APPENDIX C:
MAGNETIC FIELD MANAGEMENT PLAN

Detailed Magnetic Field Management Plan for the Salt Creek Substation Project

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Transmission Lines: **TL 643, 6910, 6964, 6965, 23041, 23042**

Central File No.: **ELA 140.B.XX**

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I. Proposed Project Scope

The "Salt Creek Substation Project" (Proposed Project) is to develop a 120 MVA 69/12kV distribution substation, loop-in existing power line, tieline (TL) TL 6910[1] and construct a new five-mile-long 69 kV power line, TL 6965, from Miguel Substation to the new substation, in order to serve future development and load growth in the eastern portion of the City of Chula Vista in southwestern San Diego County. The proposed substation site and the majority of the proposed power line are located in the eastern portion of City of Chula Vista, near State Route 125 (SR-125). Approximately 4,700 linear feet of the northern most portion of the new 69 kV power line is located in the unincorporated portion of San Diego County on SDG&E fee- owned undeveloped land surrounding the Miguel Substation. The majority of the Proposed Project is located east of SR-125, in the southwesterly portion of San Diego County. Approximately 6,100 linear feet of the proposed power line is located on the west side of SR-125 with two overhead crossings over SR-125. The Proposed Project substation site is approximately 15 miles southeast of Downtown San Diego and 5 miles north of the international border with Mexico. (see "Appendix 1-Segment Map")

The eastern portion of the City of Chula Vista is a rapidly growing area that includes the developing communities of Otay Ranch, Eastlake, and approximately 5,000 acres of undeveloped land. A study of the area was done and concluded that in addition to building out and adding planned substation bank additions at the two existing distribution substations serving eastern Chula Vista (Proctor Valley and Telegraph Canyon Substations), a new distribution substation would be required to serve an ultimate residential and commercial area load of 107 MW. The new substation would add needed capacity and substation/circuit reliability to the area.

The Proposed Project would be constructed within the existing SDG&E utility corridor or rights-of-way (ROW) throughout the entire scope. This "Detailed Magnetic Field Management Plan (FMP)" is for analysis of three primary components of the Proposed Project:

- Construction of a 120 MVA 69/12 kV low profile Salt Creek Substation southeasterly of Hunte Parkway;
- Construction of a new 69 kV power line (TL 6965) from the existing Miguel Substation to the proposed Salt Creek Substation;
- Construction of a 69 kV power line loop-in (TL 6910) to the Salt Creek Substation;

For purposes of this FMP, the term "Proposed Project" does not include the distribution lines, per the SDG&E "EMF[2] Design Guidelines for Electrical Facilities" which states, "For distribution facilities, utilities would apply no-cost and low-cost measures by integrating reduction measures into construction and design standards, rather than evaluating no-cost and low-cost measures for each project."

[1] In accordance with CPUC General Order 131-D, the term "power line" is used in this document in reference to 69 kV tielines. The term "transmission," when used, refers to internal SDG&E operating departments, internal SDG&E standards and/or other guidelines, existing electric lines energized at or above 200 kV, or existing gas transmission pipelines. It is not intended to suggest that the 69 kV tielines in this Proposed Project are designed for immediate or eventual operation at 200 kV or above.

[2] EMF refers to electric and magnetic fields.

II. Magnetic Field Management Design Guidelines

The CPUC requires SDG&E apply its *EMF Design Guidelines for Electrical Facilities* ("Guidelines") to all new electric transmission projects to reduce public exposure to magnetic fields. SDG&E filed its Guidelines with the CPUC in accordance with CPUC Decision 93-11-013 and updated them in accordance with the 2006 CPUC Decision 06-01-042.

Consistent with SDG&E's Guidelines and with the CPUC order, magnetic fields and possible magnetic field management measures were evaluated along the power line locations associated with the Proposed Project. The results of this evaluation are contained in this FMP.

The FMP deals solely with magnetic fields. Moreover, reducing the magnetic field strength is but one of many factors to be considered in planning and designing a transmission system, along with other issues such as safety, environmental concerns, reliability, insulation and electrical clearance requirements, aesthetics, cost, operations and maintenance.

III. Methodology

In Decision 06-01-042, the CPUC notes that modeling is used to compare the relative effectiveness of field-reduction options and is not to be used to predict post-construction field levels. CPUC Decision 06-01-042, Finding of Fact 14: "Utility modeling methodology is intended to compare differences between alternative EMF [Electromagnetic Field] mitigation measures and not determine actual EMF amounts."[3] The CPUC also notes that "modeling indicates relative differences in magnetic field reductions between different transmission line construction methods, but does not measure actual environmental magnetic fields."[4]

In accordance with its Guidelines, SDG&E would take the following measures for the Proposed Project:

- Apply SDG&E's EMF Guidelines for transmission circuit facilities to the Proposed Project design.
- Identify and implement appropriate "no-cost" measures, i.e., those that will not increase overall project costs but will reduce the magnetic field levels.
- Identify and implement appropriate "low-cost" measures, i.e., those measures costing in the range of 4% of the total budgeted project cost that will reduce the magnetic field levels by 15% or more at the edge of the right-of-way (ROW).
- When a sufficiency of "low-cost" measures is available to reduce magnetic field levels, such that it is difficult to stay within the 4% cost guideline, apply these "low-cost" measures by priority, per the Guidelines.

The 15% minimum reduction required for low-cost measures is in addition to any field reduction due to "no-cost" measures. It is not cumulative.

