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Docket Number:	24-OPT-02
Project Title:	Compass Battery Energy Storage
TN #:	255535-3
Document Title:	Section 3_Electric Transmission
Description:	This section discusses the transmission interconnection between the Project and the existing electrical grid, and the potential effects that operation of the facility will have on the flow of electrical power in the Project region.
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3 Electric Transmission

3.1 Introduction

This section discusses the transmission interconnection between the Project and the existing electrical grid, and the potential effects that operation of the facility will have on the flow of electrical power in the Project region. The following topics are discussed:

- The proposed electrical interconnection between the Project and the electrical grid
- The impacts of the electrical interconnection on the existing transmission grid
- Potential nuisances (electrical effects, aviation safety, and fire hazards)
- Safety of the interconnection
- Description of applicable laws, ordinances, regulations, and standards (LORS)

3.2 Transmission Line Description, Design, and Operation

The Project will be interconnected with the regional electrical grid by a loop-in transmission line that will transfer power to and from the proposed Project and the SDG&E Trabuco to Capistrano 138kV transmission line approximately 500 feet to the east of the Project site, running north-south adjacent to the railroad. The loop-in generation transmission line will be approximately 0.1 miles in length and have a right-of-way (ROW) width of between 75 to 125 feet total. The loop-in transmission line poles will be sited to avoid Oso Creek and construction and operation of the line and poles will fully avoid Oso Creek. Figure 3-1, Electric Transmission, shows the route between the Project site and the existing Trabuco to Capistrano 138kV transmission line.

3.2.1 Overhead Transmission Line Characteristics

The loop-in transmission line will consist of a double-circuit configuration constructed overhead. Up to six poles will be constructed to support the line. These consist of two new poles on the west side of Oso Creek, one new pole on the east side of Oso Creek, and two pole replacements on the east side of Oso Creek. Figure 3-2, Representative Transmission Pole, depicts an example of the poles to be used as part of the overhead transmission interconnection. The transmission line design was selected to take advantage of the existing SDG&E Trabuco to Capistrano 138kV transmission line directly adjacent to the Project site. Electrical one-line diagrams of the line are shown in Figure 3-3, Electrical One-Line Diagrams.

3.2.2 SDG&E Switchyard Characteristics

A general arrangement for the proposed onsite switchyard is shown in Figure 2-1. The switchyard will be owned by SDG&E. The switchyard will be installed adjacent to the Project substation that will include open rack, air insulated switch gear and the main power transformer to deliver power to the nearby Trabuco to Capistrano 138kV transmission line.

3.3 Transmission Interconnection Studies and Interconnection Agreement

Compass Energy Storage, LLC filed an Interconnection Request (IR) with the California Independent System Operator (CAISO) (in the Cluster 13 Interconnection Request window) in April 2020. CAISO, in cooperation with SDG&E, prepared the Phase I Interconnection Study (dated January 25, 2021), which considered the potential system impacts of the proposed Project interconnect. As part of the interconnection process with CAISO and SDG&E, Compass Energy Storage, LLC prepared the Phase II Interconnection Study (dated November 22, 2021) (see Appendix 3A). A Large Generator Interconnection Agreement (LGIA) was executed between Compass Energy Storage LLC, San Diego Gas and Electric Company, and California Independent System Operator on May 18, 2022 (see Appendix 3B).

3.3.1 New Equipment Installation

The IR Studies indicate that the following equipment will be installed by Compass Energy Storage, LLC:

- The new switchyard with associated foundations, structures, and relaying
- The 138kV loop-in transmission line
- One dead end structure
- Three tiedowns
- Three arrestors
- One PT
- Associated foundation structures, metering, and equipment
- Communication and network equipment
- Panels and monitoring equipment for existing, proposed, and new Remedial Action Scheme (RAS)

3.3.2 System Impact Studies

The IR Studies assessed the effects of the addition of Cluster 13, including the Project (at 250 MW), to the local electrical system under various conditions of stress.

3.3.2.1 Power Flow Reliability

The reliability assessment identified that the Project did not contribute to overloads in the SDG&E system. A combination of congestion management and RAS to trip the Project under identified contingency outage conditions would be required to mitigate the power flow impacts of the Project.

3.3.2.2 Short Circuit Duty

A Phase II short circuit analysis was performed. The analysis evaluates the impact of increased fault current resulting from the addition of the Project. Short circuit analysis results indicated that the addition of this Project did not contribute a significant amount of fault duty to the QC13 overstressed breakers or to overstressed circuit breakers found in previous clusters.

