4.1 TRANSMISSION INTERCONNECTION LINE LOCATION

There will be four new transmission cables exiting the substation that will be looped into the existing 69 kV Vermont-Yorba and Dowling-Yorba lines.

4.2 TRANSMISSION CABLE CONFIGURATION

All new connections to the existing transmission system will be made with fully shielded 69 kV XLPE cable with 2,000 thousand circular mil (kcmil) copper conductors There will be two double circuits installed, each in a 6-inch-diameter conduit within duct banks for three phase 69 kV 2,000 kcmil copper cable conductors. Two communication circuits used for relay and SCADA purposes will be enclosed in separate 4-inch conduits within the duct bank.

The onsite interconnection facilities will consist of 69 kV outdoor gas-insulated switchyard with a sun shelter, high-voltage disconnect switches, high-voltage circuit breakers, metering and relaying devices, foundations, ground grid, fencing, and all other components necessary to connect the output of the generators to the system. The new sections of the transmission cables will be underground except the two riser poles located in front of the site and south of East Miraloma Avenue. See Figure 4-1 for the line diagram of the project's transmission system.

4.2.1 Conductors

Two-thousand kcmil copper cable conductors will be used for the three-phase 69 kV exits.

4.2.2 Ground Wires

The ground wires, if any, on the existing transmission lines will be sufficient. No new ground wires are contemplated.

4.2.3 Structures

The only transmission structures on the Canyon Power Plant (CPP) project will be the two riser pole structures, to be located just south of the facility on the south side of East Miraloma Avenue, which will connect the underground loop from the CPP station to the overhead Vermont-Yorba transmission line (Figure 4-2). There are no other transmission structures required.

The transmission structures for the riser pole connections will be specially designed tubular steel construction to permit cables to be contained within the hollow interior of the steel structure (see Figure 4-3). The cables will emerge at the appropriate height to bring them at the cross arm heights.

4.2.4 Foundations

For the new transmission line dead end structures drilled pier type foundations (35 feet to 45 feet deep) will be designed and installed underneath the existing double-circuit transmission cable to facilitate the riser pole connections.

4.2.5 Access to Structures

The two new transmission pole structures are to be located along East Miraloma Avenue and will have easy construction and maintenance access from the existing street.

4.2.6 Route

The proposed interconnection point with the Vermont-Yorba line would be on East Miraloma Avenue directly south of the substation. The other proposed interconnection point with the Dowling-Yorba line would be at the intersection of East La Palma Avenue and Miller Street and then going north on Miller Street and then west on East Miraloma Avenue to the new onsite switchyard.

4.2.7 Switchyard Interconnect

The gas-insulated switchgear (GIS) switchyard will serve as the connection point to the City of Anaheim (COA) 69 kV transmission system.

4.3 TRANSMISSION INTERCONNECTION CONSTRUCTION

All four transmission circuits connecting into the COA transmission system from the CPP switchyard will involve underground cable installation. The preferred installation method will use underground concrete-encased duct bank construction. In the event that other existing utilities are encountered along the planned duct bank route, jack-and-bore construction techniques may be adopted. Two circuits will be placed in a single duct bank (Figure 4-4).

The two new steel riser poles to be constructed south of East Miraloma Avenue will involve drilled pier foundations. Lines will be totally enclosed in the hollow riser poles.

4.4 TRANSMISSION SYSTEM OPERATION AND MAINTENANCE

4.4.1 Introduction

The COA will be responsible for the maintenance, inspection, and normal operation of the four new cables connecting to the CPP. Operation of the electrical interconnection facilities will be locally controlled at the CPP. Operation may also be remotely monitored and controlled by the COA via the CPP supervisory control and data acquisition system

(SCADA). Control and protection equipment at the CPP will monitor and control the safe operation of the cables. The COA will have continuous access to all of the electrical interconnection facilities in the event of an emergency.

