statutory limit for electric and magnetic field levels, the CPUC, which regulates electric transmission lines, mandates EMF reduction as a practicable design criterion for new and upgraded electrical facilities. As a result of this mandate, the regulated electric utilities have developed their own design guidelines to reduce EMF at each new facility. The California Energy Commission (CEC), which regulates transmission lines to the point of connection, requires independent power producers to follow the existing guidelines that are in use by local electric utilities or transmission-system owners.

In keeping with the goal of EMF reduction, the interconnection of the CECP will be designed and constructed using the principles outlined in the SDG&E and SCE publications, "EMF Design Guidelines for Electrical Facilities." These guidelines explicitly incorporate the directives of the CPUC by developing design procedures compliant with Decision 93-11-013 and General Orders 95, 128, and 131-D. That is, when the transmission line structures, conductors, and rights-of-way are designed and routed according to the SCE & SDG&E guidelines, the transmission line would be consistent with the CPUC mandate.

The primary techniques (per SCE & SDG&E guidelines) for reducing EMF anywhere along the line are to:

- Increase the pole height for overhead design
- Use compact pole-head configuration
- Minimize the current on the line
- Optimize the configuration of the phases (A, B, C)

The CEC normally requires actual measurements of pre-interconnection background EMF for comparison with measurements of post-interconnection EMF levels. Because of the unique circumstances that ensure there will be no EMF changes caused by CECP, the Applicant does not believe that such measurements are necessary.

3.3.2.3.2 Conclusion on EMF and Audible Noise

After having evaluated the electrical effects of the high-voltage transmission lines, it is the Applicant's conclusion that:

- Electrical effects calculations do not have to be submitted with this AFC to the CEC for the approximately 0.6 mile long, 230-kV and 138-kV CECP interconnect transmission lines since these transmission lines are to be constructed on the property wholly-owned by Cabrillo Power I LLC with no public receptors.
- Electrical effects calculations do not have to be submitted with this AFC for the existing 230-kV and 138-kV switchyards transmission line outlets since there is no change to the existing lines' electric field, audible noise, voltage, and line configuration. Power flows in the transmission system are in all directions and depends on imports, internal generation, transmission lines that may be out of service and system load demand. No change on the existing transmission lines conductor size is expected. The existing line EMF is based on the capacity rating of the transmission lines and therefore, the EMF levels for these lines will not change.

3.3.2.4 Induced Current and Voltages

A conducting object such as a vehicle or person in an electric field will have induced voltages and currents. The strength of the induced current will depend upon the field strengths, the size and shape of the conducting object, and the object-to-ground resistance. When a conducting object is isolated from the ground and a grounded person touches the object, a perceptible current or shock may occur as the current flows through the person to ground. To prevent such situations and to mitigate hazardous and nuisance shocks, all metallic objects below and near the transmission lines will be grounded, at several locations, if necessary for fences and pipes that run parallel to the transmission lines, and adequate clearances will be maintained above roads, railroad lines, and parking facilities to minimize induced currents in vehicle and people to safe levels.

The CECP interconnection transmission lines will run parallel to and cross over an existing railroad. CECP will coordinate with the railroad to minimize any interference with the railroad cars and signal & communications circuits. The proposed routing of the 230-kV and 138-kV lines will be constructed in conformance with GO-52, GO-95, and Title 8 California

Code of Regulations Section 2700 (8 CCR 2700) requirements. A minimum of 34 feet of vertical clearance will be maintained when the lines cross over the railroad.

It is not anticipated that hazardous shocks will occur as a result of the CECP construction or operation.

3.3.2.5 Communications (Radio/TV) Interference

Corona from transmission lines can cause interference with radio and television reception. Corona typically becomes a design concern for transmission lines having voltages of 345 kV and above. Corona on the 138-kV and 230-kV interconnection transmission lines will be minimized by proper selection of hardware and conductors. A survey will be performed of the ambient noise levels before construction and it will then be compared with level measured after the construction and energization.

Any interference issues from public will be reviewed and any required modifications would be done to mitigate the interference.

3.3.3 Aviation Safety

Federal Aviation Administration (FAA) Regulations, Title 14 of the Code of Federal Regulations (CFR), Part 77 establishes standards for determining obstructions in navigable airspace in the vicinity of airports that are available for public use and are listed in the Airport Directory of the current Airman's Information Manual. These regulations set forth requirements for notification of proposed obstruction that extend above the earth's surface. FAA notification is required for any potential obstruction structure erected over 200 feet in height above ground level. Also, notification is required if the obstruction is greater than specified heights and falls within any restricted airspace in the approach to airports. For airports with runways longer than 3,200 feet, the restricted space extends 20,000 feet (3.3 nautical miles) from the runway with no obstruction greater than a 100:1 ratio of the distance from the runway. For airports with runways measuring 3,200 feet or less, the restricted space extends 10,000 feet (1.7 nautical miles) with a 50:1 ratio of the distance from the runway. For heliports, the restricted space extends 5,000 feet (0.8 nautical miles) with a 25:1 ratio.

McClellan Palomar Airport is located about 14,300 feet away from the CECP transmission line interconnection to the existing SDG&E Encina switchyards. The separation to this airport requires that FAA be notified if the proposed transmission pole height exceeds 143 feet (100:1 ratio of distance from runway to pole height). The CECP will comply with this limit by designing the interconnect-transmission line pole to be less than 143 feet tall. At 400 feet, the existing exhaust stack at the Encina Power Station is currently, and will remain, the tallest structure on the Encina Power Station site.

There is no heliport located within 5,000 feet of the CECP site. The CECP including the transmission line interconnection will pose no deterrent to aviation safety as defined and regulated in 14 CFR Part 77 of the FAA regulations.