3.3.2.3 Transient Stability

Transient stability studies were conducted using the Heavy Summer and Light load cases to verify that the addition of the Project will not adversely impact the stability of the interconnected system following disturbances and abnormal operating conditions. With the proposed congestion management and RASs in place, the study concluded that the addition of the Project would not cause the SDG&E transmission system to become unstable following the select disturbances studied. Using the Heavy Summer and Light Load cases specified in the Area Report, the post-transient voltage stability analysis indicated that, under the studied conditions and system configuration, the addition of the Project did not result in any post-transient voltage deviations.

3.3.2.4 Power Factor Requirements

Per FERC Order 827, the Project will be required to maintain a composite power delivery at continuous rated power output at the high side of the main step-up transformer at a power factor within the range of 0.95 leading to 0.95 lagging. This power factor range shall be dynamic. A base case power flow was evaluated to determine reactive power losses internal to the Project to ascertain if the reactive capability of the Project is adequate to supply these losses and meet the power factor requirements. Based on the technical details provided with inverters operating at the generator net gross output to meet the requested MW output at POI, the Project meets the power factor capability requirements.

3.3.2.5 Deliverability

The Project does not contribute to any overloads in the On-Peak Deliverability Assessment. The Project was not evaluated in the off-peak deliverability assessment because it is an energy storage facility. No Network Upgrades are assigned to the Project to address deliverability constraints.

3.4 Transmission Line Safety and Nuisances

This section discusses safety and nuisance issues associated with the proposed electrical interconnection.

3.4.1 Electrical Clearances

Typical high-voltage overhead transmission lines are composed of bare conductors connected to supporting structures by means of porcelain, glass, or plastic insulators. The air surrounding the energized conductor acts as the insulating medium. Maintaining sufficient clearances, or air space, around the conductors to protect the public and utility workers is paramount to the safe operation of the line. The required safety clearance required for the conductors is determined by considering factors such as the normal operating voltages, conductor temperatures, short-term abnormal voltages, windblown swinging conductors, contamination of the insulators, clearances for workers, and clearances for public safety. The line will conform to the minimum clearances specified in the California Public Utilities Commission (CPUC) General Order (GO) 95. Electric utilities, state regulators, and local ordinances may specify additional (more restrictive) clearances. Typically, clearances are specified for the following:

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

The transmission interconnection for the Project will be designed to meet applicable national, state, and local clearance requirements.

3.4.2 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 attributable to 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. Field effects are the voltages and currents that may be induced in nearby conducting objects. A transmission line's inherent electric and magnetic fields cause these effects.

3.4.2.1 Electric and Magnetic Fields

Operating power lines, like energized components of electrical motors, home wiring, lighting, and other electrical appliances, produce electric and magnetic fields commonly referred to as an electromagnetic field (EMF). The EMF produced by the alternating current (AC) electrical power system in the U.S. has a frequency of 60 hertz, meaning that the intensity and orientation of the field changes 60 times per second. 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 (i.e., increased voltage produces a stronger electric field).

At a given distance from the transmission line conductor, 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 kV per meter. The electric field around a transmission line remains 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 also directly proportional to the current (i.e., 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 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 last 30 years on the possible biological effects and human health effects from EMFs. This research has produced many studies that offer no uniform conclusions about whether long-term exposure to EMFs is harmful. In the absence of conclusive or evocative evidence, some 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 would be minimized by encouraging electric utilities to use cost-effective techniques to reduce the levels of EMFs.

3.4.2.2 Audible Noise and Radio and Television Interference

Corona from a transmission line may result in the production of audible noise or radio and 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.

3.4.2.3 EMFs, Audible Noise, and Radio and Television Interference Assumptions

It is important to remember that EMFs, audible noise, and radio and television interference near power lines vary regarding the line design, line loading, distance from the line, and other factors.

Electric fields, corona, audible noise, and radio and television interference depend on line voltage and not on the level of power flow. Because line voltage remains nearly constant for a transmission line during normal operation, the audible noise associated with the 138 kV lines in the area will be of the same magnitude before and after the Project.

Corona typically becomes a design concern for transmission lines having voltages of 345 kV and above. Since the Project will be connected at 138 kV voltage level, it is expected that no corona-related design issues will be encountered.

The magnetic field is proportional to line loading (amperes), which varies as demand for electrical power varies and as generation from the generating facility is changed by the system operators to meet changes in demand. Construction and operation of the Project, including the interconnection of the facility with SDG&E's transmission system, are not expected to result in significant increases in EMF levels, corona, audible noise, or radio and television interference.

