SECTION 5.0

Electric Transmission and Interconnection

5.1 Introduction

Section 5.0 discusses the transmission interconnection between the South Bay Replacement Project (SBRP), the existing SDG&E electrical grid, and the anticipated affects that operation of the SBRP will have on the flow of electrical power in and around the San Diego area. This analysis includes the following:

- The existing electrical transmission system in the immediate vicinity of SBRP.
- The proposed electrical interconnection between SBRP and the SDG&E owned electrical transmission grid.
- The proposed electrical transmission line alignments.
- The impacts of the interconnection of SBRP on the SDG&E owned and CAISO controlled transmission network.
- Potential nuisances (electrical, magnetic, audible noise, and corona effects).
- Transmission interconnection safety.
- Description of applicable laws, ordinances, regulations, and standards (LORS).

The SBRP Project consists of three phases:

- **The Construction Phase**—The first phase of the project will involve the demolition of existing structures and foundations associated with the former Liquefied Natural Gas (LNG) Facility, preparation of construction lay down areas, and the construction of the SBRP. Initial operations of SBRP will include an interim interconnection to the SDG&E transmission system through a 230 kV interconnection at the new South Bay 230 kV substation which will be constructed on approximately 0.6 acres, and an underground interconnection to the existing SDG&E South Bay (69/138 kV) substation.[1] The 230 kV bus will be interconnected to the SDG&E's planned new 230 kV transmission line that is currently being constructed as a part of the Otay Mesa Power Purchase Agreement Transmission Project (OMPPATP).
- **The Demolition Phase**—The second phase of the project will occur after the SBRP has achieved commercial operation. The construction activity during this phase will be the demolition of the existing SBPP facilities, excluding SDG&E's existing South Bay substation which will remain in service until the new substation is constructed.

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[1] San Diego Gas & Electric Company (SDG&E) was granted a Certificate of Public Convenience and Necessity (CPCN) for the Otay Mesa Power Purchase Agreement Transmission Project (OMPPATP). The CPCN is for the construction of two new 230 kilovolt (kV) electric transmission circuits to connect SDG&E's Miguel Substation with both the Sycamore Canyon Substation and the Old Town Substation in San Diego County. The circuit to the Old Town Substation is planned to pass within approximately 100 feet of the proposed SBRP. This project is under construction. The SBRP interconnection plan is based in part on interconnecting to this circuit.

- **The New Substation Phase**—The final phase of project will consist of the construction of the final SDG&E substation on approximately 6.5 acres south of and adjacent to the SBRP site (this includes 0.6 acres for the new 230 kV facilities at the new South Bay substation). This construction will be performed after the start up of the SBRP and demolition of SBPP. After the new SDG&E substation is completed, and the SBRP generator leads are attached to the new facilities, SDG&E could then initiate demolition activities for the South Bay substation, located north of the SBRP project site on the 115 acre SBPP site. These demolition activities, however, are not part of the scope of this AFC, but will be associated with a separate project of unknown timing and scope.

The Applicant is proposing a two step interconnection process for SBRP that involves an interim interconnection and a final interconnection. The reason an interim interconnection step is proposed is to ensure that interconnection can be secured by the proposed on-line date for the SBRP (2010). SDG&E has indicated that, given the nature of regulatory and other approval processes, the final substation facility may not be available in time to support the proposed on-line date for SBRP. Also, SDG&E holds certain obligations associated with a new substation as part of its Memorandum of Understanding (MOU) with the City of Chula Vista, but these obligations arise *after* the demolition of SBPP. The interim interconnection plan thus assures that the SBRP project will not conflict with the timing of obligations in the Chula Vista and SDG&E MOU. The MOU is included as Appendix 1A.

The existing SBPP is currently connected to SDG&E's existing 69/138 kV South Bay substation. Generation interconnection studies performed for SBRP have indicated that the SBRP should be interconnected at each of the three major transmission voltages (69 kV, 138 kV, and the new planned 230 kV) that will be available in the area. The interconnection of three generating units comprising SBRP to the SDG&E owned and CAISO controlled transmission grid will be accomplished by connecting each of the three generating units to a different voltage segment. The SBRP 230 kV interconnection will occur as part of the interim interconnection step at the new 230 kV substation located at the site of the future/final relocated South Bay substation. These facilities will not be altered during the final interconnection step.

The 'Final' interconnection referred to herein represents the anticipated future arrangement after SDG&E relocates its existing South Bay (69/138 kV) substation. Figures 5.1-1 and 5.1-2 show the one-line diagrams for both the interim and final interconnection substations configurations respectively. Figures 5.1-3 and 5.1-4 show the preferred route for the interim interconnection to the existing 69/138 kV SDG&E substation and an alternate route for this interim interconnection. These figures also show the physical layout of the new 230kV substation at which SBRP will also interconnect. This proposed interconnection will allow SBRP to serve the same electric demand and provide similar reliability and system benefits as the existing power plant.

Figure 5.1-5 shows the layout of the final interconnection of the SBRP to the relocated SDG&E Substation. This substation will replace the existing SDG&E South Bay Substation after demolition of the existing SBRP.

SDG&E is in the process of building its OMPPATP that will impact a number of transmission facilities in the vicinity of the SBRP. Appendix 5F provides a graphical representation of the chronological progression of both the SDG&E and the proposed SBRP.

efforts. Information used to create Appendix 5F was obtained from the OMPPATP EIS, an MOU between the City of Chula Vista and SDG&E, and discussions with SDG&E as a part of the interconnection process.

5.2 Electric Transmission Lines

This subsection discusses the existing transmission facilities in the vicinity of the SBRP project and the conceptual design of the interconnections.

5.2.1 Design

The SBRP 230 kV transmission interconnection will consist of a 230 kV overhead transmission line segment, measuring approximately 400 feet in length, and extending from the ST Generator Step-Up Transformer to the 230 kV bus at the at the new SDG&E South Bay substation located adjacent to the SBRP site (see Figures 5.1-3 and 5.1-4). The 400 feet long 230 kV overhead segments will consist of steel pole structures with overhead conductor and shield wires spanning between them. A single overhead transmission structure is anticipated to be required adjacent to the SDG&E interim (and final) substation, and will be constructed of galvanized steel with steel arms and vangs bolted or welded to the pole shafts. The structure will support insulators, hardware, conductor, and shield wire. The structure will be direct embedded or set on a concrete foundation as appropriate considering geologic conditions and structure function. It is anticipated that the structure will range from 60 feet to 80 feet in height, and will be designed in accordance with applicable codes and industry standards. It is anticipated that all overhead transmission conductors will be conventional ACSR (Aluminum Conductor Steel Reinforced) or AAC (All Aluminum Conductor). It is anticipated that all overhead shield wire will be stranded steel wire or OPGW (Optical Ground Wire).

The OMPPATP 230 kV transmission line (currently under construction by SDG&E) will be looped into this new South Bay substation. The new substation will be located approximately 700 ft from the proposed location for the overhead/underground transition pole associated with the OMPPATP 230 kV line. The 230 kV loop-in is anticipated to consist of a 1000-ft long, double-circuit underground transmission line segments.

The 69 kV and 138 kV interim interconnections will consist of underground transmission segments from the CT Generator Step-Up Transformers to SDG&E's existing 69/138 kV South Bay substation. For the preferred routes, lengths of the 69 kV segment will be approximately 2700 feet, and for the 138 kV segment will be approximately 2400 feet (see Figure 5.1-3).

When SDG&E relocates the existing South Bay substation, the 69 kV and 138 kV interim interconnections will be removed and replaced by shorter transmission segments to the new/relocated South Bay substation (see Figure 5.1-5). The underground segment lengths for the final routing configuration are anticipated to be approximately 600 feet for the 69 kV interconnection and 900 feet for the 138 kV interconnection.

The underground segments for the 138 kV and 69 kV circuits will consist of solid dielectric XLPE high voltage cables placed in concrete-encased duct banks. Depending on ampacity calculations relative to the thermal characteristics of the surrounding soil, final number and size of cables required, and spare conduit needs, the underground segments for different circuits could be placed in one wide duct bank or in multiple duct banks with up to ten feet of separation.

All underground transmission conductors will be conventional high voltage copper or aluminum cable with XLPE (Cross-Linked Polyethylene) insulation. Fiber optic communications cable may also be installed in the underground duct banks.

All overhead conductors and underground cables will be chosen and designed in accordance with industry standards and facility requirements.

5.2.2 Construction

5.2.2.1 Transmission Construction Schedule and Workforce

Construction of the three interconnection segments for the interim interconnection (69 kV, 138 kV, and 230 segments) is expected to start 18 months prior to commercial operations of the SBRP and will be completed in time to allow for start-up and testing of the generation facility.

The underground segments will be constructed by small, specialized crews skilled in duct bank construction, cable pulling, and cable terminating. The overhead segments will be constructed by small, specialized crews skilled in foundation construction, structure erection, and wire stringing.

At any one time, 8 to 10 workers can be expected onsite as part of the interconnection construction effort. It is expected that all skilled and unskilled labor needed to construct the overhead and underground segments will be available in the southern California area, with the possible exception of cable splicing personnel provided by the underground cable manufacturer. Each of the specialized crews will utilize different construction equipment, though only a few would be operating at any one time. The required equipment will likely consist of a large track hoe for trench excavation, a truck-mounted auger for foundation excavation, dump trucks for the removal of excavated material, concrete trucks, various types of material delivery vehicles, small to medium sized cranes, reel trailers and pulling equipment for underground cable, pulling and tensioning equipment for overhead wire, and common utility vehicles.

5.2.2.2 Construction Plan

Several phased tasks will be required to construct the interconnection segments between the proposed generating facility and the SDG&E substation facilities. These will include the following:

- Surveying
- Trench excavation
- Duct bank construction and backfill
- Underground cable pulling and terminating
- Foundation excavation and construction
- Steel structure framing and erection
- Overhead cable stringing
- Testing

- Energization

The trenches for the underground segments for the 69 kV and 138 kV cables will be excavated by a track hoe. The excavated trench for the duct bank will be approximately 6 inches to 1 foot wider than the final designed duct bank, and will likely range from 60 to 80 inches deep. PVC conduits will be placed approximately 3 inches apart within the duct bank and at least 3 inches from the top, bottom, and sides of the duct bank. Four conduits will be installed for each circuit. Three of the conduits will be used for each three-phase circuit, with the fourth being available as a spare. The PVC conduits will be encased in concrete, with the top of the duct bank typically 36 inches below grade. Backfill above the duct bank will consist of native soils, granular backfill, or concrete backfill. It is anticipated that the use of pulling manholes will not be required. The underground transmission cables will be pulled through the conduits and terminated at each end.

The 400 feet long, overheard 230 kV segment (between the high-side of the STG step-up transformer and the 230 kV bus at the new South Bay substation will consists of one new transmission pole structure and an H-frame structure adjacent to the generation step-up transformer with overhead conductor and shield wires spanning between them. Each structure will be either direct embedded or set on a concrete foundation. A drill rig will be used to excavate the holes. Direct embedded structures will placed in the holes and backfilled with sand or concrete. Where a concrete foundation is required, a reinforcing/anchor bolt cage will be lowered into the hole before the concrete is placed. After an adequate period for concrete curing, the steel structures will be placed atop the foundations and secured with the anchor bolts. Wire will then be strung between the structures and terminated on the adjacent electrical equipment.