3.3.4 Fire Hazards

The proposed 230-kV/138-kV interconnecting transmission lines within the existing Encina Power Station to SDG&E 138-kV and 230-kV switchyards will be designed, constructed, and maintained in accordance with CPUC GO-95. CPUC GO-95 establishes clearances from other man-made and natural structures as well as tree-trimming requirements to mitigate fire hazards. The existing trees along the existing railroad corridor that crosses the CECP site, can present a fire hazard. These trees will be trimmed as necessary and a distance will be maintained from these trees to the CECP transmission line interconnection. However, it is unlikely that any vegetation management will be required because the entire proposed route is over areas that have existing transmission and distribution lines. The Applicant or its designate will maintain the interconnection corridor in accordance with accepted industry practices. This will include identification and abatement of any fire hazards to ensure safe operation of the line.

3.4 Applicable Laws, Ordinances, Regulations, and Standards

This section provides a list of applicable laws, ordinances, regulations, and standards (LORS) that apply to the proposed interconnecting transmission line, switchyard/substation and engineering during the construction and operations phases of the CECP. The following compilation of LORS is in response to Section (h), of Appendix B attached to Article 6, of Chapter 6, of Title 20 of the California Code of Regulations. Inclusion of these data is further outlined in the CEC's publication entitled "Rules of Practice and Procedure & Power Plant Site Certification Regulations."

3.4.1 Design and Construction

Table 3.4-1 lists the applicable LORS for the design and construction of the proposed transmission line and connection to the existing SDG&E switchyard.

TABLE 3.4-1
Design and Construction LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
General Order 95 (GO-95), CPUC, "Rules for Overhead Electric Line Construction"	CPUC rule covers required clearances, grounding techniques, maintenance, and inspection requirements.	3.2.2.1 3.2.2.2
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.	3.2.2.1 3.2.2.2
General Order 128 (GO-128), CPUC, "Rules for Construction of Underground Electric Supply and Communications Systems"	Establishes requirements and minimum standards to be used for the underground installation of AC power and communications circuits.	3.2.2.1 3.2.2.2
General Order 52 (GO-52), CPUC, "Construction and Operation of Power and Communication Lines"	Applies to the design of facilities to provide or mitigate inductive interference.	3.2.2 3.3.1 3.3.2
ANSI/IEEE 693 "IEEE Recommended Practices for Seismic Design of Substations"	Provides recommended design and construction practices.	3.2.2.1 3.2.2.2

TABLE 3.4-1
Design and Construction LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
IEEE 1119 “IEEE Guide for Fence Safety Clearances in Electric-Supply Stations”	Provides recommended clearance practices to protect persons outside the facility from electric shock.	3.2.2
IEEE 998 “Direct Lightning Stroke Shielding of Substations”	Provides recommendations to protect electrical system from direct lightning strokes.	3.2.2
IEEE 980 “Containment of Oil Spills for Substations”	Provides recommendations to prevent release of oil into the environment.	3.2.2.1 3.2.2.2
Suggestive Practices for Raptor Protection on Power lines, April 1996	Provides guidelines to avoid or reduce raptor collision and electrocution	3.2.2.1 3.2.2.2

3.4.2 Electric and Magnetic Fields

The applicable LORS pertaining to electric and magnetic field interference are tabulated in Table 3.4-2.

TABLE 3.4-2
Electric and Magnetic Field LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
Decision 93-11-013 of the CPUC	CPUC position on EMF reduction.	3.2.2 3.3.2
General Order 131-D (GO-131), CPUC, Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California	CPUC construction-application requirements, including requirements related to EMF reduction.	3.2.2 3.3.2
EMF Design Guidelines for Electrical Facilities, Southern California Edison Company, EMF Research and Education, 6090 Irwindale Avenue, Irwindale, California 91702, (626) 812-7545, September 2004	Large local electric utility’s guidelines for EMF reduction through structure design, conductor configuration, circuit phasing, and load balancing. (In keeping with CPUC D.93-11-013 and GO-131)	3.2.2 3.3.2
ANSI/IEEE 644-1994 “Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines”	Standard procedure for measuring EMF from an electric line that is in service	3.3.2

3.4.3 Hazardous Shock

Table 3.4-3 lists the LORS regarding hazardous shock protection for the CECP.

TABLE 3.4-3
Hazardous Shock LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
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.	3.2.2.1 3.2.2.2
ANSI/IEEE 80 “IEEE Guide for Safety in AC Substation Grounding”	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	3.2.2.1 3.2.2.2
National Electrical Safety Code, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C.	Covers overhead clearances for electrical supply and communications overhead lines.	3.2.2.1 3.2.2.2

3.4.4 Communication Interference

The applicable LORS pertaining to communication interference are tabulated in Table 3.4-4.

TABLE 3.4-4
Communications Interference LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
Title 47 CFR Section 15.25, “Operating Requirements, Incidental Radiation”	Prohibits operations of any device emitting incidental radiation that causes interference to communications. The regulation also requires mitigation for any device that causes interference.	3.2.2 3.3.1 3.3.2
General Order 52 (GO-52), CPUC	Covers all aspects of the construction, operation, and maintenance of power and communication lines and specifically applies to the prevention or mitigation of inductive interference.	3.2.2.1 3.2.2.2 3.3.2.4
CEC staff, Radio Interference and Television Interference (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.	3.2.2.1 3.2.2.2 3.3.2.5

3.4.5 Aviation Safety

Table 3.4-5 lists the aviation safety LORS that may apply to the construction and operation of the CECP.

TABLE 3.4-5
Aviation Safety LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
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 in navigable airspace.	3.2.2.1 3.2.2.2 3.3.3
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.	3.2.2.1 3.2.2.2 3.3.3
Public Utilities Code, Sections 21656-21660	Discusses the permit requirements for construction of possible obstructions in the vicinity of aircraft landing areas, in navigable airspace, and near the boundary of airports.	3.2.2.1 3.2.2.2 3.3.3

3.4.6 Fire Hazard

Table 3.4-6 tabulates the LORS governing fire hazard protection for the CECP.

TABLE 3.4-6
Fire Hazard LORS

LORS	Applicability	Applicability (AFC Section Explaining Conformance)
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.	3.2.2 3.3.4
ANSI/IEEE 80 "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	3.2.2.1 3.2.2.2 3.3.4
General Order 95 (GO-95), CPUC, "Rules for Overhead Electric Line Construction" Section 35	CPUC rule covers all aspects of design, construction, operation, and maintenance of electrical transmission line and fire safety (hazards).	3.2.2 3.3.4

3.4.7 Jurisdiction

Table 3.4-7 identifies federal, state, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, and/or enforce the above referenced LORS. Table 3.4-7 also identifies the associated responsibilities of these agencies as they relate to the construction and operation of CECP.