3.4.2.4 Induced Current and Voltages

A conducting object such as a vehicle or person in an electric field will experience induced voltages and currents. The strength of the induced current will depend on the electric field strength, 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 to ground. 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 low enough to prevent vehicle short-circuit currents from exceeding 5 milliamperes.

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 like that described for an ungrounded object. Mitigation for this problem is to ensure multiple grounds on fences or pipelines, especially those oriented parallel to the transmission line.

The proposed 138 kV transmission interconnection line will be constructed in conformance with CPUC GO-95 and Title 8 California Code of Regulations (CCR) 2700 requirements. Therefore, hazardous shocks are unlikely to occur because of Project construction, operation, or maintenance.

3.4.3 Fire Hazards

The proposed 138 kV transmission interconnection will be designed, constructed, and maintained in accordance with applicable standards including GO-95, which establishes clearances from other man-made and natural structures as well as tree-trimming requirements to mitigate fire hazards.

The Project will maintain the gen-tie corridor and immediate area in accordance with existing regulations and accepted industry practices that will include identification and abatement of fire hazards.

3.5 Laws, Ordinances, Regulations and Standards

This section provides a list of applicable LORS that apply to the proposed transmission line, substations, and engineering.

3.5.1 Design and Construction

Table 3-1 lists the LORS for the design and construction of the proposed transmission line and switchyard.

Table 3-1. Design and Construction LORS

LORS	Applicability
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
Title 8 CCR, Section 2700 et seq. "High Voltage Electrical Safety Orders	Applies to the design of facilities subject to CPUC's jurisdiction to provide or mitigate inductive interference.
ANSI/IEEE 593, "IEEE Recommended Practices for Seismic Design of Substations"	Recommends design and construction practices.
IEEE 1119, "IEEE Guide for Fence Safety Clearances in Electric-Supply Stations"	Recommends clearance practices to protect persons outside the facility from electric shock. Applies to the design of facilities subject to CPUC's jurisdiction to provide or mitigate inductive interference.
IEEE 980, "Containment of Oil Spills for Substations"	Recommends preventions for release of fluids into the environment.

Notes: ANSI = American National Standards Institute; IEEE = Institute of Electrical and Electronics Engineers

3.5.2 Electric and Magnetic Fields

Table 3-2 lists the LORS pertaining to EMF that apply to the proposed transmission line and switchyard.

Table 3-2. Electric and Magnetic Field LORS

LORS	Applicability
Decision 93-11-013, CPUC	CPUC position on EMF reduction.
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.
ANSI/IEEE 544-1994, “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.

3.5.3 Hazardous Shock

Table 3-3 lists the LORS regarding hazardous shock protection that apply to the proposed transmission line and switchyard.

Table 3-3. Hazardous Shock LORS

LORS	Applicability
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.
ANSI/IEEE 80, “IEEE Guide for Safety in AC Substation Grounding”	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.
NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C	Covers grounding methods for electrical supply and communications facilities

3.5.4 Communications Interference

Table 3-4 lists the LORS pertaining to communications interference that apply to the proposed transmission line and switchyard.

Table 3-4. Communications Interference LORS

LORS	Applicability
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.
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.

3.5.5 Aviation Safety

Table 3-5 lists aviation safety LORS that may apply to the proposed transmission line and switchyard.

Table 3-5. Aviation Safety LORS

LORS	Applicability
Title 14 CFR, Part 77, "Objects Affecting Navigable Airspace"	Describes the criteria used to determine whether a "Notice of Proposed Construction or Alteration" (FAA Form 7450-1) is required for potential obstruction hazards
FAA Advisory Circular No. 70/7450-1G, "Obstruction Marking and Lighting"	Describes the FAA standards for marking and lighting of obstructions as identified by FAA Regulations Part 77

3.5.6 Fire Hazards

Table 3-6 lists the LORS pertaining to fire hazard protection that apply to the proposed transmission line and switchyard.

Table 3-6. Fire Hazard LORS

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

3.5.7 Jurisdiction

Table 3-7 identifies national, state, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, or enforce the above-referenced LORS. Table 3-7 also identifies the responsibilities of these agencies as they relate to Project construction, operation, and maintenance.

Table 3-7. Jurisdictions

Agency or Jurisdiction	Responsibility
FAA	Establishes regulations for marking and lighting of obstructions in navigable airspace (AC No. 70/7450-1G).
CEC	Jurisdiction over new transmission lines associated with thermal power plants that are 50 MW or more (PRC 25500).