Once all facilities have been installed, field acceptance testing will be performed to determine if any damage or defects have occurred as a result of installing, terminating, or splicing the cables and overhead wires. Energization will occur upon the satisfactory completion of field acceptance testing and SDG&E's completion of their substation facilities.

5.2.2.3 Transmission Line Construction Safety Practices

Construction of the proposed interim and final interconnection segments will be performed in a manner that meets or exceeds the safety standards, rules, regulations, and requirements of California General Order No. 95 (GO95), California General Order No. 128 (GO128), the National Electrical Safety Code (NESC), US Occupational Safety and Health Administration (OSHA), the State of California, and the City of Chula Vista. In addition, the safety program of the selected contractor(s) will be reviewed and approved by the facility prior to any construction activities.

5.2.3 Routing

In the interim configuration constructed as part of this project, there will be one 69 kV and one 138 kV interconnection to SDG&E's existing 69/138 kV South Bay substation and one 230 kV interconnection to SDG&E's new South Bay substation.

The final routing of each transmission interconnection segment within the identified corridors, will be determined after SDG&E completes the conceptual design of their substation facilities, and will be conducted in coordination with the Port. The final routing will be based upon the criteria of minimizing circuit lengths, avoiding conflicts with other plant facilities, avoiding conflicts with the SDG&E facilities and Port facilities requirements, and minimizing impacts to the public.

5.2.3.1 230 kV Interconnection Route

An overhead transmission line approximately 400 feet in length will be used for connecting the 230 kV side of the ST Generator Step-Up Transformer to a new 230 kV bus at the new South Bay substation located immediately south of the new generation facility. SDG&E will loop their proposed OMPPATP 230 kV transmission line into the new substation to connect it to the grid. This work is anticipated to consist of two parallel underground duct banks approximately 1000 feet in length from the new substation to the vicinity of an overhead/underground transition structure and splicing manhole that SDG&E are installing as part of their OMPPATP. This route is shown on Figures 5.1-1 and 5.1-2.

5.2.3.2 69/138 kV Interconnection – Preferred Route

The preferred routing for the 69 and 138 kV interconnections is shown on Figure 5.2-1. The 69 kV and 138 kV circuits would be routed in an underground duct bank from the two Combustion Turbine Step-Up Transformers to SDG&E's existing South Bay 69/138 kV Substation. The preferred route consists of traversing north under the Combustion Turbine building and between the Heat Recovery Steam Generators to the northern boundary of the plant property. A double circuit duct bank would be used on Port property until the circuits split going into SDG&E's existing substation. The route generally follows an abandoned gas pipeline that will be removed as part of this project. The route lengths are approximately 2700 feet for the 69 kV circuit and 2400 feet for the 138 kV circuit. This route is preferred as it is shortest in length and that it avoids potential conflicts with the facilities in SDG&E's easement.

5.2.3.3 69/138 kV Interconnection – Alternate Route

An alternate routing for the 69 and 138 kV interconnections using SDG&E right-of-way is shown on Figure 5.2-2. As in the preferred alternative, the 69 kV and 138 kV circuits would again be routed in an underground duct bank from the two Combustion Turbine Step-Up Transformers to SDG&E's existing South Bay 69/138 kV Substation. The alternate route consists of going east within the plant access road to the eastern boundary of the plant property to an existing SDG&E transmission easement. A double circuit duct bank would be used in the SDG&E easement until the circuits split going into the existing substation. The route lengths are approximately 3400 feet for the 69 kV circuit and 3500 feet for the 138 kV circuit. This is not the preferred route because it is longer in length and would require SDG&E approval for an overlapping easement.

5.3 Substation Facilities

5.3.1 Design

SDG&E currently operates the existing 138/69 kV South Bay substation located just north of the existing SBRP. Independent of whether the SBRP is constructed, SDG&E plans to relocate this substation somewhere locally and with a preference for a location in the bay front west of Interstate 5 (I-5). This preference is described in the MOU between SDG&E and the City of

Chula Vista (see Appendix 1A). According to MOU between SDG&E and the City of Chula Vista, the existing South Bay substation will be removed, but only after the SBPP is removed from service. Therefore, the relocation of these facilities may occur well after the SBRP becomes operational. During the interim interconnection phase SBRP, only minor modifications will be required at the existing 69/138 kV substation to the north to interconnect the project (see Figure 5.1-1). This interim interconnection is contemplated in the Interconnection Facilities Study performed for this project by SDG&E and reviewed by the CAISO. Both the 69 kV and 138 kV underground interconnection segments would terminate at existing open bay positions. Each interconnection would require the addition of two circuit breakers, four disconnect switches, and miscellaneous bus and control equipment.

SDG&E will build a new multi-voltage (69 kV, 138 kV and 230 kV) South Bay substation to facilitate the multi-voltage interconnection of the SBRP and to accommodate load growth in the San Diego area (see Appendix 5E). The proposed new South Bay substation includes room for additional bays at all voltage level to accommodate future SDG&E transmission facilities that may required to serve the San Diego load growth (both in near and distant future) and to preserve the reliability of the local transmission system (see Figure 5.1-2). SDG&E is working with the Applicant and the CAISO in the conceptual design phase of the new substation project as a part of the Interconnection Facilities Studies process. The new substation may require limited utilization of Gas Insulated Substation (GIS) technology at the 230 kV level to enable the generation facilities, the new 230 kV facilities, and the future 69/138 kV relocated facilities to all fit within the footprint of the former LNG site without encroaching of SDG&E's 300-foot transmission easement. It should be noted however, that the size of the substation and need to use of the GIS equipment is attributed to both the needs of the SBRP and the needs of the San Diego area future load growth, not solely driven by the SBRP.

In total, 6.5 acres, or 283,140 square feet are allocated for the new substation facilities, compared to approximately 6 acres for the existing substation.

5.4 Interconnection Studies

At the request of the Applicant, SDG&E initially performed a System Impact Study (SIS) to identify the feasibility and the transmission system impacts associated with the interconnection of the SBRP to the SDG&E transmission grid. The study deemed the interconnection to be feasible and that it does not require any network upgrades to the SDG&E existing transmission system (existing transmission lines outside the South Bay substation). A copy of the final System Impact Study Report dated October 28, 2005 along with the SDG&E transmittal letter is provided in Appendix 5A. The CAISO acceptance letter for the SIS is included in Appendix 5B.

SDG&E has subsequently performed an Interconnection Facilities Study for the SBRP, which included power flow, transient stability, post-transient stability, and short circuit analyses. The study reconfirmed the results of the SIS and concluded that there are no planning criteria violations due to the addition of SBRP, and hence no Delivery Upgrades would be required. A copy of the preliminary draft version of the Interconnection Facilities Study dated April 7, 2006 is included in Appendix 5C. The Applicant's response letter to SDG&E (with copies to the CAISO) is included in Appendix 5D. This study is currently being finalized by SDG&E.

5.5 Transmission Line Safety and Nuisance

As part of an MOU between the City of Chula Vista and SDG&E, SDG&E plans to relocate the existing South Bay Substation (see Appendix 1A). This AFC proposes to relocate the new South Bay substation adjacent to the SBRP (see Figure 5.1-5). The existing transmission lines are and will continue to be owned and maintained by SDG&E. SDG&E is also in the process of adding, repositioning, and replacing sections of the transmission lines in the vicinity as part of their OMPPATP project (and the MOU). The most significant modification SDG&E will be making in the area involves adding a new 230 kV line, removing two existing 138 kV transmission lines, and undergrounding significant portions of the 230 and 138 kV lines. The segments and stages of each line segment is described in Figure 5.5-1.

This section discusses safety and nuisance issues associated with the proposed electrical interconnection of SBRP with the electrical grid. The scope of the transmission line system safety study for the SBRP project is intended to reveal potential hazards resulting from Electric and Magnetic Fields (EMF) as a result of power transmission via the existing transmission lines that serve both the existing SBPP and the SBRP. The information and findings of this safety study is explained in the following paragraphs of this section.

5.5.1 Existing Conditions

The existing SBPP is located in the City of Chula Vista, and the SBRP will be located adjacent and to the south of the SBPP. The surrounding area includes heavy and light industrial, commercial and marine environments, and buildings and facilities for recreational and residential uses, and numerous overhead high voltage power lines and towers.

SBPP provides energy to several SDG&E substations including the existing South Bay 69/138 kV substation. There are three 138 kV transmission lines and three 69 kV transmission lines that currently travels north out of the existing South Bay substation towards downtown San Diego. In addition, there are two 138 kV transmission lines and three 69 kV transmission lines that currently run south and southeast out of the South Bay Substation. Most of these transmission lines are grouped within common easement corridors. Figure 5.5-1 shows the existing network of substations, transmission lines and power plants as well as their locations relative to residential areas and schools. The nominal easement widths and approximate distances to the closest residences and schools are provided in Table 5.5-1.

TABLE 5.5-1
Proximity to Public

	Segment					
	A	B	C	D	E	F
Nominal Easement Width (ft)	250	300	150	150	N/A	N/A
Distance to Closest Residence (ft)	150	500	300	300	400’	150
Distance to Closest School (ft)	700	2,000	1,200	1,200	500	800

5.5.2 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. Transmission lines are designed with standard practices and components designed to reduce or eliminate the effects of corona. Field effects are the voltages and currents that may be induced in nearby conducting objects. A transmission line's 60-hertz (Hz) electric and magnetic fields can cause these effects.

5.5.2.1 Audible Noise and Radio/Television Interference

Corona is a function of the voltage of the line, the diameter of the conductor, and the condition of the conductor and 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. Also, 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 principal design concern for transmission lines having voltages of 345 kV and above.

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

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

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

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

It is difficult to define “acceptable” levels of noise on a signal as “acceptable” depends on individual perception. One way to measure the acceptability of radio or TV noise can be explained in terms of the signal-to-noise ratio. The signal-to-noise ratio is defined as the ratio of the average signal power to the average noise power. A signal-to-noise ratio above 20 is generally considered to provide acceptable radio reception. For TV reception, a signal-to-noise ratio of 30 to 40 provides acceptable reception.

5.5.2.2 Induced Current and Hazardous/Nuisance Shock

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 electric field strength, the size and shape of the conducting object, and the object-to-ground resistance. Examples of measured induced currents in a 1-kV/m electric field are about 0.016 milliamperes (mA) for a person, about 0.41 mA for a large school bus, and about 0.63 mA for a large trailer truck.

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 to ground. Shocks are classified as below-perception, above-perception, secondary, and primary. The mean perception level is 1.0 mA for a 180-pound man and 0.7 mA for a 120-pound woman. Secondary shocks cause no direct physiological harm, but may annoy a person and cause involuntary muscle contraction. The lower average secondary-shock level for an average-sized man is about 2 mA.

Primary shocks can be harmful. Their lower level is described as the current at which 99.5 percent of subjects can still voluntarily “let go” of the shocking electrode. For the 180-pound man this is 9 mA; for the 120-pound woman, 6 mA; and for children, 5 mA. The NESC specifies 5 mA as the maximum allowable short-circuit current to ground from vehicles, trucks, and equipment near transmission lines.

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

Magnetic fields can also induce voltages and currents in conducting objects. Typically, this requires a long metallic object, such as a wire fence or aboveground pipeline that is grounded at only one location. A person who closes an electrical loop by grounding the object at a different location will experience a shock similar to that described above for an ungrounded object. Mitigation for this problem is to ensure multiple grounds on fences or pipelines, especially those that are orientated parallel to the transmission line.

Where railroads are crossed or are parallel to the transmission line, coordination is required with the railroad company to ensure that the magnetically induced voltages and currents in the rails do not interfere with railroad signal and communications circuits, which can be transmitted through the rails.