4.4.2 Right-of-way Management

The only new transmission line overhead structures are the two riser poles located in the front of the site and south of East Miraloma Avenue; the rest is underground. There are adequate clearances and right-of-way to maintain these two poles.

4.4.3 Access Maintenance

The 69 kV cables enter the GIS switchyard underground from generator step-up transformers (GSUs) and leave underground into East Miraloma Avenue. Access for maintenance to the switchyard will be from the access road directly in front of the switchyard or from the 15-foot alley between the switchyard and the plant perimeter wall. CPP will have continuous access to all the electrical interconnection facilities.

4.4.4 Inspections

Inspection of the transmission lines and structures at the CPP is anticipated to occur every 12 months. Cleaning will be performed based on visual inspections scheduled by plant and switchyard operating personnel.

4.4.5 Emergency/Safety Repairs

Control and protection equipment at the plant and within the switchyard will monitor and control the safe operation of the lines. The COA will have continuous access to all of the electrical interconnection facilities in the event of an emergency.

4.4.6 Insulator Washing

Because the 69 kV switchyard is gas-insulated, and connections between the GSU and the switchyard are made with underground cables, there is no need for insulator washing at this location.

4.5 TRANSMISSION SYSTEM EVALUATION

The new 69 kV generating switchyard will be located approximately one-half mile north of the existing Dowling Substation. The new switchyard will be looped into two existing COA 69 kV lines nearby to form four new lines to the switchyard. The COA transmission system interconnects with a Southern California Edison (SCE)/California Independent System Operators (CAISO) system at the Lewis 230/69 kV Substation. SCE is currently performing the combined System Impact and Facility Studies. A System Impact Study evaluates the

impact of the project on the SCE system. The study also provides a short circuit analysis and an assessment of the stability of the system under various contingencies. A Facility Study identifies mitigation measures for transmission facility overloads, and upgrades, if necessary, due to the added generation.

4.5.1 Transmission System Reliability Criteria

SCE is currently performing the evaluation of the transmission system based on criteria as established by the North American Electric Reliability Council (NERC), the Western Electricity Coordinating Council (WECC), the CAISO, and the SCE reliability criteria. These criteria will be monitored throughout the transmission system evaluations to address any changes to the criteria, which may impact the evaluation.

4.5.2 Transmission System Interconnection Study

As detailed above, SCE is currently performing the evaluation of the project's potential impact on the SCE system. The COA has executed a System Impact Study Agreement with SCE and has paid the fees required under that agreement. A copy of that agreement and proof of payment is included in Appendix P.

4.5.3 Transmission Line and Cable Safety and Nuisance

4.5.3.1 Electric and Magnetic Fields

The electric and magnetic fields (EMF) were analyzed for the proposed CPP site. The study modeled the 69 kV gas-insulated switchyard and the underground cables crossing East Miraloma Avenue and terminating at the top of the two proposed riser poles, as well as the 7,000-foot span of underground cable that will connect with the Dowling – Yorba Linda lines. The EMF effects were analyzed for field levels before and after commissioning of the CPP. The field effects include the power frequency electric and magnetic fields. The corona effects include audible noise, radio interference voltage (RIV), and television interference (TVI). The comparisons were made of these electrical effects between the existing 69 kV and 12 kV overhead power lines adjacent to the project site and proposed changes associated with the CPP project.

4.5.3.2 Generation of Electric and Magnetic Fields

Any object with an electrical charge on it will have a voltage at its surface. The voltage effect is not limited to the surface of the object but extends into the space surrounding the object with diminishing intensity. The change in voltage over distance is known as the electric field. The units describing an electric field are volts per meter (V/m), or kilovolts per meter (kV/m). This unit is a measure of the difference in electrical voltage existing between two

points one meter apart. The electric field is strongest near a charged object and decays with distance.