TABLE 3.4-7
Agencies with Jurisdiction for Transmission System Engineering

Agency or Jurisdiction	Responsibility
CEC	Jurisdiction over new transmission lines associated with thermal power plants that are 50 MW or more. (PRC, 25500)
CEC	Jurisdiction of lines out of a thermal power plant to the interconnection point to the utility grid. (PRC, 25107)
CEC	Jurisdiction over modifications of existing facilities that increase peak operating voltage or peak kilowatt capacity 25 percent. (PRC, 25123)
CPUC	Regulates construction and operation of overhead transmission lines. (General Order No. 95 and 131-D) (those not regulated by the CEC)
CPUC	Regulates construction and operation of power and communications lines for the prevention of inductive interference. (General Order No. 52)
FAA	Establishes regulations for marking and lighting of obstructions in navigable airspace. (AC No. 70/7460-1G)
CAISO	Provides Final Interconnection Approval
City of Carlsbad	Establishes and enforces zoning regulations for specific land uses. Issues variances in accordance with zoning ordinances.
City of Carlsbad	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity. (NFPA, 70)
City of Carlsbad	Issues and enforces certain ordinances and regulations concerning fire prevention and electrical inspection

3.5 References

California Public Utilities Commission. Decision 93-11-013.

California Public Utilities Commission. General Order 128 – Rules for Construction of Underground Electric Supply and Communications Systems.

California Public Utilities Commission. General Order 131D – Rules for Planning and Construction of Utilities Generation, Line, and Substation Facilities.

California Public Utilities Commission. General Order 52 – Construction and Operation of Power and Communication Lines

California Public Utilities Commission. General Order 95 – Rules for Overhead Electric Line Construction.

Electric Power Research Institute. 1975. Transmission Line Reference Book, 345-kV and Above. Palo Alto, California.

Electric Power Research Institute. 1978. Transmission Line Reference Book, 115-138kV Compact Line Design. Palo Alto, California.

EMF Research and Education. 2004. EMF Design Guidelines for Electrical Facilities, Southern California Edison Company. Irwindale, California. September.

IEEE Power Engineering Society. 1985. Corona and Field Effects of AC Overhead Transmission Lines, Information for Decision Makers. July.

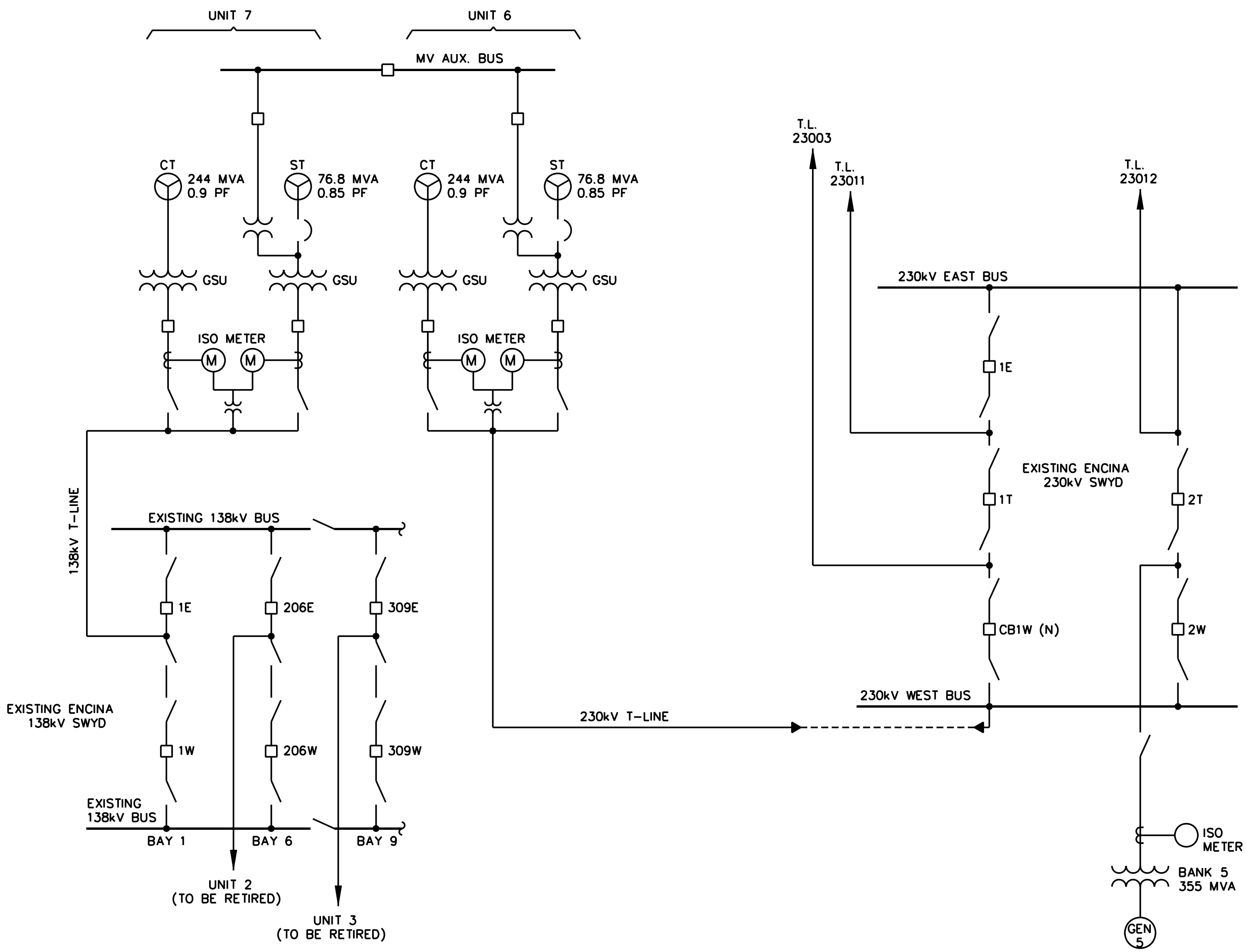
National Electrical Safety Code. ANSI C2.