Induced current or spark discharge shocks can occur under certain conditions, in fields associated with 230 kV or higher voltage transmission lines, when a person comes into contact with an object in an electric field. These resulting short-term or long-term effects are the possible nuisances from electric fields. The grounding of nearby metal objects reduces the potential for these effects.

5.5.2.3 Electric and Magnetic Fields

Operating power lines, like the energized components of electrical motors, home wiring, lighting, and all other 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, meaning that the intensity and orientation of the field changes 60 times per second.

The 60-Hz power line fields are considered to be extremely low frequency. Other common frequencies are AM radio, which operates up to 1,600,000 Hz (1,600 kHz); television, 890,000,000 Hz (890 MHz); cellular telephones, 900,000,000 Hz (900 MHz); microwave ovens, 2,450,000,000 Hz (2.4 GHz); and X-rays, about 1 billion, billion (10^{18}) hertz. Higher frequency fields have shorter wavelengths and greater energy in the field. Microwave wavelengths are a few inches long and have enough energy to cause heating in conducting objects. High frequencies, such as X-rays, have enough energy to cause ionization (breaking of molecular bonds). At the 60-Hz frequency associated with electric power transmission, the electric and magnetic fields have a wavelength of 3,100 miles and 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. Electric fields are easily shielded by most objects, including trees, fences and buildings. 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 steady 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 terms of amperes, through the conductors. The magnetic field strength is 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 and, therefore, the strength of the magnetic field rapidly decreases as distance is increased from the conductor. Thus, like the electric field, the magnetic field strength declines as the distance from the conductor increases, though magnetic fields are not shielded by most materials. Magnetic fields are expressed in units of milligauss (mG). The amperes and, therefore, the magnetic field around a transmission line fluctuate daily and seasonally as the usage of electricity varies.

Considerable research has been conducted over the past 30 years on the possible biological effects and human health effects from EMF. This research has produced many 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, most states, including California, 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.

5.5.3 EMF and Audible Noise Assessment – Assumptions and Calculations

Along the existing transmission line corridors, there were three critical segments selected for modeling. EMF measurement points within Segments A, C, and D, as shown on Figure 5.5-1, were selected for analysis due to the magnitude of electric current and the proximity to residential neighborhoods and elementary schools. Segment B was not modeled due to an inconsistent cross-section and a lengthy distance to schools and residences. Field strengths at the edge of the Segment B right-of-way are expected to be similar to those in Segment C. Segments E and F were not modeled because their field strengths are expected to be much smaller than in the other segments. Segment E consists of only one 230 kV underground circuit which is a considerable distance from the project site and Segment F consists of only one 69 kV circuit.

The ENVIRO program developed by the Electric Power Research Institute (EPRI) was used to calculate the electric and magnetic fields for the most significant transmission line right-of-way (ROW) cross section configurations that carry power generated by the SBPP. The ENVIRO program is used to predict values of electric and magnetic fields that have been confirmed by field measurements by EPRI and numerous utilities. To estimate the maximum EMF, calculations are performed at mid-span where the conductor is at its lowest point between structures, and at a height of 1 meter above ground.

The study compared the field strengths of the "before" (pre-project) case to the field strengths in the "after" (post-project) case. The "before" case assumes the existing SBPP is operating at capacity and the OMPPATP 230 kV line is energized, but is prior to the relocation of the SDG&E substation. The "after" case assumes the "interim" condition where the new SBRP is operating at capacity and is interconnected to the grid at both the existing SDG&E South Bay 69/138 kV Substation and the new SDG&E 230 kV GIS Substation. These cases are shown as Stage 2 and Stage 3 respectively on Fig 5.5-1. Since the reconfiguration of the SDG&E transmission lines associated with the final configuration (Stage 4) is expected to have negligible EMF impacts, the projects' EMF analysis for the interim configuration is also valid for the final configuration. Graphical representations of each cross-section are shown in Figures 5.5-2, 5.5-3, 5.5-4, and 5.5-5.

Each "before" and "after" case was modeled within the ENVIRO software for a 600-foot cross-section centered at the northern or eastern boundary of the existing SDG&E easement.

The ENVIRO output consists of field strengths reported at 10-foot intervals across the entire section.

The calculated numerical and graphical output from the ENVIRO program is included in Appendix 5G. The maximum electric, magnetic, and (fair condition) audible noise field strengths reported within the easements and at the edge of the easements are summarized in Table 5.5-2.

TABLE 5.5-2
EMF Computations

	SEGMENT A		SEGMENT C		SEGMENT D	
	Max. Within ROW	Max. At Edge of ROW	Max. Within ROW	Max. At Edge of ROW	Max. Within ROW	Max. At Edge of ROW
Electric Field (kV/m) Profile “Before”	.781	.503	8.394	.871	3.235	.917
Electric Field (kV/m) Profile “After”	.781	.503	7.110	.490	3.161	.915
Magnetic Field (mG) Profile “Before”	33.24	18.94	227.80	67.75	67.75	47.74
Magnetic Field (mG) Profile “After”	27.89	18.88	199.25	16.65	93.40	64.74
Audible Noise (dB) Profile “Before”	15.5	12.6	78.5	67.6	23.3	22.0
Audible Noise (dB) Profile “After”	15.5	12.6	78.5	67.6	18.4	17.3

5.5.4 EMF and Audible Noise Assessment – Results

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

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

5.5.4.1 Audible Noise and Radio/Television Interference

The intensity of noise levels and potential for radio and TV interference from transmission lines is related to the corona performance of the lines. Corona performance can be predicted using empirical equations that have been developed from measurements on several high-voltage lines. The ENVIRO program utilizes an empirical equivalent method to analyze corona performance that agrees with long-term data. Outputs of the program include audible noise predictions under both fair and foul weather conditions. These outputs are indices of corona performance. Appendix 5G, Table A includes the audible noise results under a typical “Fair” weather condition.

For Segments A and C the audible noise was essentially unchanged from the “before” to the “after” case and for Segment D the audible noise was reduced approximately 11 percent. The study indicates that the audible noise should not be an issue of concern as a result of the SBPP project.

5.5.4.2 Electric and Magnetic Fields

For Segment A the electric field strength did not change. For the magnetic field, the maximum value within the ROW showed a 16 percent decrease and the maximum value at the edge of the ROW was essentially unchanged.

For Segment C the electric field maximum field strengths showed a 43 percent decrease at the edge of the ROW and a 15 percent decrease for the maximum value within the ROW. For the magnetic field, the maximum value within the ROW showed a 12 percent decrease and the maximum value at the edge of the ROW showed a 75 percent decrease.

For Segment D the electric field maximum value within the ROW showed a 2 percent decrease and the maximum value at the edge of the ROW was essentially unchanged. For the magnetic field, the maximum value within the ROW showed a 38 percent increase and the maximum value at the edge of the ROW showed a 36 percent increase.

5.5.5 Conclusion on EMF and Audible Noise

Several states have established regulatory limits on electric and magnetic field strengths at the edge of the right-of-way. For electric fields, these limits vary from 1.0 kV /m to 2.0 kV /m at the edge of the ROW. For magnetic fields, these limits vary from 150 mG to 250 mG at the edge of the ROW. The California Energy Commission does not presently specify any limits on electric or magnetic fields.

As shown in Table 5.5-2, the maximum field strengths within the ROW and at the edge of the ROW were lower in the “after” cases for each cross-section except for the magnetic fields in Segment D. Although Segment D showed an increase in magnetic field strength, the maximum value predicted at the edge of the ROW for the “after” case (64.74 mG) is still well below the 150 mG to 250 mG levels established by states that do have regulatory limits. The maximum predicted value for electric field strength at the edge of the ROW (0.915 kV /m) is below the 1.0 kV /m to 2.0 kV /m levels established by those states that do have regulatory limits.

Additionally, the output from the ENVIRO program (included in Appendix 5G) predicts that the maximum electric field strength will be below 0.04 kV /m and the maximum magnetic field strength will be below 3 mG at distances greater than 300 feet from the northern and eastern boundaries of the SDG&E ROW. As shown in Figure 5.5-1 and summarized in Table 5.5-1, there are no schools and only a few residences within 300 feet of the affected transmission lines.

5.5.6 Mitigation Measures

The potential impacts and cumulative impacts due to the project are minor. SDG&E already maintains its transmission lines to meet the requirements of their standard EMF reduction guidelines. All new lines will also meet those guidelines. As a result, no additional mitigation measures are required.

5.6 Applicable Laws, Ordinances, Regulations, and Standards (LORS)

This section provides a list of applicable laws, ordinances, regulations, and standards (LORS) that apply to the proposed transmission line, substations and engineering. 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."

The existing transmission lines associated with the South Bay Substation have been designed, operated and maintained in accordance with applicable guidelines. Relocated and new transmission lines associated with the SBRP and the relocated South Bay Substation will similarly be designed, operated, and maintained. As discussed in Section 5.5.5, there are no significant audible noise, radio and TV interference, or EMF impacts due to the Project. Thus, the transmission lines will remain in compliance with existing LORS.

5.6.1 Design and Construction

Table 5.6-1 lists the applicable LORS for the design and construction of the proposed transmission line and substations.

TABLE 5.6-1
Design and Construction LORS

LORS	Applicability	AFC Reference
GO-95, CPUC, "Rules for Overhead Electric Line Construction"	CPUC rule covers required clearances, grounding techniques, maintenance, and inspection requirements.	Section 5.2
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 installation and equipment to provide practical safety and freedom from danger.	Section 5.2
GO-128, CPUC, "Rules for Construction of Underground Electric Supply and Communications Systems"	Establishes requirements and minimum standards to be used for the station AC power and communications circuits.	Section 5.2
GO-52, CPUC, "Construction and Operation of Power and Communication Lines"	Applies to the design of facilities to provide or mitigate inductive interference.	Section 5.2
ANSI/IEEE 693, "IEEE Recommended Practices for Seismic Design of Substations"	Recommends design and construction practices.	Section 5.3
IEEE 1119, "IEEE Guide for Fence Safety Clearances in Electric-Supply Stations"	Recommends clearance practices to protect persons outside the facility from electric shock.	Section 5.3
IEEE 998, "Direct Lightning Stroke Shielding of Substations"	Recommends protections for electrical system from direct lightning strokes.	Section 5.3
IEEE 980, "Containment of Oil Spills for Substations"	Recommends preventions for release of fluids into the environment.	Section 5.3

5.6.2 Electric and Magnetic Fields

The applicable LORS pertaining to EMF interference are tabulated in Table 5.6-2.

TABLE 5.6-2
Electric and Magnetic Field LORS

LORS	Applicability	AFC Reference
Decision 93-11-013, CPUC	CPUC position on EMF reduction.	Section 5.5.2.3
GO-131-D, 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.	Section 5.2 Section 5.5.2.3
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.	Section 5.5.3

5.6.3 Hazardous Shock

Table 5.6-3 lists the LORS regarding hazardous shock protection that apply to the project.

TABLE 5.6-3
Hazardous Shock LORS

LORS	Applicability	AFC Reference
8 CCR 2700 et seq. "High Voltage Electrical Safety Orders"	Establishes essential requirements and minimum standards for installation, operation and maintenance of electrical equipment to provide practical safety and freedom from danger.	Section 5.2 Section 5.5
ANSI/IEEE 80, "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	Section 5.3
NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C.	Covers grounding methods for electrical supply and communications facilities.	Section 5.2 Section 5.5.2.2

5.6.4 Communications Interference

The applicable LORS pertaining to communication interference are tabulated in Table 5.6-4.