The 60 Hertz (Hz) electric field from a transmission line or cable decreases with distance, away from the outermost conductor, typically at a rate of approximately one divided by the distance squared ($1/d^2$). Since the voltage of the cable is kept within ±5 percent of its rated voltage, the electric field in the vicinity of the transmission cables remains nearly constant over time.

An electric current flowing in a conductor creates a magnetic field. The commonly used measure of magnetic field intensity is milligauss (mG), which is one thousandth of a gauss (G). The magnetic field is stronger near a charged object and decreases with distance away from the object. Magnetic fields are also influenced by the spacing of the current-carrying conductors and their phasing arrangement.

Similar to the electric field, the magnetic field strength decreases with distance away from the cable, typically at a rate of approximately one divided by the distance squared ($1/d^2$). Unlike electric fields that vary little over time, magnetic field changes with increasing and decreasing electrical load current. Unlike electric fields, magnetic fields cannot be easily shielded.

The new 69 kV GIS, underground cable connections, and the increase in the load current on the existing transmission lines have been modeled and the fields (both electric and magnetic) have been evaluated. The changes in the electrical and magnetic field effects anticipated due to the commissioning of the new power plant were determined.

Since the CPP project will use existing 69 kV cables and line voltage remains unchanged, the electric fields will not change due to commissioning of CPP project. The calculated electric field is about 78 V/m directly underneath the existing lines along East Miraloma Avenue and it decays to about 17 to 19 V/m at a distance of 200 feet from the centerline.

Since the conductor spacing on the new steel riser poles is larger (12 feet vs. 5 feet) the electric field changes slightly in the area near the proposed riser poles.

4.5.3.3 Line Loads for EMF Calculation

Table 4.5-1 shows the current load on existing lines and the proposed current loads once the project is completed.

Certain assumptions were made in performing these computer calculations:

1) Two-foot conductor sag was assumed between supporting structures.

TABLE 4.5-1
SUMMARY OF MAXIMUM LOADING ON THE EXISTING AND PROPOSED TRANSMISSION, AND DISTRIBUTION LINE CIRCUITS

Circuit Name	Existing Load (Amps [A])	Proposed Load (A)
Vermont-Yorba 69 kV	590 A	N/A[1]
Vermont-Dowling 69 kV	970 A	370 A
Johnson 12 kV (Upper)	300 A (30A on Neutral)	300 A (30A on Neutral)
Steven 12 kV (Lower)	340 A (1A on Neutral)	340 A (1A on Neutral)
CPP-Yorba #1 69 kV	N/A	760 A
CPP-Dowling 69 kV	N/A	810 A
Vermont-CPP 69 kV	N/A	770 A
CPP-Yorba #2 69 kV	N/A	720 A

[1] This line is replaced by two lines in the proposed project.

2) The direction of load flow on the distribution circuits was assumed to be in the same direction as power flow on the transmission lines. This condition represents a worst case scenario of compounding magnetic fields.

4.5.3.4 Calculation Methods

A software package called EPRI EMF Workstation (developed by Enertech) was used to model and calculate the electric and magnetic fields.

For the corona effects, modeling software developed by the Bonneville Power Administration was used. Both software tools are fairly standard tools that are widely used in the industry for such calculations.

4.5.3.5 Magnetic Fields Along the Rights-of-way

The magnetic field produced by existing transmission lines is expected to change with the increased current loading on one of the two transmission lines. The magnetic fields from the two existing transmission lines have been modeled and calculated for the ‘as-is’ present condition and compared with the increased new loads after the commissioning of CPP.

The maximum calculated magnetic field located directly under the lines along East Miraloma Avenue, from the double-circuit overhead 69 kV line with its present loading, is 29.7 mG. The commissioning of the CPP project will alter the system power flows on many lines including the Vermont-Dowling line that shares the structures of the directly impacted Vermont-Yorba line. This change decreases the power flow on the Vermont-Dowling line to approximately one third of its current power flow, and also changes the direction of power flow. As a result, the magnetic field directly under the double-circuit 69 kV line is reduced to

26.5 mG west of the CPP, and only 18.4 mG east of the CPP. This represents 11 percent and 38 percent reduction in the magnetic fields. Since the magnetic field at any given time varies with the power flow and its direction, the most important conclusion that can be drawn from the modeling of the transmission lines is that the CPP would not change the magnetic field significantly, and, if anything, may reduce the field under the lines affected by the CPP.