Southwire. Overhead Conductor Manual.

United States of America. 14CFR1250-1258 – Fire Prevention Standards for Electric Utilities.

United States of America. 15CFR77 – Objects Affecting Navigable Airspace.

United States of America. 47CFR15.25 – Operating Requirements, Incidental Radiation.



Source: Shaw Stone & Webster, Inc.

FIGURE 3.1-1
ONE-LINE DIAGRAM
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

CH2MHILL

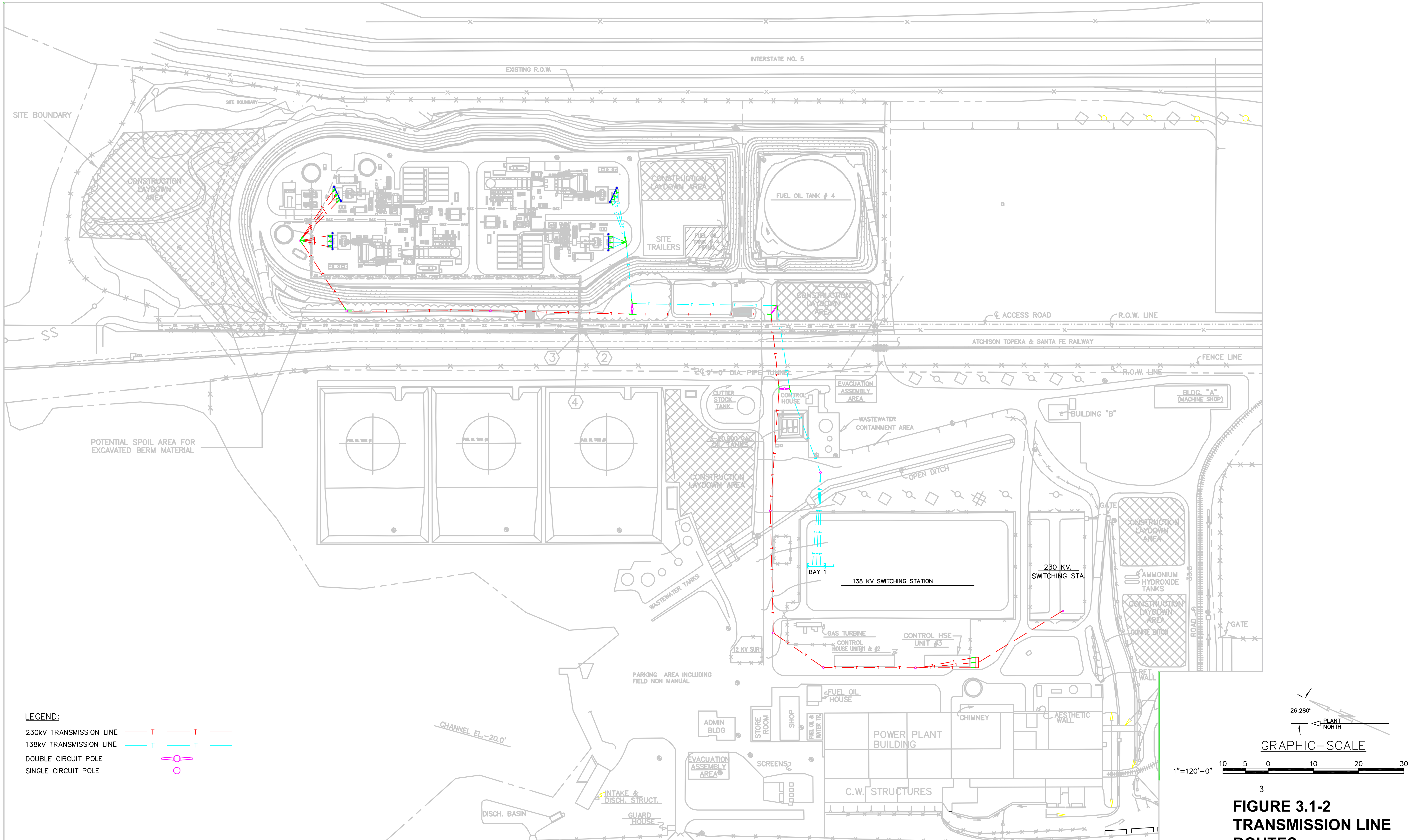


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FIGURE 3.1-2
TRANSMISSION LINE ROUTES

CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

Source: Shaw Stone & Webster, Inc.