TABLE 5.6-4
Communications Interference LORS

LORS	Applicability	AFC Reference
47 CFR 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.	Section 5.2 Section 5.5.2.1
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.	Section 5.2 Section 5.5.2.2

TABLE 5.6-4
Communications Interference LORS

LORS	Applicability	AFC Reference
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 citing cases.	Section 5.2 Section 5.5.2.1

5.6.5 Fire Hazards

Table 5.6-5 tabulates the LORS governing fire hazard protection for the SBRP project.

TABLE 5.6-5
Fire Hazard LORS

LORS	Applicability	AFC Reference
14 CCR Sections 1250-1258, "Fire Prevention Standards for Electric Utilities"	Provides specific exemptions from electric pole and tower firebreak and electric conductor clearance standards, and specifies when and where standards apply.	Section 5.2
ANSI/IEEE 80, "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	Section 5.3
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).	Section 5.2

5.6.6 Jurisdiction

Table 5.6-6 identifies national, state, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, and/or enforce the above-referenced LORS. Table 5.6-6 also identifies the associated responsibilities of these agencies as they relate to the construction and operation of SBRP. For informational purposes, the list of applicable permits that would be required, but for the commission exclusive siting jurisdiction, are as follows.

TABLE 5.6-6
Jurisdiction

Agency or Jurisdiction	Responsibility
CEC	Jurisdiction over new transmission lines associated with thermal power plants that are 50 megawatts (MW) or more (Public Resources Code [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).
FAA	Establishes regulations for marking and lighting of obstructions in navigable airspace (AC No. 70/7460-1G).
Local Electrical Inspector	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity (NFPA 70).

5.7 References

California Energy Commission. Rules of Practice and Procedure and Power Plant Site Certification Regulations.

California Public Service Commission, Decision 93-11-013.

California Public Service Commission, General Order 52—Construction and Operation of Power and Communication Lines.

California Public Service Commission, General Order 95—Rules for Overhead Electric Line Construction.

California Public Service Commission, General Order 128—Rules for Construction of Underground Electric Supply and Communications Systems.

California Public Service Commission, General Order 131D—Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities.

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

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

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.

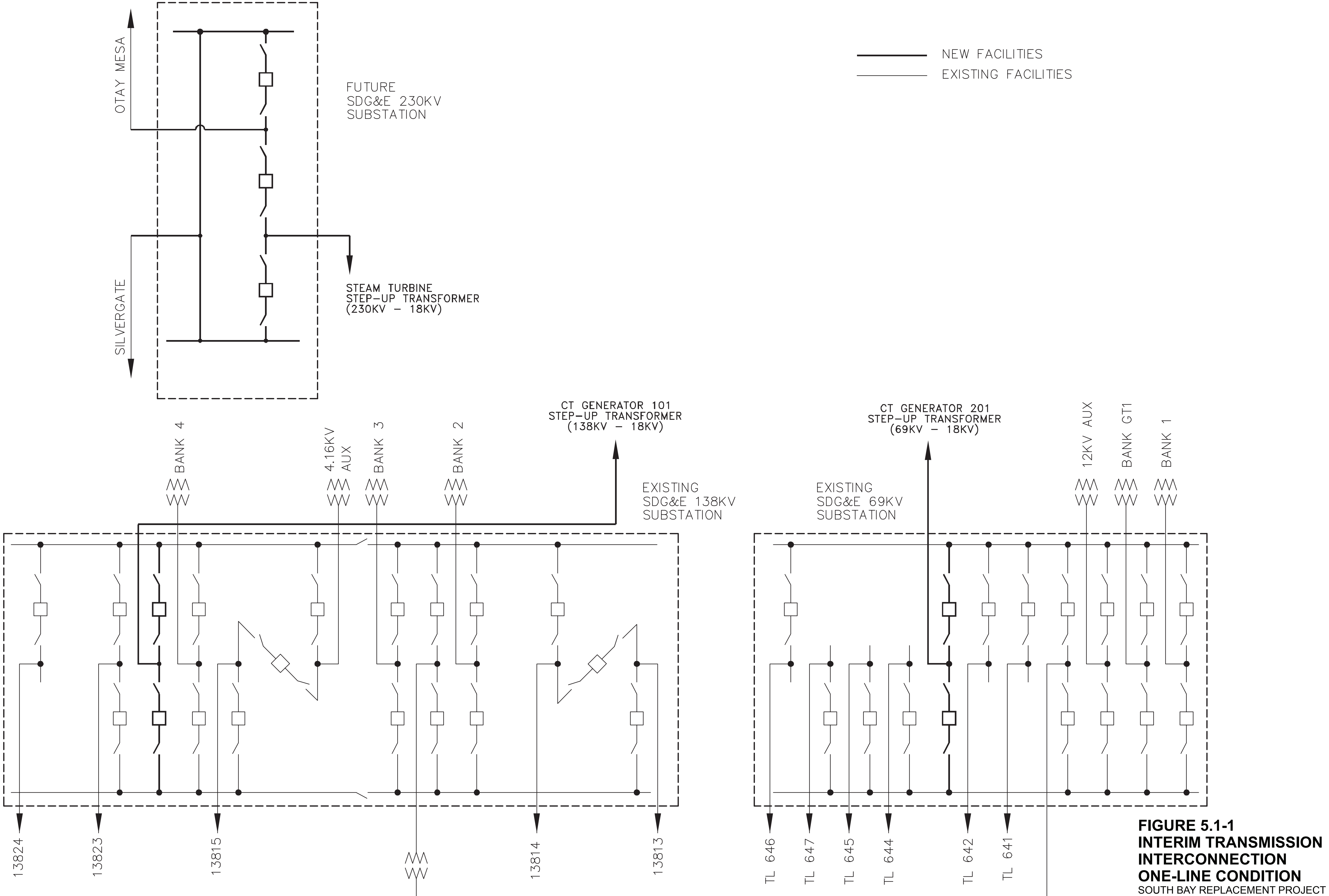
Southwire. *Overhead Conductor Manual*.

U.S. Department of Energy. 1989. *Electrical and Biological Effects of Transmission Lines, A Review*. Bonneville Power Administration, Portland, Oregon. June.

California EMF Consensus Group. Issues and Recommendations for Interim Response and Policy Regarding Power Frequency EMFs. 1992.

California Energy Commission (Commission). High Voltage Transmission Lines, Summary of Health Effects Studies. 1992.

California Public Utilities Commission (CPUC). Order Instituting Investigation (I.91-01-0120). 1991.



Source: Black and Veatch, 05/19/06

FIGURE 5.1-1
INTERIM TRANSMISSION INTERCONNECTION ONE-LINE CONDITION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

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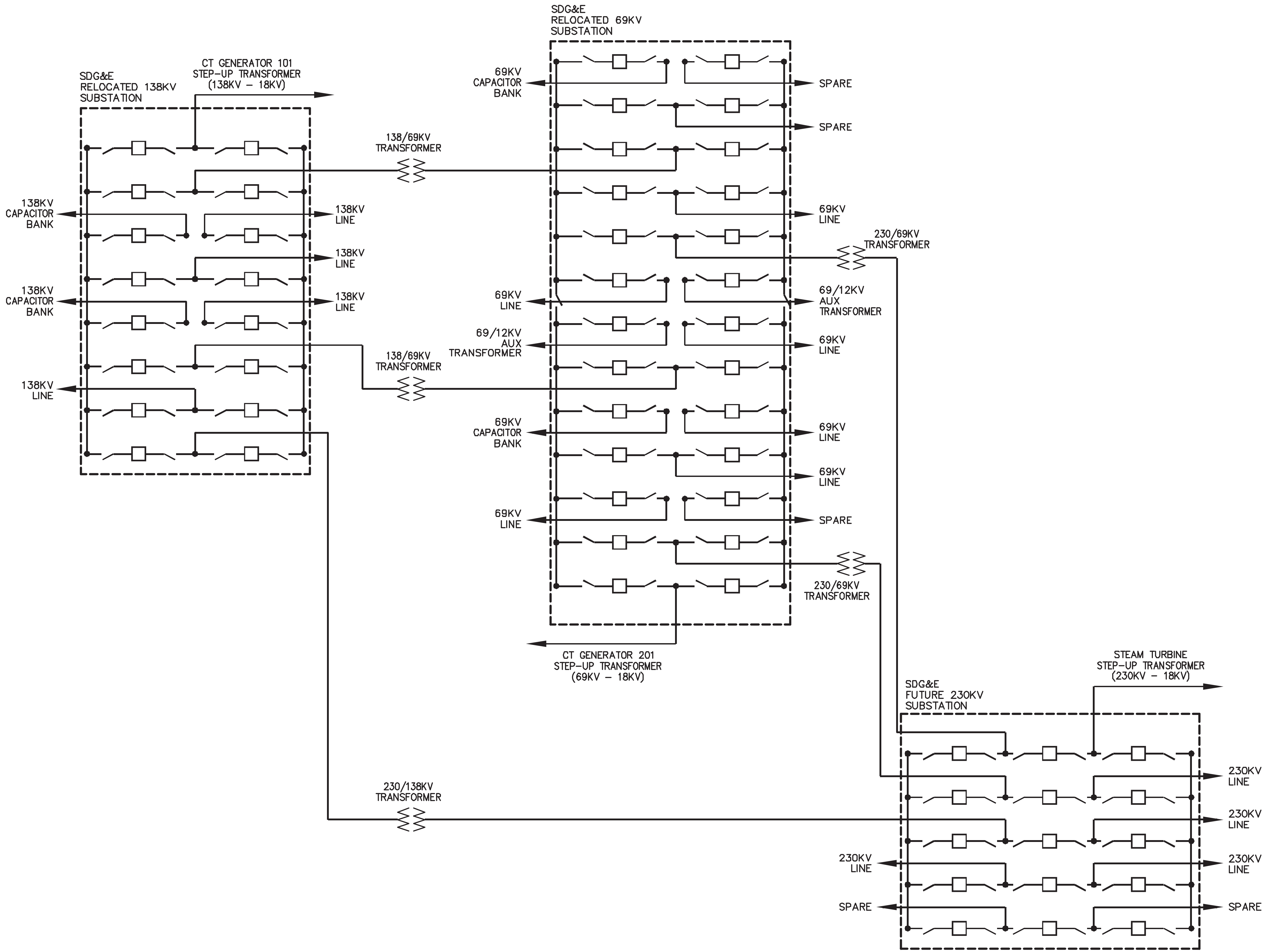