Since the Proposed Project requires permitting under General Order 131-D, a Detailed Field Management Plan (FMP) will be used. The Detailed FMP consists of a project description, a

[3] CPUC Decision D.06-01-042, Finding of Fact 14, p. 20.
[4] Ibid, p.11.

checklist table showing evaluation of magnetic field reduction measures adopted or rejected per transmission line, evaluation of "no-cost" and "low-cost" magnetic field reduction measures, magnetic field models where multiple lines are involved within the same easement or ROW, and a summary with recommendations.

Field levels were calculated using the RESICALC program developed and maintained by the Electric Power Research Institute**.** As the in-service date of the Proposed Project would be March 2016 the projected high usage currents, "2016 heavy summer," were used in the calculations. For the purpose of evaluating the field management measures, magnetic field levels were calculated and compared at a height of one meter above ground.

To evaluate the effectiveness of various magnetic field reduction measures, calculated values for a given measure were compared to calculated values without the measure. Since all power lines of the Proposed Project are within SDG&E-fee-owned undeveloped land, or the Miguel – Mexico utility corridor, magnetic field levels were calculated and compared at the adjacent parallel edges-of-ROW. Modeling for this Proposed Project included Segment 2, the utility corridor, since the other Segments were well within undeveloped land owned by SDG&E.

The edges-of -ROW are identified as "west", "east", "north", or "south" for consistency when reviewing the sketches included in "Appendix 1" and the tables included in "Section VIII- Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project" in this report.

IV. Project Description

The "Salt Creek Substation Project" (Proposed Project) substation site is located adjacent to, and southeasterly of, Hunte Parkway where SDG&E's Miguel-Mexico utility corridor crosses Hunte Parkway. The Project site consists of 11.6 acres of undeveloped land. The site is bordered by Hunte Parkway to the northwest, SDG&E's Miguel to Mexico utility corridor and open space to the east, and undeveloped land to the south and southwest. The 120-foot wide SDG&E utility corridor contains overhead electric power line, TL 6910, and overhead transmission lines, TL23041 and TL 23042; a 36-inch high pressure gas transmission pipeline (SDG&E pipeline 3010), a four-inch high pressure gas line, San Diego County Water Authority (SDCWA) 69-inch water pipeline, and a SDCWA 72-inch water pipeline. Other surrounding land uses include existing residences located north of Hunte Parkway and undeveloped land to the south and southwest which is proposed for future development. The Proposed Project is situated approximately 15 miles southeast of Downtown San Diego and 5 miles north of the international border with Mexico.

An approximately five (5) mile long overhead 69 kV power line (TL 6965) would be constructed from the existing Miguel Substation extending southerly to the proposed Salt Creek Substation. The northernmost 4,700 linear feet would be located in the unincorporated portion of San Diego County on SDG&E fee-owned undeveloped land surrounding the existing Miguel Substation. Approximately 6,100 linear feet of the proposed power line would be located on the west side of SR-125 with two overhead crossings over SR-125. The remainder of the power line would be constructed within SDG&E's existing 120-foot-wide utility corridor within the City of Chula Vista where it would terminate on a new cable pole located approximately 1,200 feet southeast of Hunte Parkway. The new TL 6965 would then transition from overhead to underground at this

cable pole and traverse underground in a northwesterly direction approximately 1,000 feet within an SDG&E getaway into the new substation. (see "Appendix 1-Segment Map")

TL 6910 is an existing 69 kV circuit with terminal points at SDG&E's Miguel and Border Substations. As part of the Proposed Project, SDG&E would open TL 6910 by installing two new steel cable poles, intercept and loop the power line underground via two new 69 kV duct packages in separate trench alignments from the existing corridor into the proposed Salt Creek Substation on SDG&E fee-owned property, a distance of approximately 300 feet. TL 6910 would then be re-configured as TL 6910 (Border-Salt Creek Substation) and TL 6964 (Miguel – Salt Creek Substation). (see "Appendix 1-Segment Map")

As previously stated, the Proposed Project would be constructed within the existing SDG&E 120 foot wide utility corridor or ROW and/or on SDG&E fee- owned undeveloped land. This Detailed FMP is for analysis of three primary components of the Proposed Project:

- **Salt Creek Substation** - The proposed Salt Creek Substation would be a distribution substation located adjacent to and southeast of Hunte Parkway, where SDG&E's Miguel-Mexico Transmission Corridor crosses Hunte Parkway. The proposed site consists of 11.64 acres of undeveloped land. (see "Appendix 1-Segment Map" and "Section IX: Simplified Field Management Plan Checklist for the Salt Creek Substation portion of the proposed Project")

- **New 69 kV TL 6965** - A new overhead 69kV power line, approximately 5 miles long, would be constructed from the existing Miguel Substation extending southerly to the proposed Salt Creek Substation. The northernmost 4,700 linear feet would be located on SDG&E's fee-owned property in an unincorporated portion of San Diego County. (see "Appendix 1- Segment Map_Segment 1") The remainder of the overhead power line would be constructed within SDG&E's existing 120-foot-wide transmission corridor and 15 feet west of the south ROW. It would terminate on a new cable pole located approximately 1,200 feet southeast of Hunte Parkway County. (see "Appendix 1-Segment Map_Segment 2") At that point it would extend underground within SDG&E owned undeveloped land to the proposed Salt Creek Substation. (see "Appendix 1-Segment Map_Segment 3")