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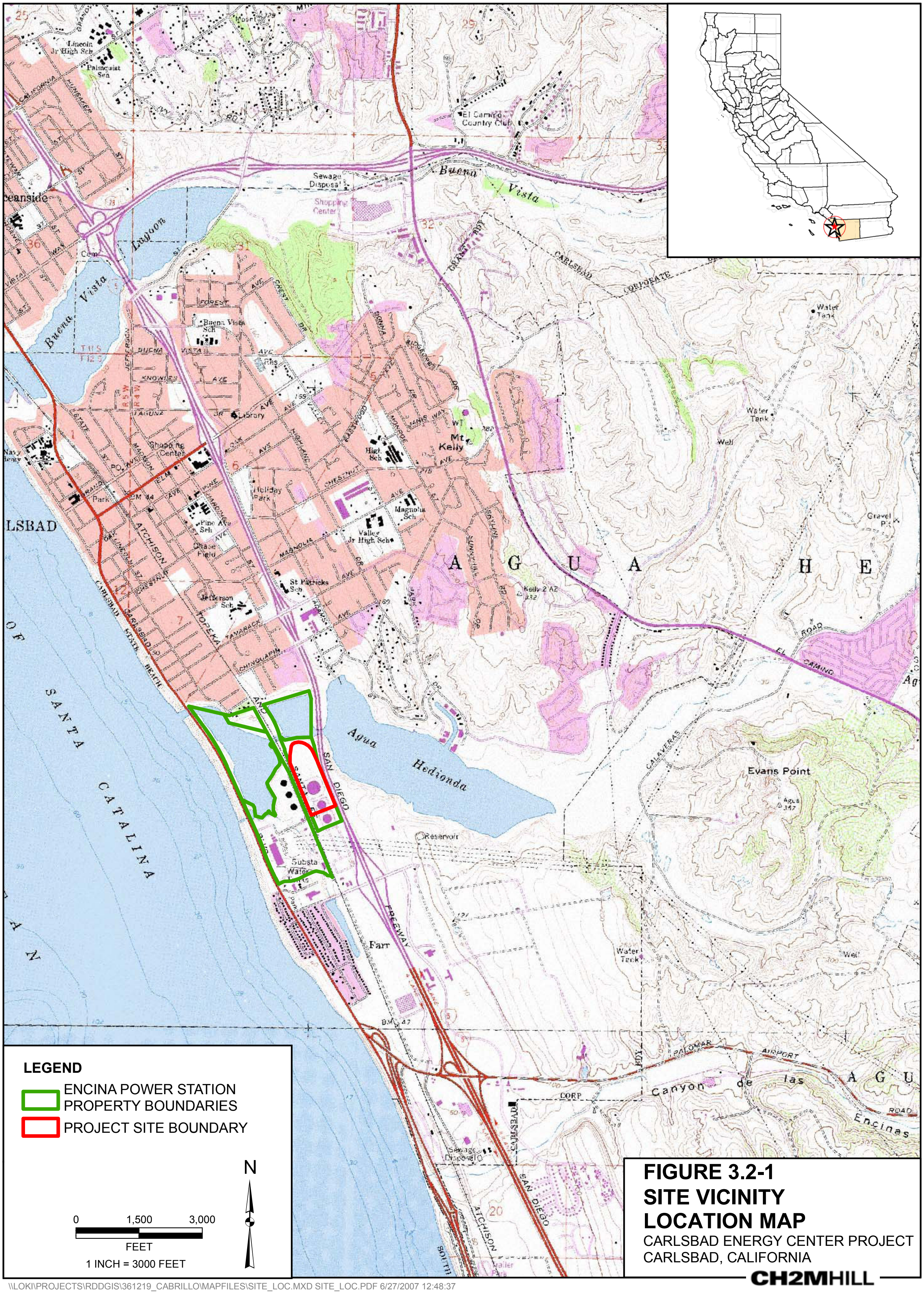

FIGURE 3.2-1
SITE VICINITY LOCATION MAP
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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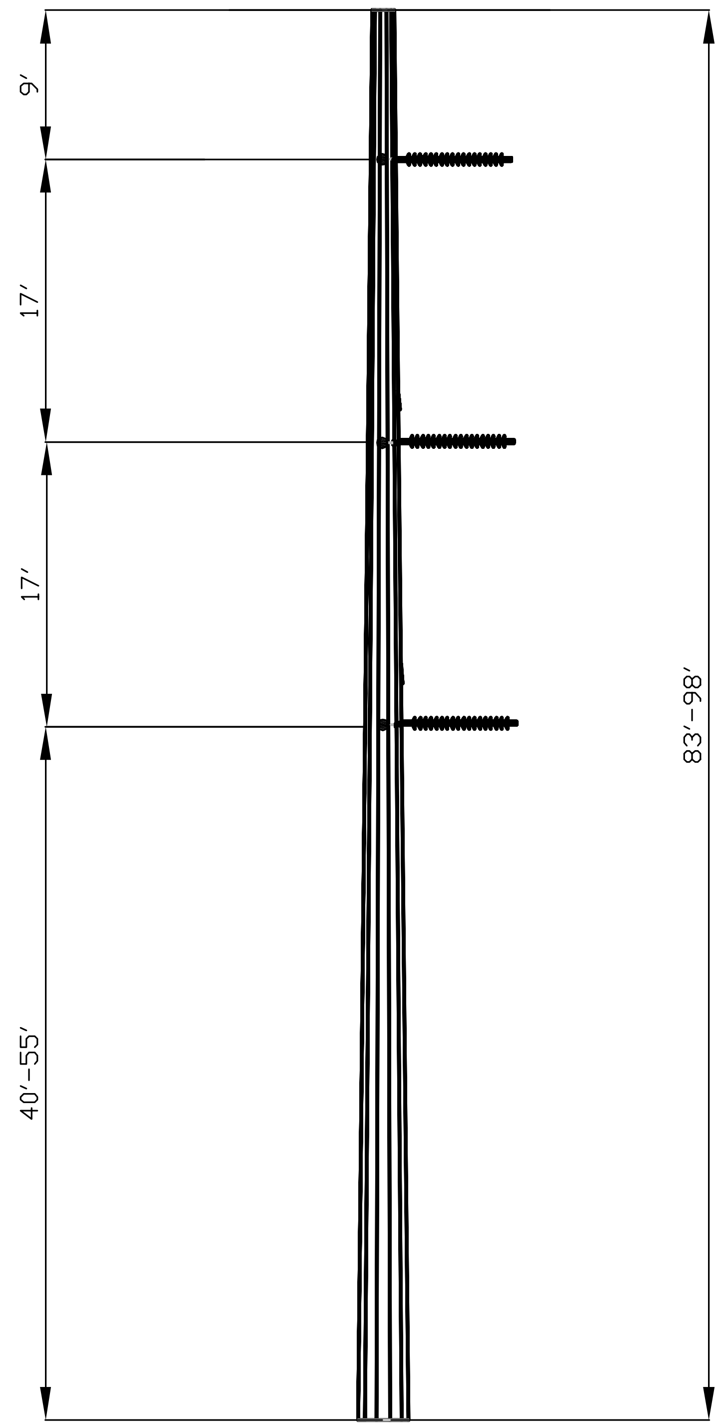

Source: Shaw Stone & Webster, Inc.