4.5.3.6 Magnetic Fields from Proposed New Facilities

4.5.3.6.1 GIS Switchyard. Due to the proximity of the conductors in a 3-in-1 enclosure GIS design, the magnetic fields from the GIS will be significantly lower than other designs. The calculated magnetic field at the exterior station wall (about 10 feet away) is about 11 to 15 mG and it drops to 2 mG at about 25 feet, which is 15 feet from the curb on East Miraloma Avenue.

4.5.3.6.2 69 kV Underground Cables. All four circuits (12 cables) that will travel beneath East Miraloma Avenue (both the 100-foot span and the 7,000-foot span) will be installed in a phase-reversed configuration to minimize the magnetic fields. The anticipated maximum current load on the 69 kV cables is 810 A, as shown in Table 4.5-1. The magnetic field lateral profile calculated at a height of 1 meter above ground, directly over the duct banks, is shown in Figure 4-5. The calculated maximum magnetic field is 24.4 mG directly above the double-circuit underground cable duct banks with their current loads of 810 A and 760 A. As clearly seen on the following profile the magnetic field rapidly attenuates with distance from the underground cables.

4.5.3.7 Audible Noise and Radio and TV Interference

No audible noise or RIV interference is anticipated for the GIS or shielded cables. This is due to the totally enclosed GIS design along with fully shielded cable conductors expected to carry the power exported from this power station. The overhead portion of the interconnection with the existing Vermont-Yorba line will be unchanged from the existing configuration.

4.5.3.8 Induced Currents and Hazardous/Nuisance Shocks

No induced currents or hazardous/nuisance shocks are anticipated due to the shielding of the riser cables into the overhead transmission line.

4.6 TRANSMISSION LINE AGREEMENTS AND NECESSARY APPROVALS

The COA owns and operates all the transmission systems and no agreement is necessary.

4.7 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS (LORS)

This Section describes the LORS concerning transmission, as also summarized in Table 4.7-1.

4.7.1 Federal

No federal LORS governing the transmission facilities were identified.

4.7.2 State

4.7.2.1 Design and Construction

4.7.2.1.1 GO-128, CPUC, Rules for Underground Electric Line Construction. All proposed transmission facilities will be designed and constructed in accordance with all applicable elements contained in GO-128, CPUC. Sections 4.2, 4.3, and 4.4 describe the proposed design, operation and maintenance and safety and reliability elements of the transmission system. Operation and maintenance will be compliant with all requirements contained in GO-128, CPUC.

4.7.2.1.2 Title 8 CCR, Section 2700 et seq. High Voltage Electrical Safety Orders. Requirements contained in Title 8 CCR, Section 2700 et seq. will be adhered to in the design, construction, operation, and maintenance of the electrical systems for the CPP. Sections 4.2, 4.3, 4.4, and 4.5 describe the design, operation and safety and maintenance and reliability of the proposed transmission system of the CPP.

4.7.2.1.3 GO-52, CPUC, Construction and Operations of Power and Communication Lines. The design and construction of the transmission facility of the CPP will be performed so as to meet or exceed the requirements of GO-52, CPUC. Section 4.2 describes the proposed design of the transmission facilities and Sections 4.3, 4.4, and 4.5 describe the operations and safety and reliability components of the transmission system. The operation of the CPP transmission system will also be compliant with GO-52, CPUC.

4.7.2.1.4 GO-95, CPUC, Rules for Overhead Electric Line Construction. The design and construction of the CPP transmission system will be carried out in compliance with GO-95, CPUC. Sections 4.0 and 4.5 describe the design, operation and maintenance and safety and reliability components of the proposed CPP transmission system and all of these elements will meet or exceed the applicable section of GO-95, CPUC.