Table 3-7. Jurisdictions

Agency or Jurisdiction	Responsibility
CEC	Jurisdiction of lines out of a thermal power plant to the first point of interconnection with the grid (PRC 25107).
CPUC	Regulates construction and operation of overhead transmission lines (GO-95)
CPUC	Regulates construction and operation of power and communications lines for the prevention of inductive interference (GO-52)
Local Electrical Inspector	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity (NFPA 70).
City of San Juan Capistrano	Establishes and enforces zoning regulations for specific land uses. Issues variances in accordance with zoning ordinances. Issues and enforces certain ordinances and regulations concerning fire prevention and electrical inspection.

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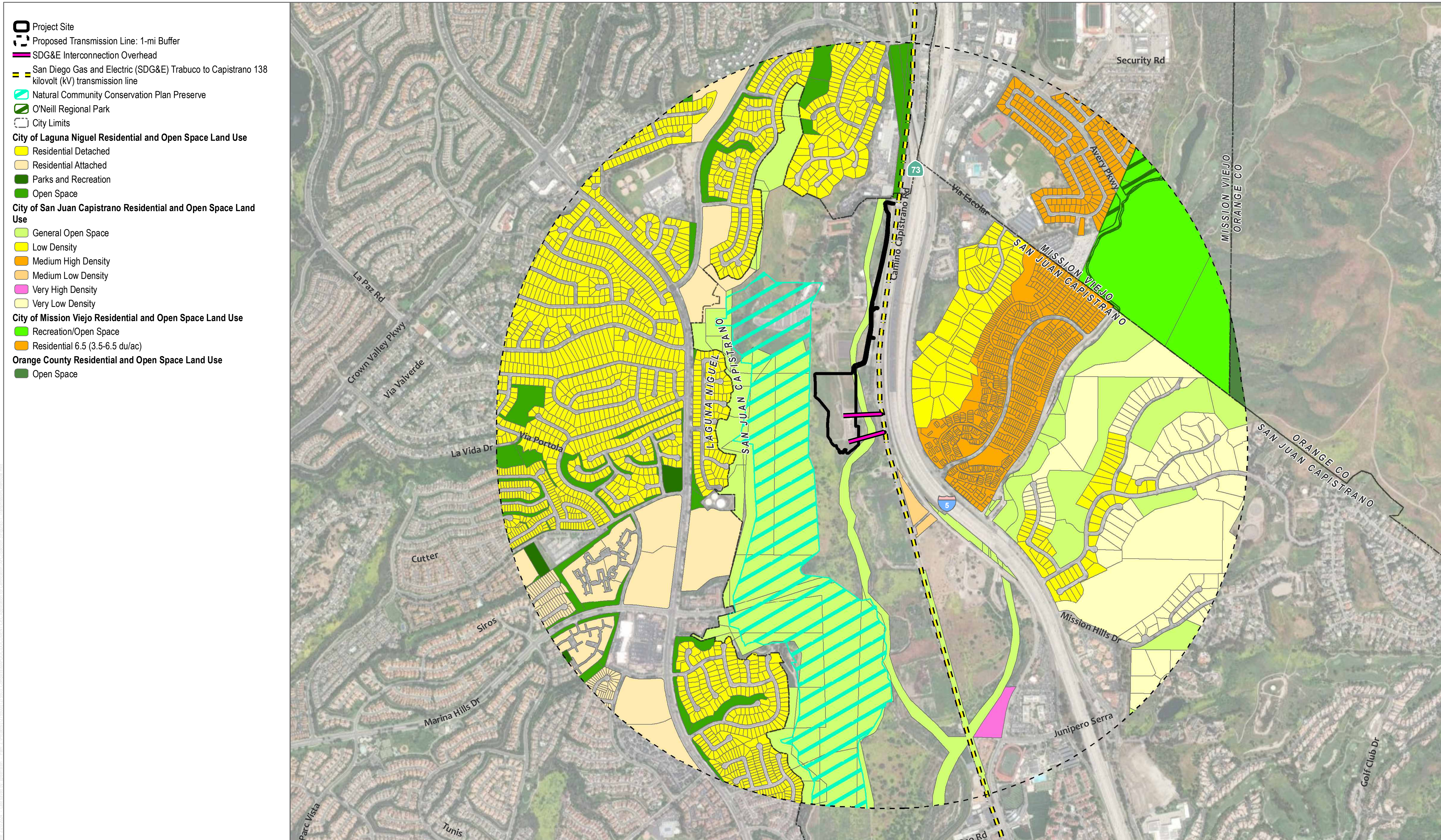