Source: Black and Veatch, 05/19/06

FIGURE 5.1-2
FINAL TRANSMISSION INTERCONNECTION ONE-LINE CONDITION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

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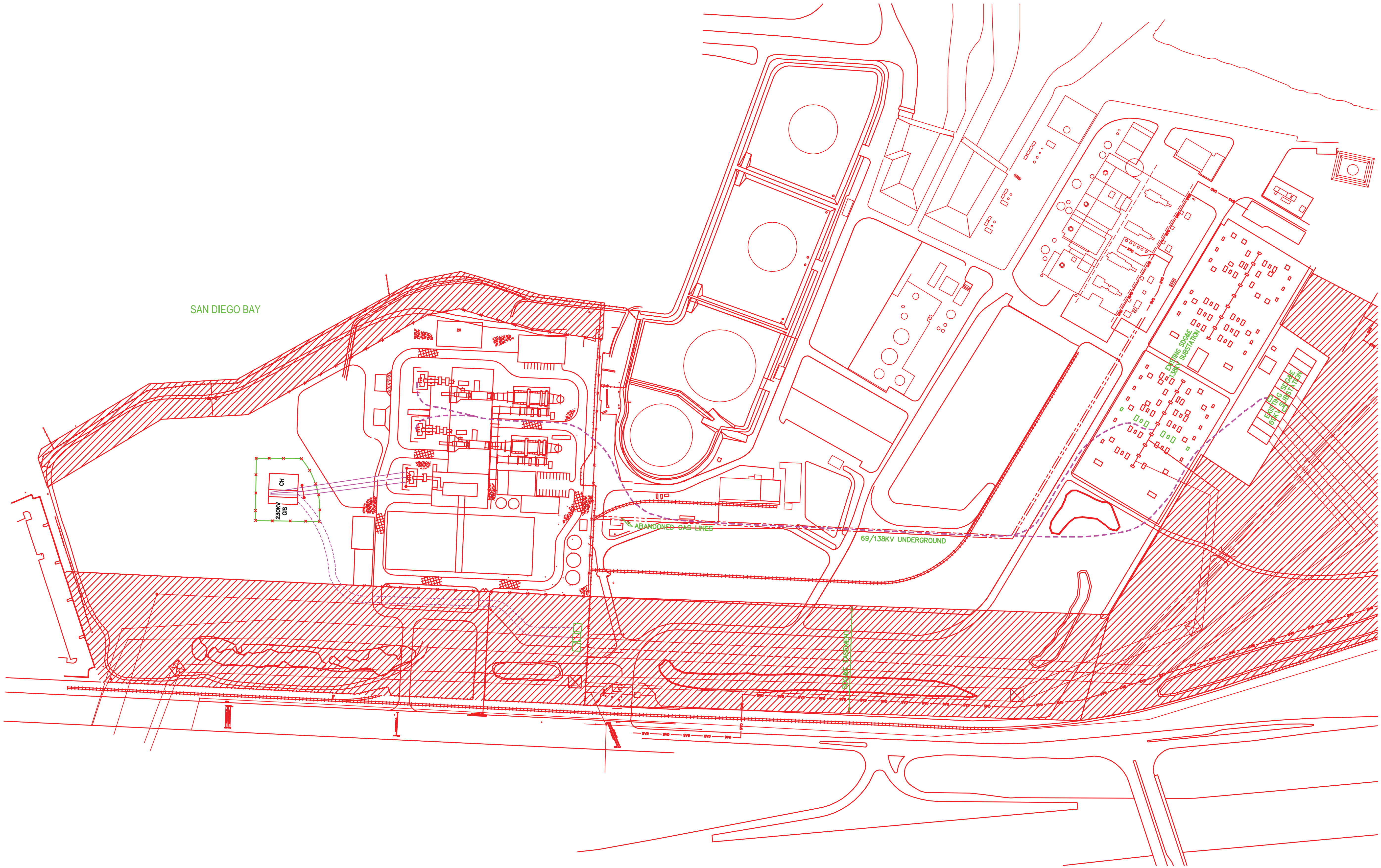


Source: Black and Veatch, 05/01/06

FIGURE 5.1-3
PREFERRED INTERIM TRANSMISSION INTERCONNECTION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

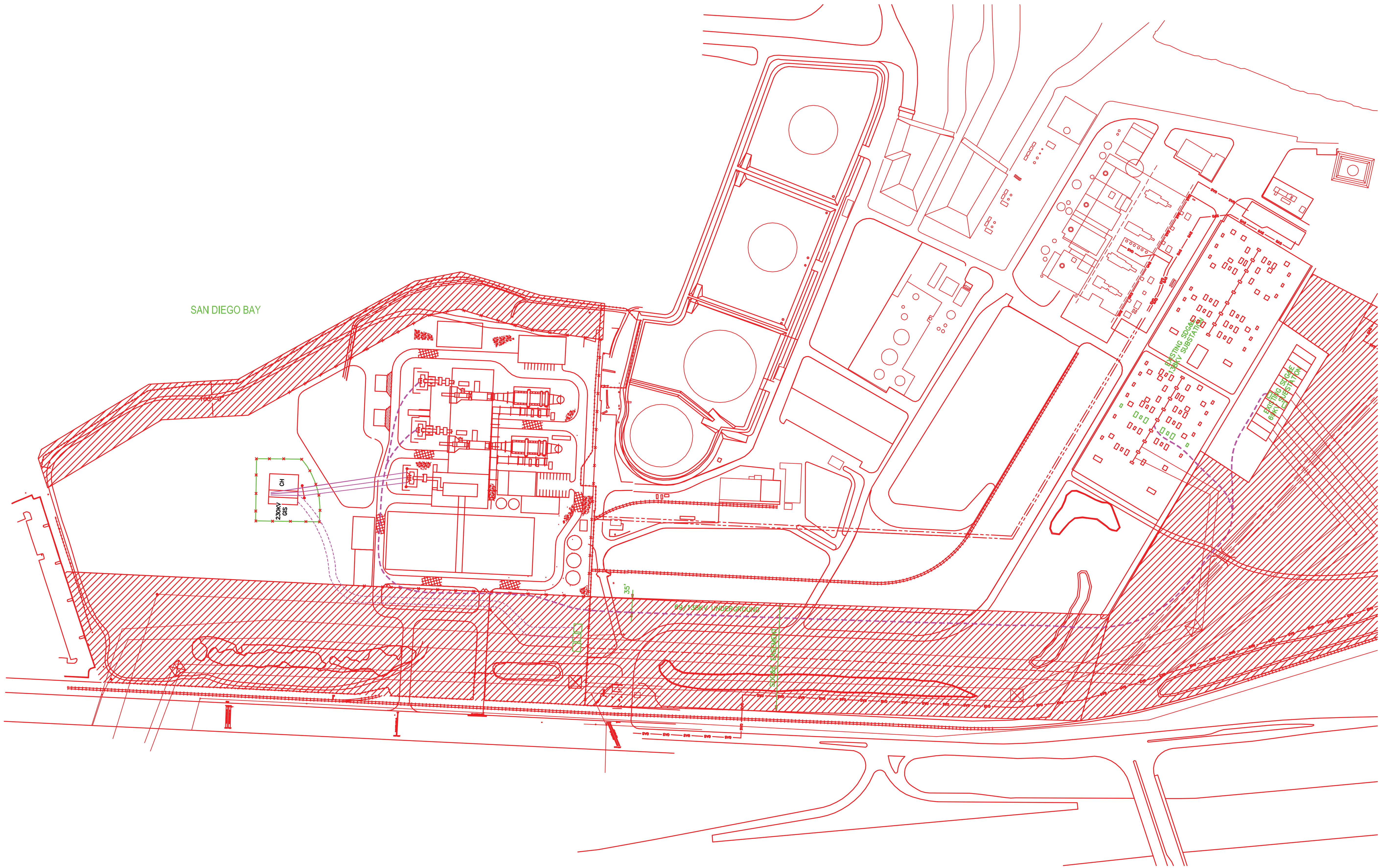
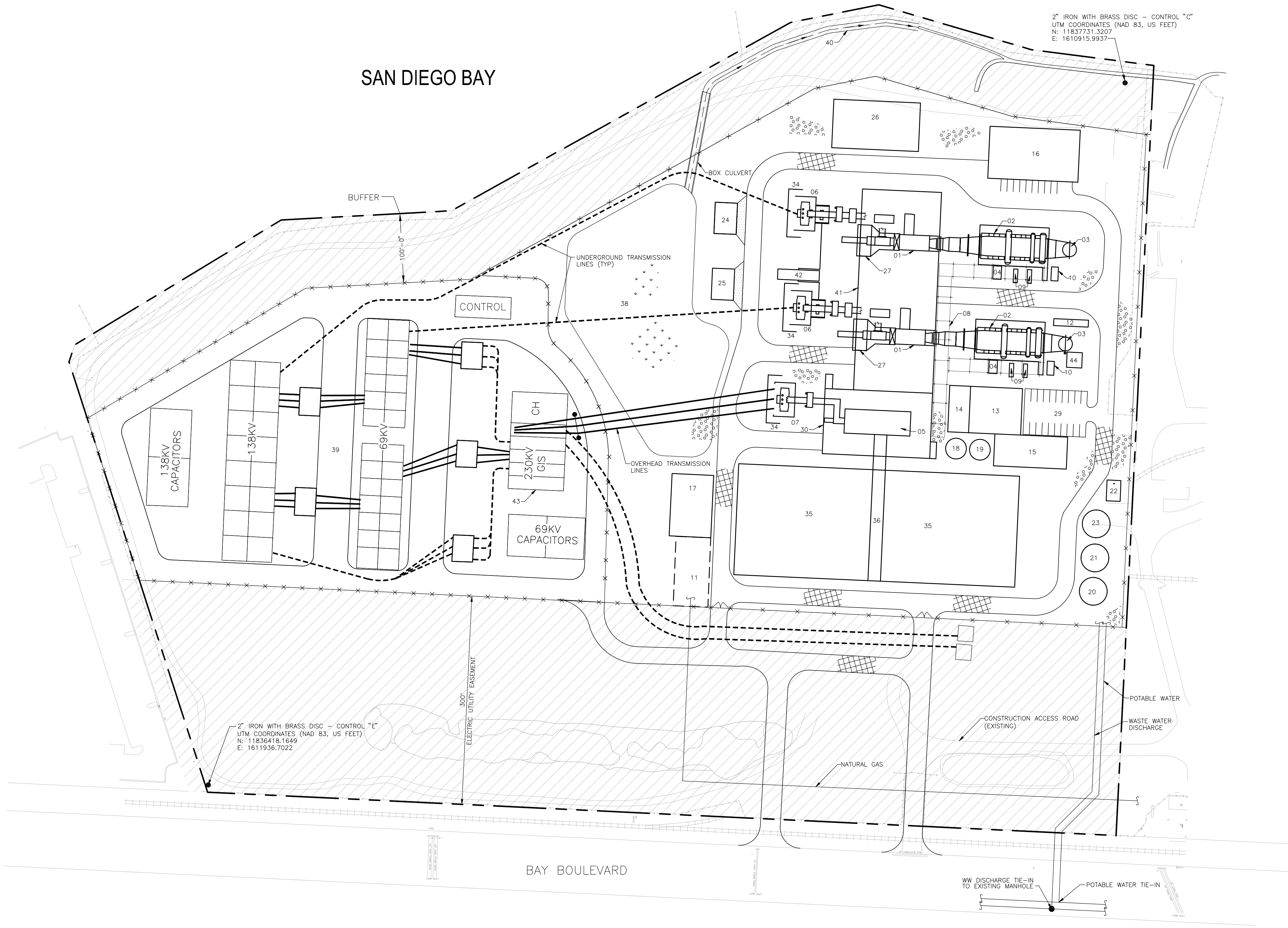


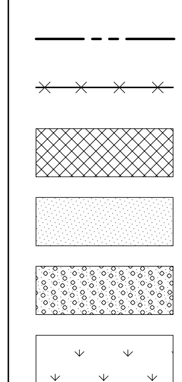
FIGURE 5.1-4
ALTERNATE INTERIM TRANSMISSION INTERCONNECTION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