  Existing structures and conductors along a portion of TL 643, which are located on SDG&E fee-owned Miguel Substation property, would be utilized to complete the TL 6965 connection to Miguel Substation. This includes eight poles along TL 643, of which two poles would require pole-top work to connect TL 6965 to them. The remaining six poles would not require additional work. . (see "Appendix 1-Segment Map_Segment 1")

  Currently, there are three overhead electric power and transmission line circuits located in the utility corridor between the Miguel Substation and the proposed Salt Creek Substation. Existing power line, TL 6910, is located on a combination of wood and steel poles along the west side of the 120-foot-wide transmission corridor connecting Miguel Substation to Border Substation in Otay Mesa. Existing transmission line circuits, TL 23041 and TL 23042, are located on double circuit steel lattice towers along the centerline of the corridor, connecting Miguel Substation to SDG&E's Otay Mesa switchyard in Otay Mesa. (see "Appendix 1-Segment Map")

TL 6965 would use approximately forty-nine (49) poles, including eight (8) existing poles[5]. A total of approximately forty-one (41) new galvanized steel power poles would be erected for the new 69 kV power line. Direct bury galvanized steel poles would be used for tangent structures where the power line is generally straight, and engineered poles would be used for heavy angles and freeway crossings. An engineered cable pole is required where the power line transitions from overhead to underground. The new TL 6965 poles, consist of the following:

- Twenty-nine (29) direct bury galvanized steel poles (including one two-pole H frame structure);
- Eleven (11) galvanized engineered foundation poles; and
- One (1) engineered foundation cable pole.

These structures would have an average height above ground (HAG) of approximately 68 feet, and would range in height from approximately 34 feet to 123 feet. At the proposed Salt Creek Substation, one approximately 103-foot-high cable pole would be erected to transition the line from overhead to underground.

The final approximately 1,000-foot segment of TL 6965 power line would be installed underground in a concrete encased duct bank, at the standard depth of 3.0 feet below grade to top-of-duct package, from the cable pole to the Salt Creek Substation rack for the new underground connection, all well within SDG&E owned property.

- **TL 6910 Loop-In** - TL 6910 is an existing 69 kV circuit with terminal points at SDG&E's Miguel and Border Substations. Border Substation is located on Otay Mesa in the City of San Diego. As part of the Proposed Project, SDG&E would open TL 6910 by installing two new steel cable poles (approximately 83 feet in height) near the proposed Salt Creek Substation, and loop the power line underground via two new 69 kV duct packages in two separate 300-foot trench alignments, originating at the existing transmission corridor and extending, within SDG&E fee-owned property, into the proposed Salt Creek Substation. The 69 kV concrete encased duct packages would have a standard depth of 3.0 feet below grade to top-of-duct package. TL 6910 would then be re-configured as **TL 6910 (Border-Salt Creek Substation)** and **TL 6964 (Miguel – Salt Creek Substation)**. The existing overhead poles and circuit wires would remain as is.

[5] The eight existing poles are part of the TL643.

Drawings and descriptions showing a typical pole top configuration, tieline relative locations to each other and left (west) and right (east) ROW are included in Appendix 1. Figure 1 below shows typical drawing symbols where applicable to a Project; the arrows on the drawings indicate the viewing direction for orienting each drawing and the direction of current flow.

Figure 1: Drawing Symbol Definitions

Symbol	Interpretation	Meaning
	Viewing Direction	The orientation as seen when looking toward the north
	Current flow into the page	Direction of current flow is same as viewing direction
	Current flow out of the page	Direction of current flow is opposite of viewing direction
	Underground Transmission Circuit	Location of underground transmission circuit
	Underground Transmission Circuit	Location of Underground Transmission in Bridge Cell

V. Field Management Measures Considered

Per the "EMF Design Guidelines for Electrical Facilities, Table 3-1", all portions of the power lines, TL 6965, and re-named portion of TL 6910, TL 6964, within scope of the Proposed Project were reviewed for suitable application of magnetic field reduction measures, as listed in "*Table 1: Magnetic Field Reduction Measures Adopted or Rejected*" below. These measures will be discussed under the "Section VI- Magnetic Field Reduction Measures Evaluated for the Project" that follows.

Table 1: Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location (Street, Area)	Adjacent Land Use	Reduction Measure Considered	Measure Adopted? (Yes/No)	Estimated Cost to Adopt
1, 2, 3	SDGE fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Locate power lines closer to center of the utility corridor to extent possible.**	**No**	**N/A**
	Reasons not adopted: Segment 1- is utilizing existing pole structures and is well within SDG&E fee-owned undeveloped land. Relocating circuits in Segment 1 would not be a "no-cost" option, but a "low-cost" option. "Low-cost" mitigation measures are not applicable when alignment is within land considered to be "undeveloped". Segment 2 - Due to the two 230 kV transmission lines in center of the utility corridor, the alignment of TL 6965 would be 15 ft. west of the east ROW which is as close to center of the transmission corridor as possible for safety reasons. Existing TL 6910 and its re-named portion, TL 6964, are on existing poles 15 ft. east of the west ROW which is also as close to center of easement as possible. The spacing is needed in this high wind area for safety in case of blow-out during high wind conditions. Segment 3 – is the getaway underground Segment with underground duct banks well within SDG&E fee-owned undeveloped property. Relocating circuits in Segment 3 would not be a "no-cost" option, but a "low-cost" option. "Low-cost" mitigation measures are not applicable when alignment is within land considered to be "undeveloped".				
1, 2	SDGE fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Increasing structure height**	**No**	**N/A**
	Reasons not adopted: Segment 1 – SDG&E-fee-owned undeveloped land portion of TL 6965 overhead would primarily be share poles with existing TL 643. New poles needed in this Segment would be of similar height. Increased height of the new poles would be a "low-cost" option. "Low-cost" mitigation measures are not applicable when alignment is within land considered to be "undeveloped". Segment 2 - includes the utility corridor where TL 6964, TL 23042, TL 23041, and new TL 6965 would reside. SDG&E Standards for 69kV single circuit overhead transmission lines with no distribution underbuild, require minimum sag height of 30 feet from lowest circuit wire to ground as per *GO-95 Design Standards.* Through modeling, using various heights for lowest sag of new TL 6965, it was found by raising the sag height from the initial 30 feet from lowest circuit wire to ground, to as much as 120 additional feet still would not provide a 15% reduction at either east or west ROW for a "low-cost" mitigation option. To provide that height of sag between lowest circuit wire to ground, pole heights must be over 150 feet high which would be unreasonable and impose safety and maintenance concerns for SDG&E, and possible visual and/or aesthetic concerns for the area.				