4.7.2.2 Electric and Magnetic Fields

4.7.2.2.1 Decision 93-11-013, CPUC, CPUC Position on EMF Reduction. The CPUC Decision 93-11-013 created the California EMF Program. The EMF Program's charge is to

TABLE 4.7-1
APPLICABLE LORS

LORS	Description	Conformance (Section)
Federal	None Identified	
State		
Design and Construction		
GO-128,CPUC	All proposed transmission facilities will be designed and constructed in accordance with all applicable elements contained in GO-128, CPUC.	4.2, 4.3, 4.4
Title 8 CCR, Section 2700 et seq.	High Voltage Electrical Safety Orders	4.2, 4.3, 4.4, 4.5
GO-52, CPUC	Construction and Operations of Power and Communication Lines	4.2, 4.3, 4.4, 4.5
GO-95, CPUC	Rules for Overhead Electric Line Construction	4.0, 4.5
Electric and Magnetic Fields		
Decision 93-11-013, CPUC	CPUC position on EMF reduction	4.5.3
GO-131-D, CPUC	Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California	4.5.3
Hazardous Shock		
Title 8 CCR, Section 2700 et seq.	High Voltage Electrical Safety Orders	4.7.2.3.1
Communication and Interference		
47 CFR 15.25		4.7.2.4.1
GO-52, CPUC	Construction and Operations of Power and Communication Lines	4.2, 4.3, 4.4, 4.5
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.	4.7.2.4.3
Local	None Identified	
Industry Standards		
ANSI/IEEE 544-1994	Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines	4.7.4.1
ANSI/IEEE 80	IEEE Guide for Safety in AC Substation Grounding	4.7.4.2
NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C	Covers grounding methods for electrical supply and communications facilities.	4.7.4.3
ANSI/IEEE 693	Recommended Practices for Seismic Design of Substations	4.7.4.4

TABLE 4.7-1 (CONTINUED)
APPLICABLE LORS

LORS	Description	Conformance (Section)
IEEE 1119	Guide for Fence Safety Clearances in Electric-Supply Stations	4.7.4.5
IEEE 998	Direct Lightning Stroke Shielding of Substations	4.7.4.6
IEEE 980	Containment of Oil Spills for Substations	4.7.4.7

support research and provide education about whether exposure to EMF generated by the use of electricity can affect human health. Additionally, its goal is to foster a rational and fair approach to dealing with the potential hazards, if any, of exposure to EMF through research, policy analysis, education, and technical assistance. Since Decision 93-11-013 and its resulting EMF Program are focused on science and health, not on regulatory development.

CPP does not presently, nor does it foresee, any applicable compliance obligations for EMF-related LORS under this CPUC Decision.

Additional information on CPP and EMF are contained in Section 4.5.3.

4.7.2.2.2 GO-131-D, CPUC, Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California. Section X of GO-131-D, entitled Potential Exposure to Magnetic Fields (EMF), requires a description of the measures taken to reduce the potential exposure to EMF. CPP AFC Section 4.5.3 provides design and other specifications that demonstrate measures to reduce EMF exposure. This is for both the construction phase and the operational phase.

Given the CPP facility design and technology described in Sections 3 and 4, the CPP will be compliant with GO-131-D EMF rules.

4.7.2.3 Hazardous Shock

4.7.2.3.1 8 CCR 2700 et seq. High Voltage Electrical Safety Orders. The transmission interconnection will be designed and constructed in conformance with CPUC GO-95 and Title 8 California Code of Regulations (CCR) 2700 requirements. Therefore, hazardous shocks are unlikely to occur as a result of Project construction or operation.