Source: Black and Veatch, 05/01/06



NEW FACILITIES LEGEND				
ID	FACILITY	FOUNDATION ELEVATION	HEIGHT	REMARKS
01	COMBUSTION TURBINE/GENERATOR	24' +/- 1	-	
02	HEAT RECOVERY STEAM GENERATOR (HRSG)	24' +/- 1	87' TO DECK 94' TO DRUM CL 110' TO TOP OF STEEL	
03	HRSG STACK	24' +/- 1	125'	
04	HRSG BLOWDOWN TANK	24' +/- 1	-	
05	STEAM TURBINE/GENERATOR	24' +/- 1	-	
06	CT GENERATOR STEP-UP TRANSFORMER	24' +/- 1	20'	
07	ST GENERATOR STEP-UP TRANSFORMER	24' +/- 1	20'	
08	UTILITY/PIPE RACK	24' +/- 1	110'/40'	
09	BOILER FEED PUMPS	24' +/- 1	-	
10	CEMS ENCLOSURE	24' +/- 1	12'	
11	FUEL GAS METERING/CONDITIONING STATION AREA	23' +/- 1	-	
12	OIL/WATER SEPARATOR	-	-	
13	ADMIN/CONTROL ROOM BUILDING	24' +/- 1	20'	
14	POWER DISTRIBUTION CENTER (ST/HRSG/BOP)	24' +/- 1	20'	
15	WATER TREATMENT BUILDING	24' +/- 1	20'	
16	MAINTENANCE/WAREHOUSE BUILDING	23' +/- 1	32'	
17	FUEL GAS COMPRESSOR BUILDING	23' +/- 1	22'	
18	DEMIN WATER STORAGE TANK (150,000 GALLON)	24' +/- 1	30'	
19	CONDENSATE STORAGE TANK (100,000 GALLON)	24' +/- 1	21'	
20	RAW WATER/FIRE WATER STORAGE TANK (300,000 GALLON)	24' +/- 1	28'	
21	RAW WATER/FIRE WATER STORAGE TANK (300,000 GALLON)	24' +/- 1	28'	
22	FIRE PUMP HOUSE/DIESEL STORAGE (STACK ON WEST END OF BUILDING)	24' +/- 1	16' BUILDING HEIGHT 22' STACK HEIGHT	
23	WASTE WATER STORAGE TANK (300,000 GALLONS)	24' +/- 1	28'	
24	AMMONIA STORAGE/CONTAINMENT AREA	23' +/- 1	15'	
25	HYDROGEN STORAGE AREA	23' +/- 1	-	
26	COOLING WATER HEAT EXCHANGER	23' +/- 1	20'	
27	CT INLET AIR FILTER	-	70'	
28	NOT USED	-	-	
29	PARKING	23' +/- 1	-	
30	ST GENERATION BUILDING	24' +/- 1	82'	
31	NOT USED	-	-	
32	NOT USED	-	-	
33	NOT USED	-	-	
34	SOUND BARRIER WALL	24' +/- 1	-	
35	AIR COOLED DRY CONDENSER	-	94'	
36	STEAMDUCT	-	-	
37	NOT USED	-	-	
38	STORMWATER DETENTION BASIN	-	-	
39	AREA RESERVED FOR SOUTH BAY SUBSTATION	-	-	
40	STORM WATER DISCHARGE CHANNEL	-	-	
41	CT GENERATION BUILDING	24' +/- 1	40'	
42	ELECTRICAL EQUIPMENT BUILDING	24' +/- 1	14'	
43	230KV GIS	22' +/- 1	-	
44	AUXILIARY BOILER	24' +/- 1	13' BOILER HEIGHT 125' STACK HEIGHT	

GENERAL LEGEND



Source: Black and Veatch Corporation, 05/05/06

FIGURE 5.1-5
FINAL LAYOUT OF RELOCATED SDG&E SUBSTATION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

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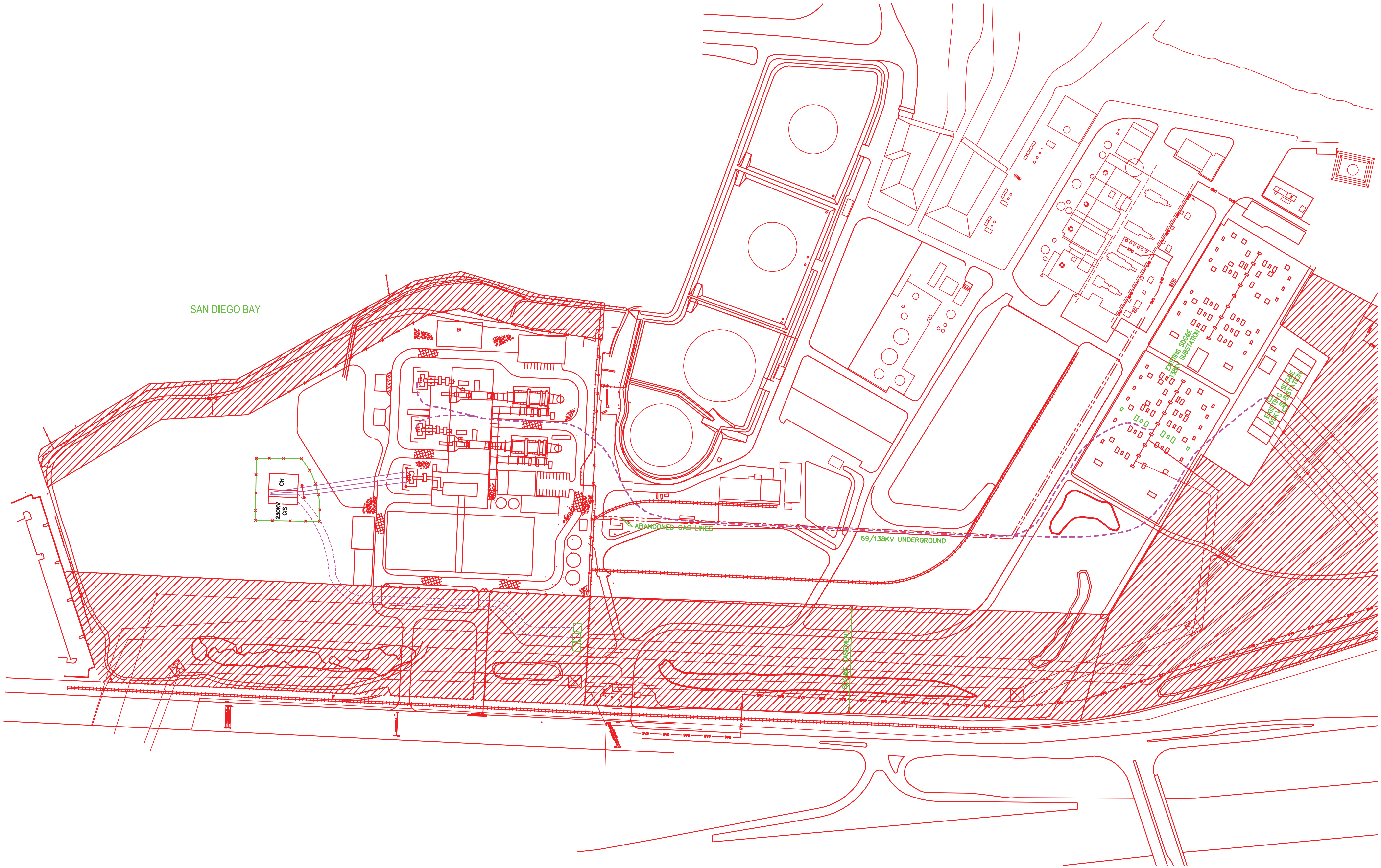

Source: Black and Veatch, 05/01/06

FIGURE 5.2-1
PREFERRED INTERIM TRANSMISSION INTERCONNECTION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

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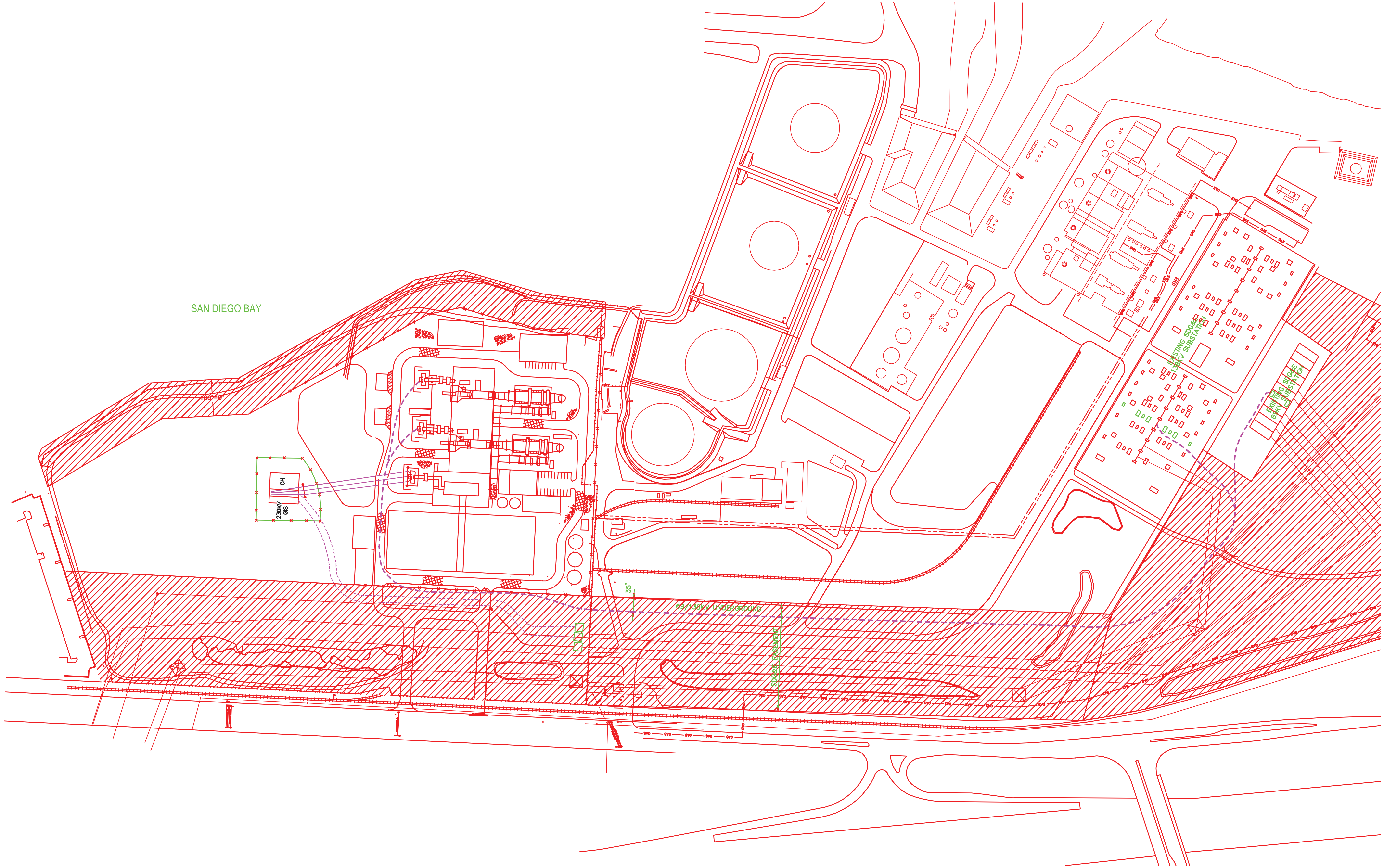