FIGURE 3.2-2
230kV LINE CROSS-SECTION
DEADEND POLE
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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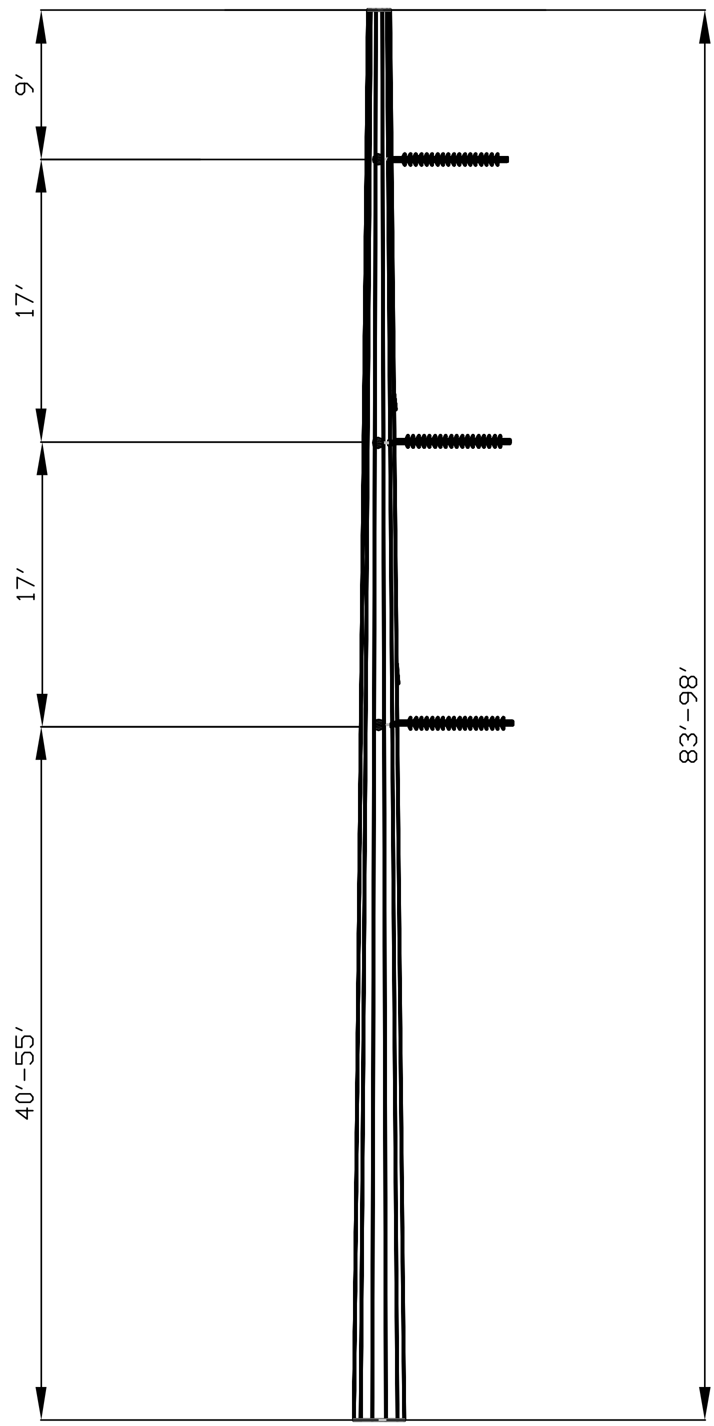

Source: Shaw Stone & Webster, Inc.

FIGURE 3.3-1
230kV LINE CROSS-SECTION
DEADEND POLE
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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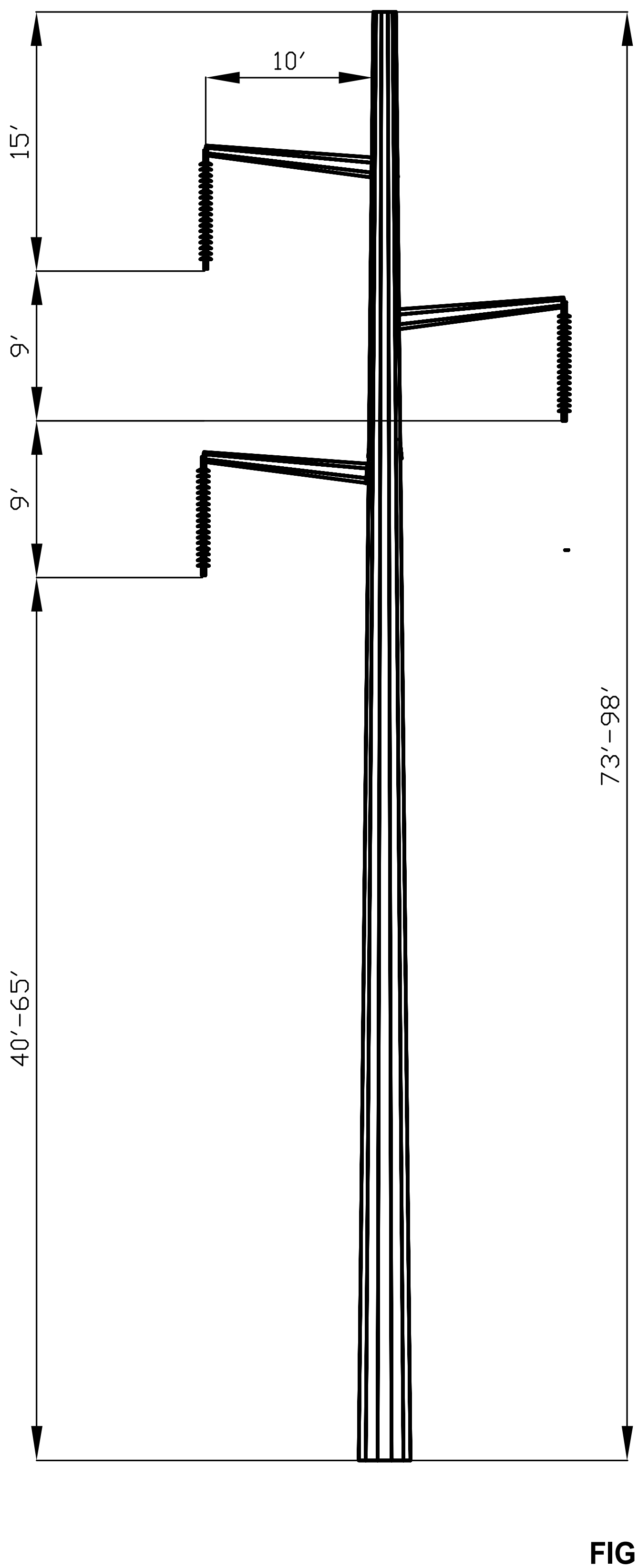

Source: Shaw Stone & Webster, Inc.