	Segment 3 – includes underground in undeveloped land. "Low-cost" mitigation measures are not applicable when alignment is within land considered to be "undeveloped".

Segment(s)	Location (Street, Area)	Adjacent Land Use	Reduction Measure Considered	Measure Adopted? (Yes/No)	Estimated Cost to Adopt
1, 2, 3	SDGE fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Reduce conductor (phase) spacing.**	**No**	**N/A**
	Reasons not adopted: Segment 1 – TL 6965 would primarily share poles with existing TL 643 in a double circuit configuration. New poles needed in this Segment would be of similar height and conductor spacing the existing pole top configuration is per "*SDG&E Electric Transmission Standards*" for 69 kV, which provides optimum magnetic field reduction at edge-of-ROW. Segment 2 - The new steel poles in the Proposed Project for TL 6965 would comply with "*SDG&E Electric Transmission Standards*" for 69 kV -WPI pole top configurations which provide optimum magnetic field reduction. There are no alternative poletop configurations to be considered for this Project. The existing power and transmission lines within the utility corridor (TL 6964, TL 23042, TL 23041) would remain on existing poles with existing pole top configuration. Modifications to their existing conductor phase spacing is out of scope of the Proposed Project. Segment 3 – The underground portion of the Proposed Project would use "*SDG&E Electric Transmission Standards*" for underground phase spacing. Therefore this option was rejected.				
2	SDG&E fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Phasing Circuits to Reduce Magnetic Fields**	**Yes**	**$6K**
	Segment 2 – was modeled with current phasing for TL 6964, TL23042, and TL23041and various configurations for TL 6965. Modeling showed the initial design phase for **TL 6965**, **A-B-C (top-to-bottom)** provided lowest magnetic fields at the east ROW, without increasing fields at the west ROW. (see section "VIII. Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project" below) Since the portion of TL 6910 from Miguel to Salt Creek Substation being re-named **TL 6964** is looping in to Salt Creek Substation, modeling was performed with various phase configurations for that portion of the circuit. Models showed if the phase of **TL 6964** was changed from **A-B-C (top-to-bottom)** to **C-B-A (top-to bottom)** a reduction in magnetic fields of **22. 1%** was achieved at the west ROW, with no increase in magnetic fields at the east ROW. (see section "VIII. Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project" below) This phase configuration should be adopted as a **"low-cost"** option since the existing circuit wires at Miguel Substation from the rack to first pole structure would need to be rolled to provide this phase the full length to the rack at Salt Creek Substation.				

Segment(s)	Location (Street, Area)	Adjacent Land Use	Reduction Measure Considered	Measure Adopted? (Yes/No)	Estimated Cost to Adopt
1, 3	SDG&E fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Phasing Circuits to Reduce Magnetic Fields**	**No**	**N/A**
	Reasons not adopted: Segment 1 – is utilizing existing pole structures and is well within SDG&E fee-owned undeveloped property. TL 6965 would primarily share poles with existing TL 643 in a double circuit configuration. The length of this Segment is 0.9 miles of the 5.0 mile total Project length. TL 6965 should be phased the same from Miguel Substation to Salt Creek Substation with the phase providing optimal magnetic field reduction at edge-of-ROW near the residential area of the Proposed Project, Segment 2. Segment 3 – consists of three (3) single circuit underground duct banks (TL 6965, TL 6964, and TL 6910) taking various paths well within SDG&E owned undeveloped property. Changing phase of a single circuit in a duct bank will not reduce magnetic fields. The remaining portion of TL 6910 leaving Salt Creek Substation continues on to Border Substation. Modeling that portion was not performed since it is out of scope of this Proposed Project. Therfore for Segments 1 and 3, this field reduction method was rejected.				
1, 2	SDG&E fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Placing Overhead Underground**	**No**	**N/A**
	Reasons not adopted: Segment 1- is utilizing existing pole structures and is well within SDG&E fee-owned undeveloped land. Any underground consideration would be a "low-cost" option which is not applicable to undeveloped land use areas. Segment 2 – is within the utility corridor which contains existing overhead power and transmission lines, SDG&E 36-inch high pressure gas transmission pipeline, a 4-inch high pressure gas line, and San Diego County Water Authority (SDCWA) 69-inch and 72-inch water pipelines. Due to these existing utilities, there is no alignment within the 120 foot ROW for an additional underground utility to be installed and still maintain clearance from the other utilities. In addition, modeling showed the standard depth of 3 feet top-of-conduit would only provide 3% reduction in magnetic fields at ROW. An additional 50 foot depth would be required to reach the 15% reduction at the east ROW. This would not only be unreasonable and impose safety and maintenance concerns for SDG&E, but it would degrade the ampacity rating of the circuit below the required ratings for the Project. For these reasons, undergrounding as a "low-cost" field reduction measure was not adopted.				
1, 2, 3	SDG&E fee-owned undeveloped land, Utility Corridor	Residential, Undeveloped	**Increase trench depth**	**No**	**N/A**
	Reasons not adopted: Segment 1 & Segment 3- The proposed and existing power line alignments are well within SDG&E fee-owned undeveloped land. Any underground consideration would be a "low-cost" option which is not applicable to undeveloped land use areas. Segment 2 - Undergrounding the proposed 69 kV tieline, TL 6965 not adopted. (see "Placing overhead underground" above in this table). Therefore increasing trench depth as a reduction measure was rejected for Segment 2.				