4.7.2.4 Communication and Interference

4.7.2.4.1 47 CFR 15.25, Operating Requirements, Incidental Radiation. Corona may result in radio and television reception interference, audible noise, light, and production of ozone. A transmission line's field effects are the voltages and currents that may be induced in

nearby conduction objects. The project design, operations, and maintenance activities will comply with 47 CFR 15.25 to minimize the effect of any device emitting incidental radiation that causes interference to communications.

4.7.2.4.2 GO-52, CPUC, Construction and Operations of Power and Communication Lines. The construction, operation, and maintenance of power and communication lines will comply with GO-52 in order to prevent or mitigate any possible inductive interference.

4.7.2.4.3 CEC staff, Radio Interference and Television Interference (RI-TVI) Criteria (Kern River Cogeneration) Project 82-AFC-2, Final Decision, Compliance Plan 13-7. Corona-generated radio interference is most likely to affect the amplitude modulation (AM) broadcast band (535 to 1,605 kilohertz); frequency modulation (FM) radio is rarely affected. Only AM receivers located very near to transmission lines have the potential to be affected by interference. The CEC's RI-TVI mitigation requirements, developed and adopted by the CEC in past citing cases, will be adhered to in the construction, operation, and maintenance of the power lines.

4.7.3 Local

No local LORS governing the transmission facilities were identified.

4.7.4 Industry Standards

4.7.4.1 ANSI/IEEE 544-1994, Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines

Where required to do so and at its discretion otherwise, the CPP will follow the ANSI/IEEE 544-1994 standard procedures for the measurement of power frequency electric and magnetic fields from its AC power lines.

4.7.4.2 ANSI/IEEE 80, IEEE Guide for Safety in AC Substation Grounding

The transmission line will have shield or ground wires in place. The location of the shield wires in relation to conductors shall be in accordance with best industry practices and will comply with ANSI/IEEE80. The shield wire shall be extra high strength galvanized steel or copper-clad steel as determined by the location and the detailed design.

4.7.4.3 NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C

The preliminary design and all detailed design for grounding methods for electrical supply and communications facilities will comply with this code as appropriate.

4.7.4.4 ANSI/IEEE 693, IEEE Recommended Practices for Seismic Design of Substations

The design and construction of the CPP switchyard will be carried out in compliance with ANSI/IEEE 693, IEEE Recommended Practices for Seismic Design of Substations for zone 4 defined by the Uniform Building Code. AFC Section 3.2.2 describes the seismic conditions for the project.

4.7.4.5 IEEE 1119, IEEE Guide for Fence Safety Clearances in Electric-Supply Stations

The design and construction of the CPP switchyard will be carried out in compliance with IEEE 1119, IEEE Guide for Fence Safety Clearances in Electric-Supply Stations. The substation will be provided with security fencing as indicated in AFC Section 3.11.1.1.

4.7.4.6 IEEE 998, Direct Lightning Stroke Shielding of Substations

The design and construction of the CPP switchyard will be carried out in compliance with IEEE 998, Direct Lightning Stroke Shielding of Substations.

4.7.4.7 IEEE 980, Containment of Oil Spills for Substations

The design, construction, operation, and maintenance of the CPP switchyard will be carried out in compliance with IEEE 980, Containment of Oil Spills for Substations consistent with the requirements of PG&E in the power purchase agreement.

4.8 INVOLVED AGENCIES AND AGENCY CONTACTS

Agencies and organizations with jurisdiction over transmission are shown in Table 4.8-1.

TABLE 4.8-1
AGENCY CONTACTS

Agency/Address	Contact/Title	Telephone(s)/Email
Southern California Edison Transmission and Distribution Business Unit 2244 Walnut Grove Avenue Rosemead, CA 91770	Lawren Minor Project Manager/Contracts	626.302.8734 626.302.1152 (fax) LawrenMinor@sce.com
California Independent System 151 Blue Ravine Road Folsom, CA 95630	Judy (Nickel) Brown Project Manager	916.608.7062 jnickel@caiso.com