FIGURE 3.3-2
230kV LINE CROSS-SECTION
TANGENT POLE
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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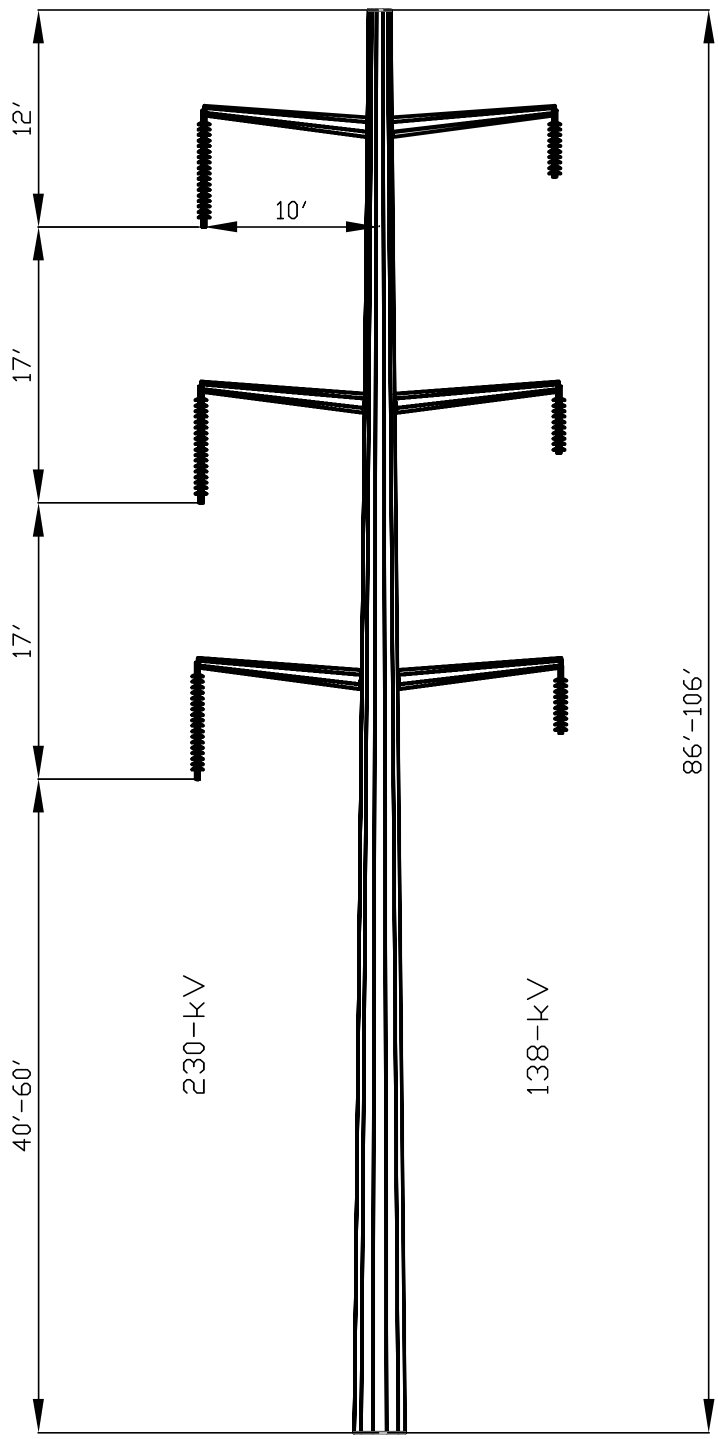

Source: Shaw Stone & Webster, Inc.