FIGURE 5.2-2
ALTERNATE INTERIM TRANSMISSION INTERCONNECTION
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

Source: Black and Veatch, 05/01/06

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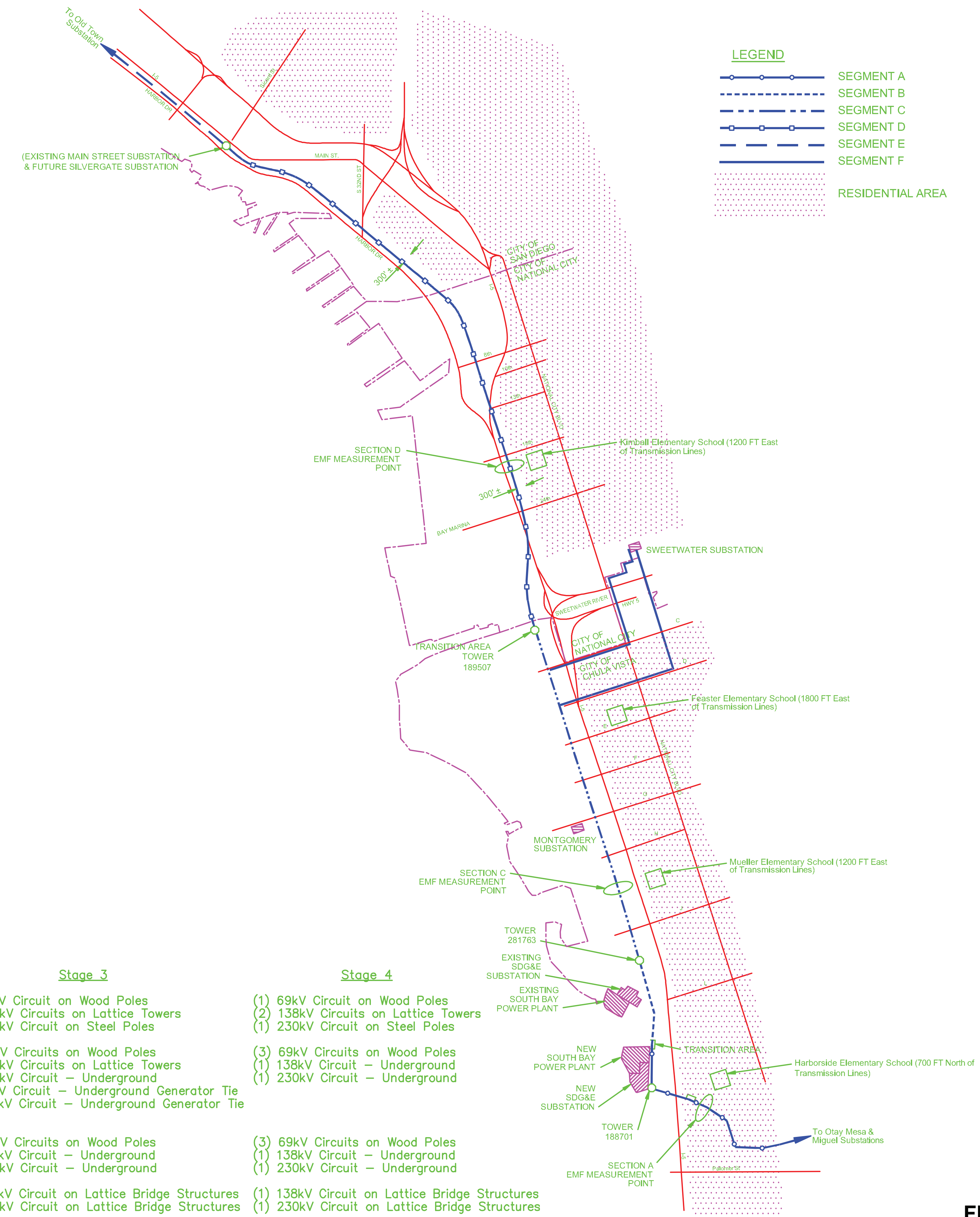

Construction Stages

Stage 1 Conditions now until energization of the Otay Mesa 230KV line.
Anticipated time frame: 2006 – 2007

Stage 2 Conditions after the Otay Mesa 230KV line is energized, but before the new South Bay Replacement Power Plant is operational.
Anticipated time frame: 2007 – 2010

Stage 3 Conditions after the new South Bay Replacement Power Plant is operational, but before the existing South Bay Substation is relocated.
Anticipated time frame: 2010 – 2012

Stage 4 Conditions after the existing South Bay Substation is relocated.
Anticipated time frame: 2013 – on

SDG&E Transmission Lines and Duke/LS Power Generator Ties by Construction Stage

Location	Stage 1	Stage 2	Stage 3	Stage 4
Segment A	(1) 69kV Circuit on Wood Poles (2) 138kV Circuits on Lattice Towers	(1) 69kV Circuit on Wood Poles (2) 138kV Circuits on Lattice Towers (1) 230kV Circuit on Steel Poles	(1) 69kV Circuit on Wood Poles (2) 138kV Circuits on Lattice Towers (1) 230kV Circuit on Steel Poles	(1) 69kV Circuit on Wood Poles (2) 138kV Circuits on Lattice Towers (1) 230kV Circuit on Steel Poles
Segment B	(3) 69kV Circuits on Wood Poles (2) 138kV Circuits on Lattice Towers	(3) 69kV Circuits on Wood Poles (2) 138kV Circuits on Lattice Towers (1) 230kV Circuit – Underground	(3) 69kV Circuits on Wood Poles (2) 138kV Circuits on Lattice Towers (1) 230kV Circuit – Underground (1) 69kV Circuit – Underground Generator Tie (1) 138kV Circuit – Underground Generator Tie	(3) 69kV Circuits on Wood Poles (1) 138kV Circuit – Underground (1) 230kV Circuit – Underground
Segment C	(3) 69kV Circuits on Wood Poles (3) 138kV Circuits on Lattice Bridge Structures	(3) 69kV Circuits on Wood Poles (1) 138kV Circuit – Underground (1) 230kV Circuit – Underground	(3) 69kV Circuits on Wood Poles (1) 138kV Circuit – Underground (1) 230kV Circuit – Underground	(3) 69kV Circuits on Wood Poles (1) 138kV Circuit – Underground (1) 230kV Circuit – Underground
Segment D	(3) 138kV Circuits on Lattice Bridge Structures	(1) 138kV Circuit on Lattice Bridge Structures (1) 230kV Circuit on Lattice Bridge Structures	(1) 138kV Circuit on Lattice Bridge Structures (1) 230kV Circuit on Lattice Bridge Structures	(1) 138kV Circuit on Lattice Bridge Structures (1) 230kV Circuit on Lattice Bridge Structures
Segment E		(1) 230kV Circuit – Underground	(1) 230kV Circuit – Underground	(1) 230kV Circuit – Underground
Segment F	(1) 69kV Circuit on Wood Poles	(1) 69kV Circuit on Wood Poles	(1) 69kV Circuit on Wood Poles	(1) 69kV Circuit on Wood Poles

Source: Black and Veatch, 04/21/06

FIGURE 5.5-1
TRANSMISSION SEGMENTS AND STAGES
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

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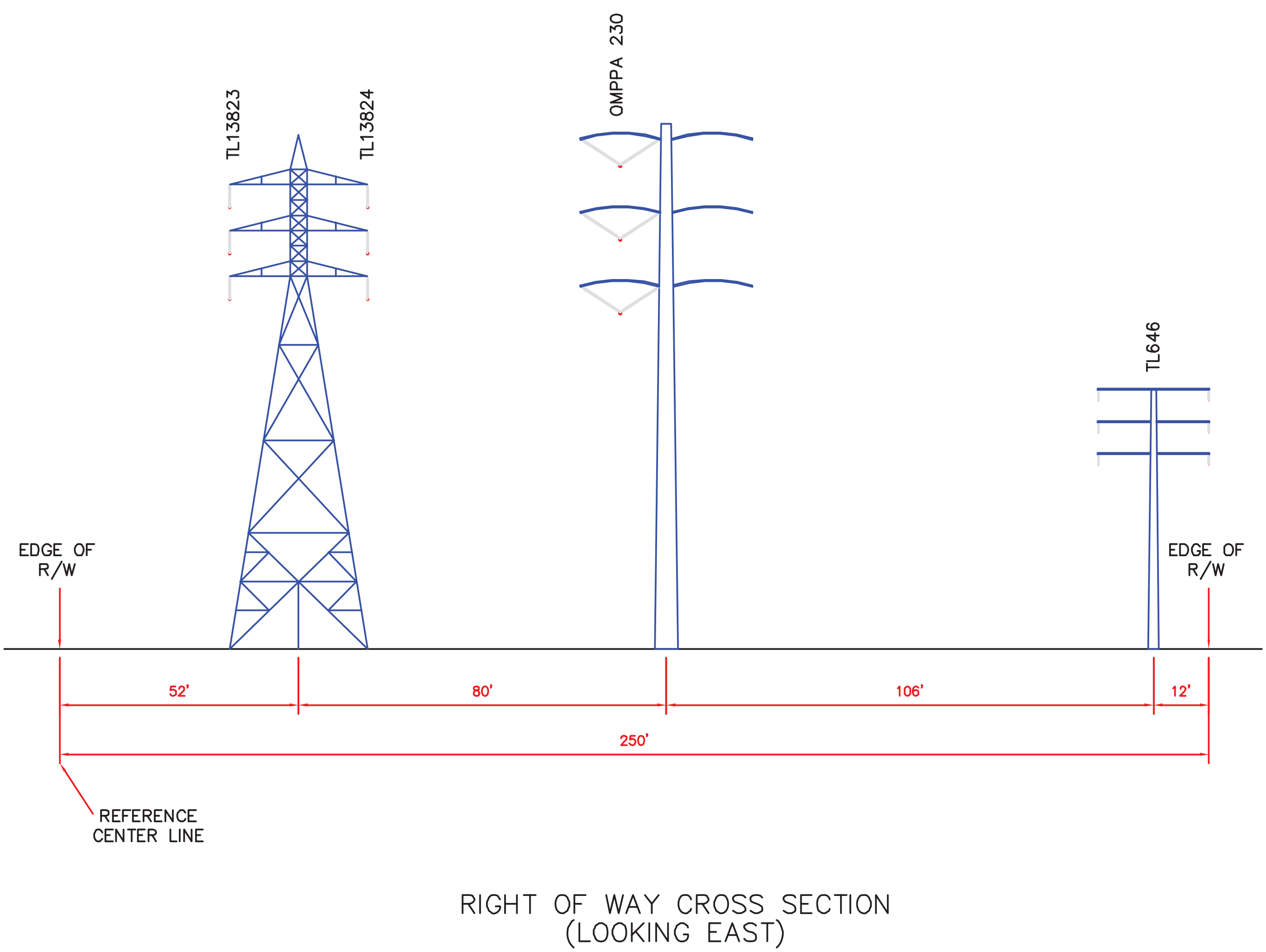
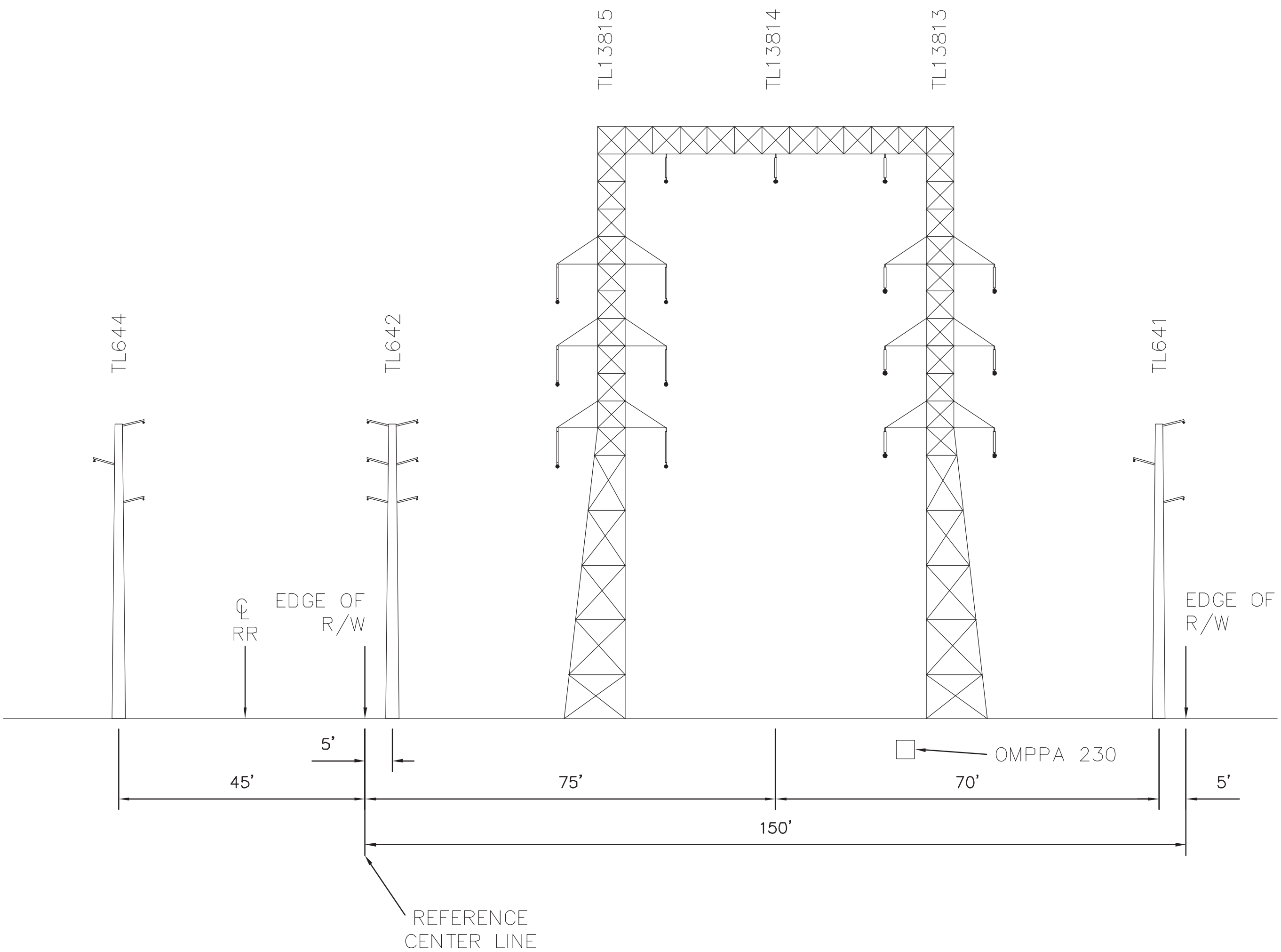