VI. Magnetic Field Reduction Measures Evaluated for the Power Line Portion of the Project

Per SDG&E's Guidelines this FMP is limited to an assessment of "phasing circuits to reduce magnetic fields" as a field reduction measure. Other measures such as locating power lines closer to the center of the easement, increasing structure height, reducing conductor (phase) spacing, placing overhead underground to reduce magnetic fields, and increasing trench depth were not implemented.

Locating power lines closer to the center of the easement: The alignment of new TL 6965 within the utility corridor (Segment 2) is as close to center of easement as possible for safety reasons. Since this is considered a high wind area, the spacing is needed in case of blow-out during high wind conditions. Alignment of TL 6965 in Segment 1 and the underground portion in Segment 3 is well within SDG&E-fee-owned undeveloped land and a "low-cost" mitigation such as this is not required over property defined as "undeveloped land". Therefore locating power lines closer to center of easement was discarded as a reduction measure.

Increasing structure height: Increasing the structure height only pertains to the new power line, TL 6965. All other power lines within scope of this project are to remain on existing poles. As Segment 2 was the longest and primary Segment to be considered for this reduction measure, and has residential homes nearby, modeling was performed using 30 feet from lowest circuit wire to ground as defined in *GO-95 Clearance Rules* as the baseline. Due to the Miguel- Mexico utility corridor having existing transmission lines, TL 23041 and TL 23042, on centerline providing a primary source of power from nearby Otay Power Plant to the SDG&E power grid, modifying sag height of TL 6965 to reduce magnetic fields did not approach the 15% reduction for "low-cost" mitigation at the east edge-of- ROW until the additional height reached 150 feet, which is unreasonable and imposes safety and maintenance concerns for SDG&E, and possible visual and/or aesthetic concerns for the area. Less than 1% reduction was achieved at that height at the west edge-of-ROW. Therefore this reduction measure was discarded.

Reducing conductor (phase) spacing: The new steel poles for TL 6965 in the Proposed Project have "SDG&E Electric Transmission Standard" pole-head configurations equivalent which provide optimum magnetic field reduction. There are no alternative poletop configurations to be considered for this Project. The other electric power and transmission lines within the utility corridor (TL 6964, TL 23042, TL 23041) would remain on existing poles with existing pole top configuration. Modifications to their existing conductor phase spacing is out of scope of the Proposed Project. Therefore this reduction measure was rejected.

Phasing Circuits to Reduce Magnetic Fields: Modeling was performed for the utility corridor Segment 2 of the Proposed Project with current phasing for TL 6964, TL23042, and TL23041and various configurations for TL 6965. Modeling showed the initial design for the Proposed Project phasing for **TL 6965**, as **A-B-C (top-to-bottom)** to provided lowest magnetic fields at the east ROW, without increasing fields at the west ROW. Modeling the re-named portion of TL 6910, **TL 6964**, showed if the phase was changed from **A-B-C (top-to-bottom)** to **C-B-A (top-to bottom)** a reduction in magnetic fields of **22. 1%** was achieved at the west ROW, with no increase in magnetic fields at the east ROW. (see section "VIII. Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project" below) . This phase configuration should be adopted as a **"low-cost"** option since the existing circuit wires at Miguel

Substation from the rack to first pole structure would need to be rolled to provide this phase the full length to the rack at Salt Creek Substation.

The remaining portion of TL 6910 leaving Salt Creek Substation continues on to Border Substation. Modeling that portion was not performed since it is out of scope of this Proposed Project.

Undergrounding to reduce magnetic fields: Segment 2 is within the utility corridor which contains existing overhead power and transmission lines, SDG&E 36-inch high pressure gas transmission pipeline, 4-inch high pressure gas line, and San Diego County Water Authority (SDCWA) 69-inch and 72-inch water pipelines. Due to these existing utilities, there is no alignment within the 120 foot wide ROW for an additional underground utility to be installed and still maintain required clearance from the other utilities. In addition, modeling underground for Segment 2 the standard depth of 3 feet top-of-conduit only provided 3% reduction in magnetic fields at edge-of-ROW. An additional 50 foot depth would be required to reach the 15% reduction at the east edge-of-ROW without increasing magnetic fields at the west edge-of-ROW. This would not only be unreasonable and impose safety and maintenance concerns for SDG&E, but it would degrade the ampacity rating of the circuit below the required ratings for the Project.
Undergrounding in Segment 1 would be a "low-cost" reduction measure, which is not applicable to undeveloped land use areas.