SOURCE: Bing Maps 2023; County of Orange 2023

DUDEK

0 650 1,300 Feet

FIGURE 3-1

Transmission Line Route

Compass Energy Storage Project

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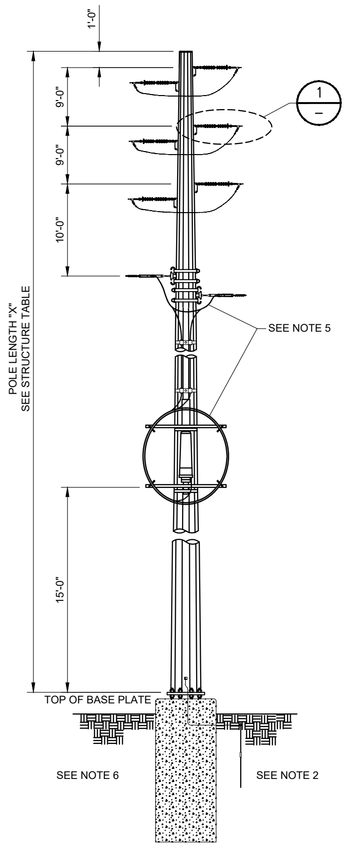
MATERIAL LIST

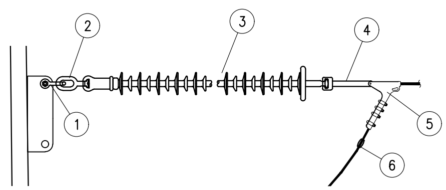
ASSEM. (SDG&E STD)	ITEM	QTY.	SDG&E STOCK NO.	DESCRIPTION	MANUF.	PART NUMBER
CONDUCTOR (19340)	1	6	S636438	SHACKLE, ANCHOR, 30K	MPS	ASH-55
	2	6	S337542	EYE, OVAL, BALL, 30K	MPS	ASBE-55
	3	6	S431396	INSULATOR, SUSPENSION, 138KV, W/ CORONA RING, SILICONE RUBBER, 25K SPECIFIED MECHANICAL LOAD, SECTION LENGTH 66"-68", BALL (HOT END) AND SOCKET END FITTINGS	NGK-LOCKE	251-SS550-SJ-08
	4	6	S337622	EYE, SOCKET, HOTLINE, EYE, 1-3/8" WIDE, 30K	MPS	SEHL-1375-6
	5	6	S230686	CLAMP, STRAIN, DEADEND, ALUM. ALLOY, RANGE 0.71"-1.318", 30K	MPS	ADE-2526
	6	3	S650338	SLEEVE, ALUM, JUMPER	AFL	5234.3

STRUCTURE TABLE

STRUCTURE NAME	POLE LENGTH X	Z NUMBER	SP NUMBER
22A	60'-0"	Z296189	
23	70'-0"	Z296192	



POLE ELEVATION



DETAIL 1
CONDUCTOR DEAD END (19340)

NOTES:

1. REFER TO DRAWING 2021-2462.5710-01 AND 04 FOR GENERAL ARRANGEMENT DRAWING.
2. REFER TO DRAWING 2021-2462.5500-06 FOR GROUNDING DETAILS.
3. 138 kV CONDUCTOR: 1033.5KCMIL 45/7 ACSR/AW "ORTOLAN".
4. FOR DRILLING PIER FOUNDATION DETAILS SEE 2023-2462.5730-01.
5. SEE SDG&E STD 18022 & 18028 FOR ADSS DEADEND & SPLICE ASSEMBLY RESPECTIVELY.

REV	BUDGET	CONST ORDER	CHANGE	DWN	CHKD	APPV	DATE
A			ISSUED FOR 60% REVIEW	GSR	SLG	AJD	01/30/23

SAN DIEGO GAS & ELECTRIC
TRANSMISSION ENGINEERING
TL13829, TL13833
COMPASS ENERGY STORAGE

ECI ELECTRICAL CONSULTANTS INC

FRAMING DRAWING
138kV STEEL POLE SINGLE CIRCUIT DE Y SC STRUCTURE 22A & 23

DRAWING NUMBER 2021-2462.5500-02

SCALE NONE **SHEET** 1 OF 1

Source: San Diego Gas & Electric 2023

FIGURE 3-2
Representative Transmission Pole
Compass Energy Storage Project

DUDEK

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