FIGURE 5.5-2
EMF CROSS-SECTIONS
SEGMENT A BEFORE AND AFTER CASE
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

EY062006001SAC figure_5.5-2.ai 06/21/06 tdaus



RIGHT OF WAY CROSS SECTION
(LOOKING SOUTH)

FIGURE 5.5-3
EMF CROSS-SECTIONS
SEGMENT C BEFORE CASE
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

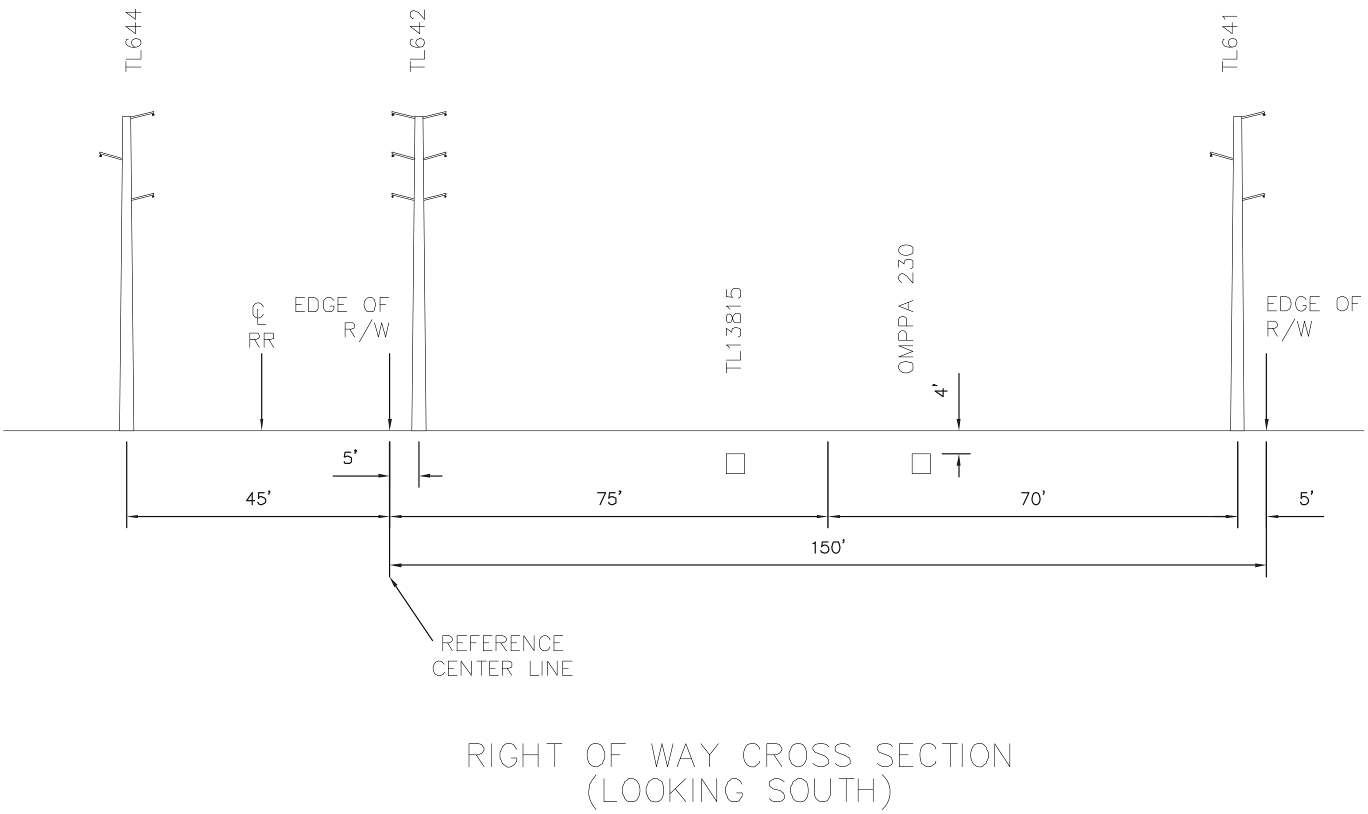


FIGURE 5.5-4
EMF CROSS-SECTIONS
SEGMENT C AFTER CASE
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL

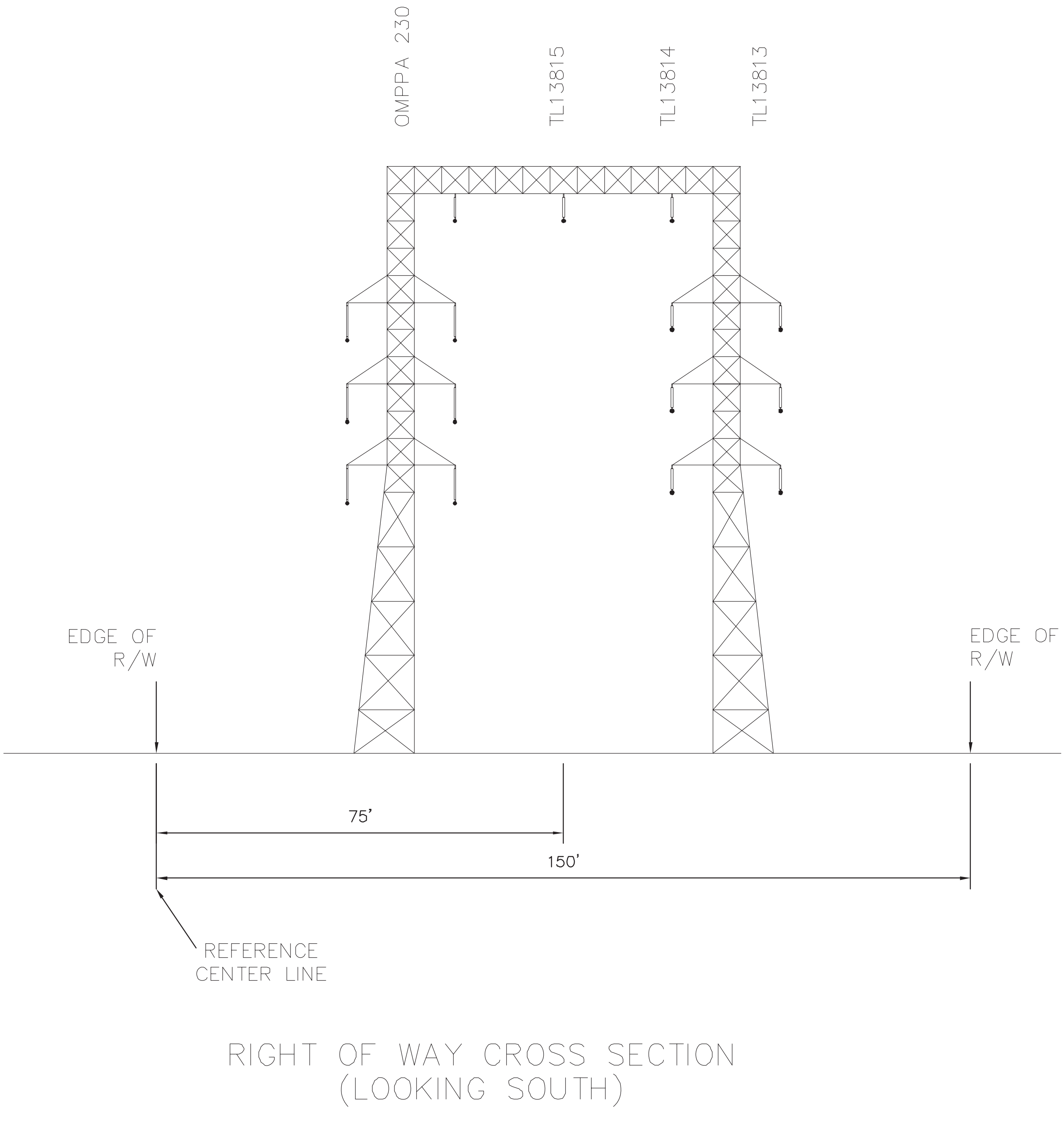


FIGURE 5.5-5
EMF CROSS-SECTIONS
SEGMENT D BEFORE AND AFTER CASE
SOUTH BAY REPLACEMENT PROJECT
CHULA VISTA, CALIFORNIA

CH2MHILL