For these reasons, undergrounding was rejected as a "low-cost" field-reduction measure.

Increasing trench depth: Undergrounding TL 6965, in Segment 2 was discarded due to the existing underground within the ROW, and degrading the ampacity rating below the required ratings for the Project. For Segments 1 and 3, any underground consideration would be a "low-cost" option which is not applicable to undeveloped land use areas. Therefore this reduction measure was rejected.

VII. Magnetic Field Reduction Measures Recommended for the Power Line Portion of the Proposed Project

Reduction of magnetic field values by increasing structure height as a field reduction measure was adopted as a viable method to reduce magnetic fields at the edge-of-ROW for the Proposed Project. The recommended field reduction measures are:

A. "No-Cost" Field Management Measures:

There are no "no-cost" magnetic field reduction measures recommended for the Proposed Project.

B. "Low-Cost" Field Management Measures:

Modeling the re-named portion of TL 6910, **TL 6964**, showed if the phase was changed from **A-B-C (top-to-bottom)** to **C-B-A (top-to bottom)** a reduction in magnetic fields of **22. 1%** was achieved at the west ROW, with no increase in magnetic fields at the east ROW. (see section "VIII. Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project" below)

This phase arrangement should be adopted as a **"low-cost"** option since the existing circuit wires at Miguel Substation from the rack to first pole structure would need to be rolled to provide this phase the full length to the rack at Salt Creek Substation.

VIII. Summary of Calculated Magnetic Field Levels for the Power Line Portion of the Proposed Project

The following tables show the initial design and recommended ("low-cost") design magnetic field values (milligauss) and the percent change for Segment 2 of the Proposed Project. A positive percentage value shows a reduction in milligauss, while a negative value shows an increase in milligauss from the initial design. The magnetic field values were calculated at the edges-of-ROW. Since increasing structure and sag height, installing TL 6965 underground, and increasing trench depth field reduction measures were not viable reduction measures for the Proposed Project, the only modeling table included shows changes to phase arrangement that provided reduction in magnetic field values (milligauss) at edge-of-ROW for TL 6964 and TL 6965.

Table 2: Segment 2 – TL 6964 and TL 6965 Recommended Phasing

Segment 2	Phasing		
	Existing	Proposed	Percent (%)
TL 6964	A-B-C (t-b)	C-B-A (t-b)	milligauss
TL 6965	A-B-C (t-b)	A-B-C (t-b)	reduction
East ROW	22.25	22.26	0.0%
West ROW	24.89	19.38	22.1%

- Residential, Undeveloped, SDG&E fee-owned undeveloped land use.
- Length = approx. 4.1 miles
- Change Phase of **TL 6964** at Miguel and Salt Creek Substations from A-B-C (t-b) to **C-B-A (t-b)**
- Use initial design phasing for **TL 6965**, **A-B-C (t-b),** which provided lowest milligauss values at edge-of-ROW.
- See "**Appendix 1**" attached for further detail.

IX. Simplified Field Management Plan Checklist for the Salt Creek Substation Portion of the Proposed Project

Generally, magnetic field values along the substation perimeter are low compared to the substation interior because of the distance to the energized equipment. Normally, the highest values of magnetic fields around the perimeter of a substation are caused by overhead power lines and underground duct banks entering and leaving the substation, and not by substation equipment. Therefore, the magnetic field reduction measures generally applicable to a substation project are as follows:

- Site selection for a new substation;
- Setback of substation structures and major substation equipment (such as bus, transformers, and underground cable duct banks, etc.) from perimeter;
- Field reduction for transmission lines entering and exiting the substation.

The Substation Checklist FMP evaluates the no-cost and low-cost measures considered for the substation project, the measures adopted, and reasons that certain measures were not adopted.