FIGURE 3.3-3
138/230kV LINE CROSS-SECTION DOUBLE CIRCUIT CONFIGURATION

CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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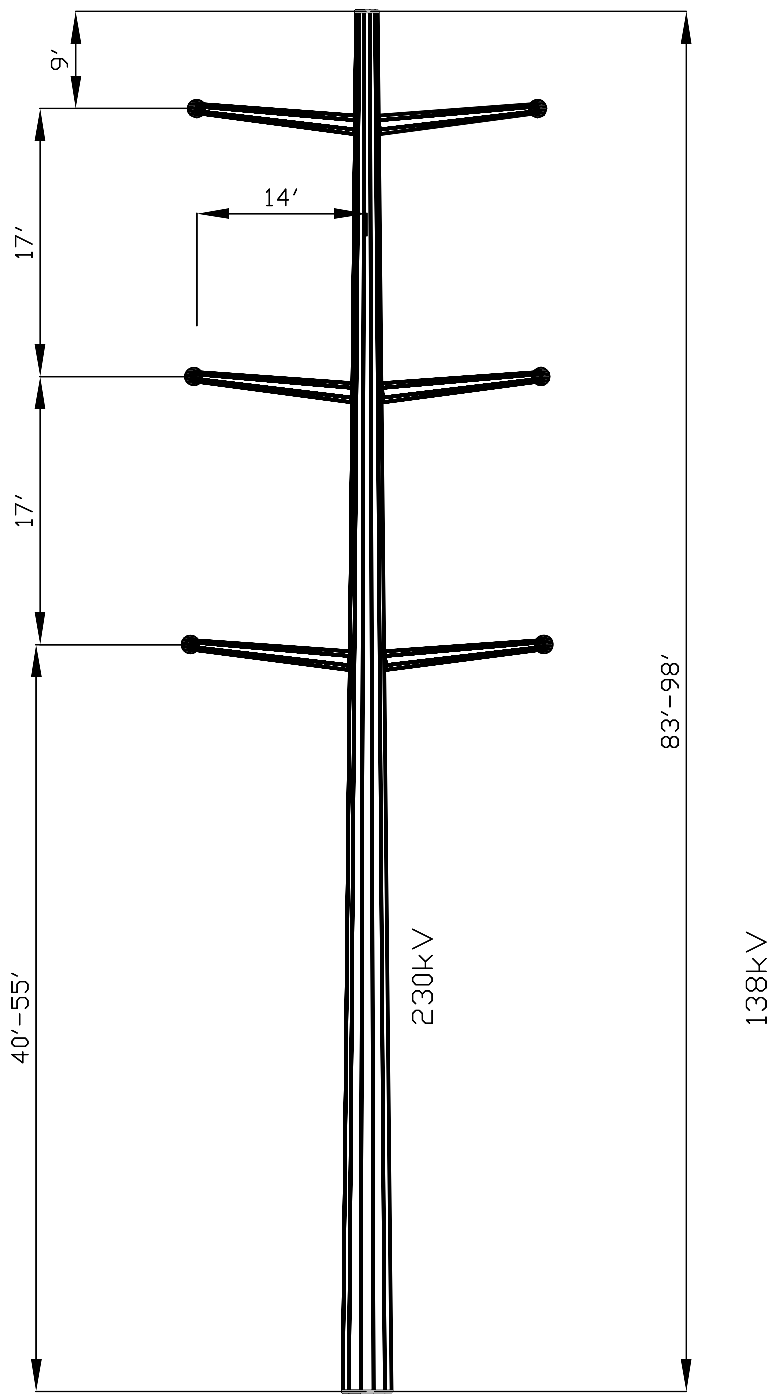

Source: Shaw Stone & Webster, Inc.

FIGURE 3.3-4
138/230kV LINE
CROSS-SECTION DOUBLE
DEADEND CONFIGURATION
LINE DIVERGENCE POINT
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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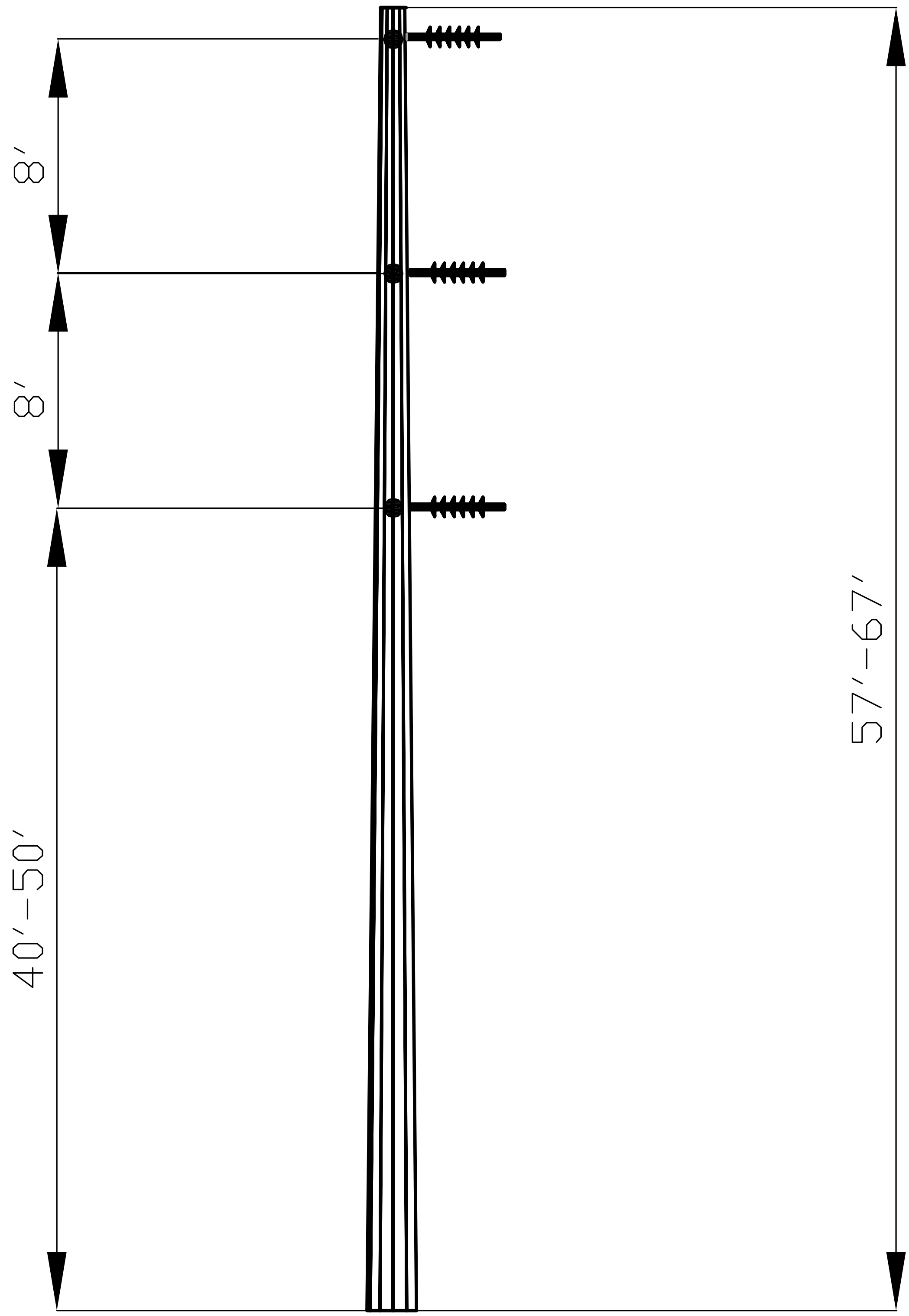

Source: Shaw Stone & Webster, Inc.

FIGURE 3.3-5
138/230kV LINE
CROSS-SECTION SINGLE
CIRCUIT TO 138-kV
SUBSTATION
CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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