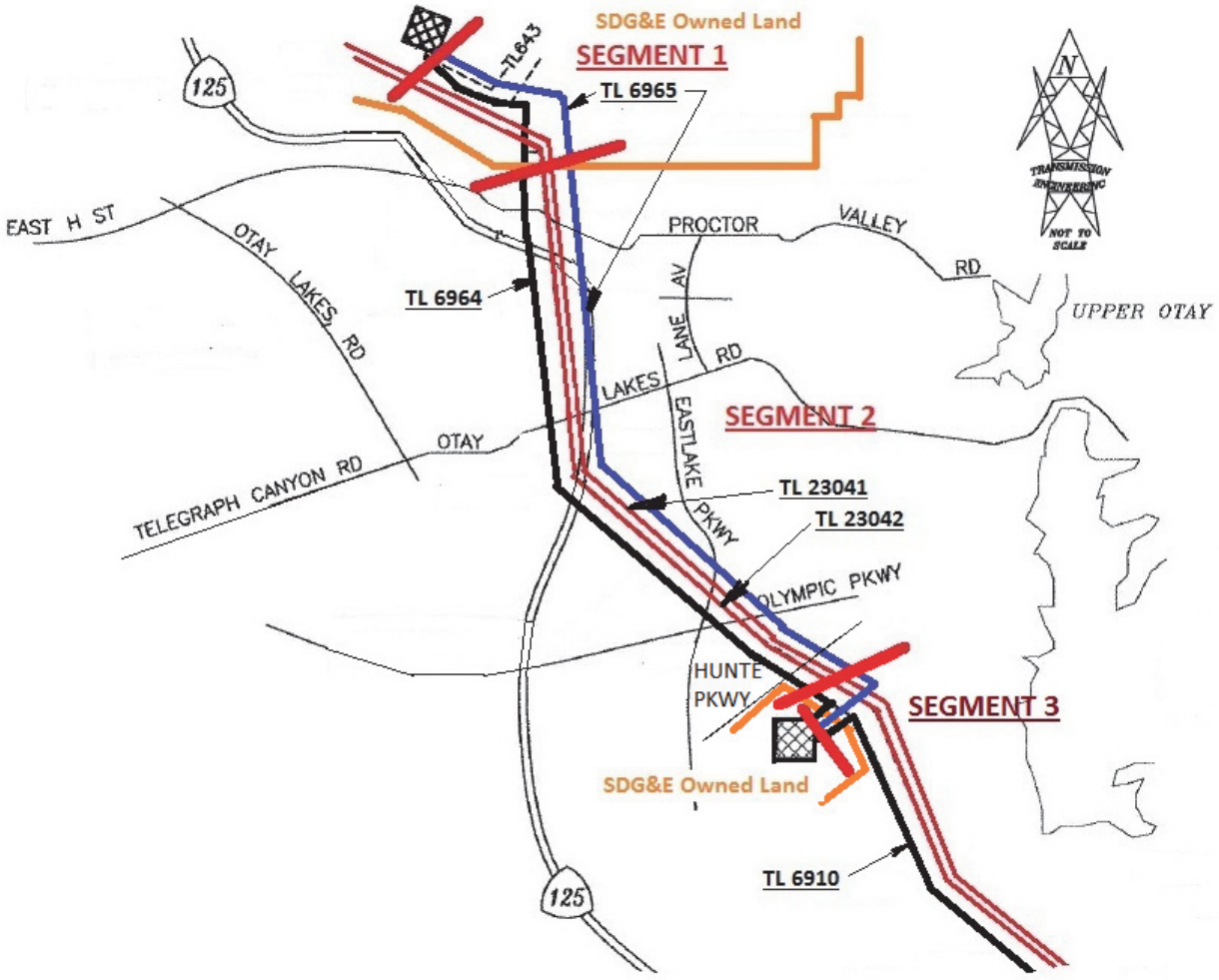
No.	No-Cost and Low-Cost Magnetic Field Reduction Measures Evaluated for a Substation Project	Measure Adopted? (Yes/No)	Reason(s) if not Adopted
1	Keep high current devices, transformers, capacitors, and reactors, away from the substation property lines by bringing into the substation property as much as possible.	Yes	
2	For underground duct banks, the minimum distance should be 12 feet from the adjacent property lines or to the extent practical.	Yes	
3	Locate new substations close to existing transmission line rights-of-way to the extent practical.	Yes	
4	Increase the substation property boundary to the extent practical.	Yes	
5	Other: NONE	N/A	

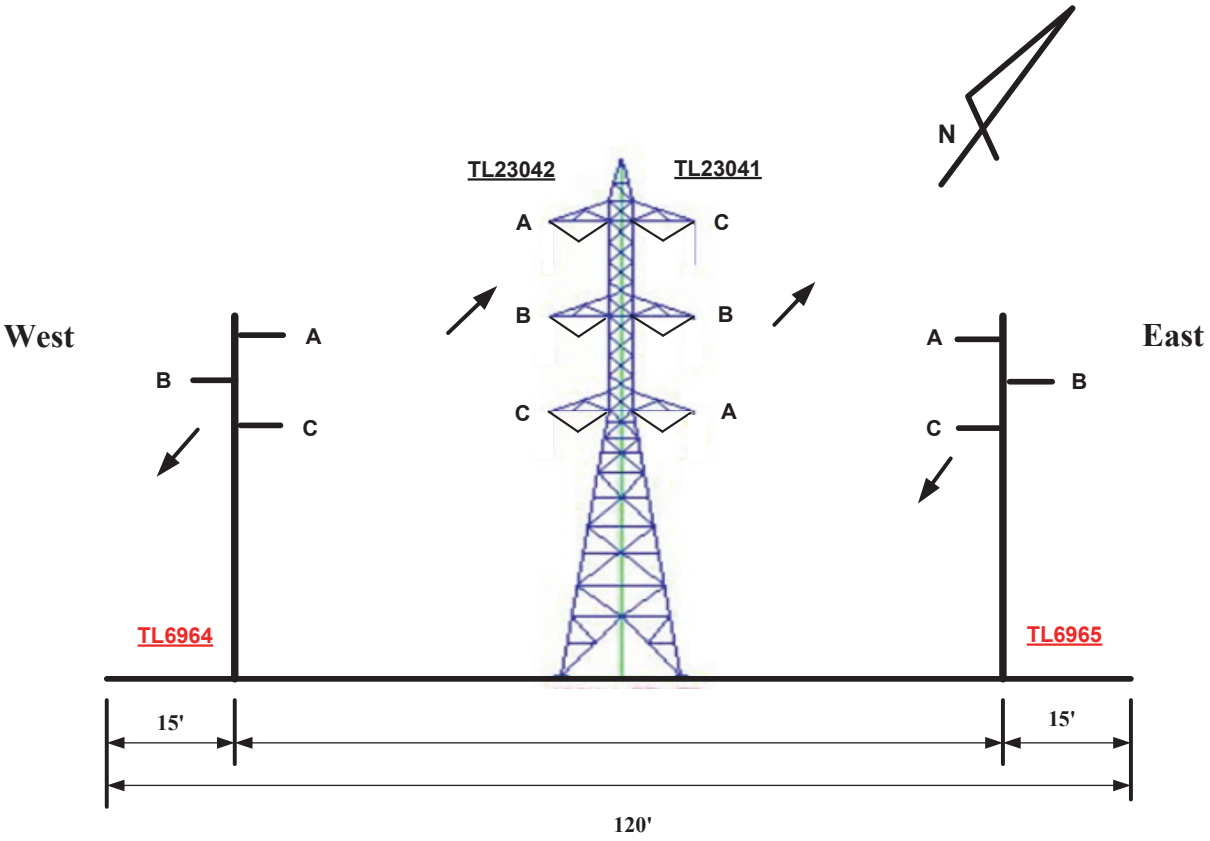
Prepared By: Date:

J.S. Lewis March 20, 2013
Engineer I, Substation Engineering

Appendix 1
Proposed Project

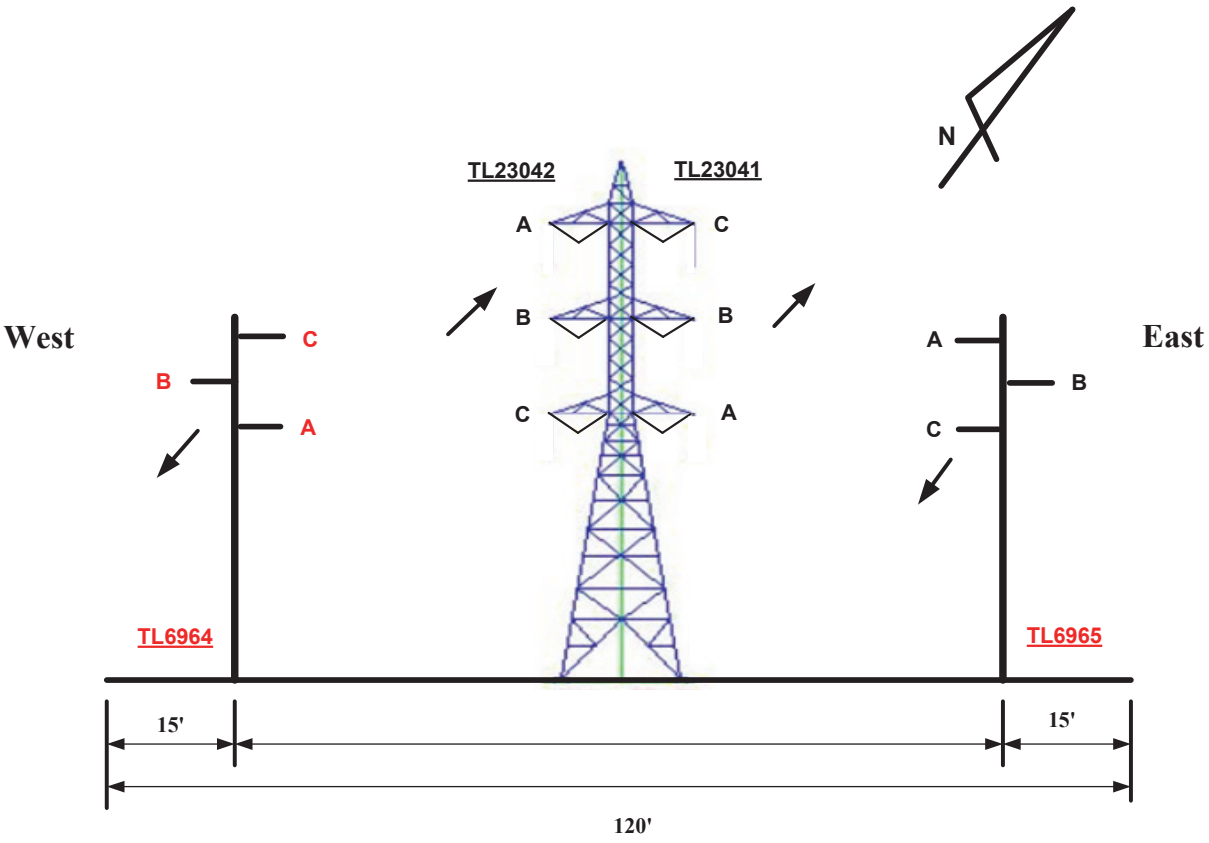
Segment Map





Segment 2 – Initial Design

Approx. Location:	Overhead – within utility corridor from SDG&E-fee-owned undeveloped land, south, to SDG&E owned Salt Creek Substation
Power Lines:	TL 6964 (old TL 6910), TL 23042, TL 23041, new TL 6965
Land use:	Residential, Undeveloped
Length:	4.1 mi.
Right-of-Way Width:	120 ft.



Segment 2 – Proposed Design

Approx. Location:	Overhead - within utility corridor from SDG&E-fee-owned undeveloped land, south, to SDG&E owned Salt Creek Substation
Power Lines:	TL 6964 (old TL 6910), TL 23042, TL 23041, new TL 6965
Land use:	Residential, Undeveloped
Length:	4.1 mi.
Right-of-Way Width:	120 ft.
Change Phasing:	TL 6964 to **C-B-A (t-b)**