Magnetic Field Management Plan for Alternative Routes in the Final Environmental Impact Report for the Proposed Sycamore to Peñasquitos 230 kV Transmission Line Project

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I. Introduction

On April 7, 2014, SDG&E filed application A.14-04-011 with the California Public Utilities Commission ("Commission") for a Certificate of Public Convenience and Necessity ("CPCN") for the proposed Sycamore-Peñasquitos 230 kilovolt ("kV") Transmission Line Project. Included with the Application was SDG&E's Magnetic Field Management Plan ("FMP") for the proposed project.

On March 7, 2016, the Commission issued the Final Environmental Impact Report ("FEIR") identifying five alternatives retained for EIR analysis and ranking alternative routes for the proposed Project.

This document constitutes the revised FMP for the ranked alternative routes. It does not address substation connections or substation FMPs, which are unchanged from that included in the FMP for the original proposed Project. As such, this FMP consists of project descriptions for each alternative route, and summary data tables showing magnetic field values calculated at the edges of the right-of-way ("ROW") or easement for such alternatives. Maps of the Proposed Project and FEIR alternative routes are included at the end of this FMP.

The results of the calculations are discussed in Section IX. Due to the preliminary design status of the alternative underground routes, calculated values provided at the edges of ROW for these routes are based on "typical" duct package placement as discussed in Section IX.

II. Magnetic Field Management Design Guidelines

Per Commission EMF policy, SDG&E applies its *EMF Design Guidelines for Electrical Facilities* ("Guidelines") to all new electric power line, transmission line and substation projects for possible reduction of public exposure to magnetic fields. Consistent with these Guidelines and with the Commission order, the transmission and power lines associated with the FEIR alternative routes were considered and evaluated for possible magnetic field management measures. The results of this assessment are contained in this document.

Per SDG&E's Guidelines,[1] magnetic field assessment and calculations referenced in this document do not include electric distribution lines.

This document 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. Magnetic Field Management Methodology

In Decision 06-01-042, the Commission 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. Decision 06-01-042 also notes that "[U]tility modeling methodology is intended to compare differences between alternative EMF mitigation measures and not determine actual EMF amounts;"[2] and that "modeling indicates relative differences in magnetic field reductions

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[1] 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. [at 1]

[2] Commission Decision D.06-01-042, Finding of Fact 14, p. 20.

between different transmission line construction methods, but does not measure actual environmental magnetic fields."[3]

Per its EMF Guidelines, SDG&E will:

- Apply the Guidelines to the power and transmission line facilities included in the FEIR identified alternative routes.
- Identify and implement appropriate "no-cost" measures, i.e., those that will not increase overall project costs but can 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 can 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 attained due to no-cost measures. It is not cumulative.

Magnetic field values for the easterly overhead segments were calculated using the RESICALC program developed and maintained by the Electric Power Research Institute (EPRI). Magnetic field values for the westerly overhead segments and portions of the alternatives for which design differs from the original proposed project were calculated using the EMF Workstation modeling program, also developed and maintained by EPRI. The projected high-current load case "2017 heavy summer" was used in all calculations. For the purpose of evaluating the field management measures, magnetic field values 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. Magnetic field values were calculated and compared at the adjacent parallel property lines, or edges of ROW, as appropriate, per Commission policy.[4]

IV. Proposed Project Segments

The original proposed Project included the four electric transmission segments listed below.

- Segment A – Construction of approximately 8.31 miles of new 230 kV transmission line on new tubular steel poles all within existing SDG&E ROW located between the existing Sycamore Canyon Substation and Carmel Valley Road.
- Segment B – Install approximately 2.84 miles of new 230 kV underground transmission line in Carmel Valley Road utilizing existing franchise position for almost the entire segment.
- Segment C – Install approximately 2.19 miles of new 230 kV conductor on existing 230 kV steel structures and one new tubular steel pole all within existing SDG&E ROW located between Carmel Valley Road and Peñasquitos Junction.

[3] Ibid, p.11.

[4] The appropriate location for measuring EMF mitigation is the utility ROW [right-of-way] as this is the location at which utilities may maintain access control. [Commission Decision D.06-01-042, Finding of Fact 17, p. 20.]

- Segment D – Install approximately 2.84 miles of new 230 kV conductor on existing 230 kV steel lattice towers all within existing SDG&E ROW located between Peñasquitos Junction and Peñasquitos Junction.

V. FEIR Project Alternatives

Section ES.5.2 of the FEIR [at ES-13], *Alternatives Fully Evaluated in the EIR*, identified these five alternatives retained for detailed analysis in the EIR:

- **Alternative 1**: Eastern Cable Pole at Carmel Valley Road (Option 1b).
- **Alternative 2**: Eastern Cable Pole at Pole P40 and Underground Alignment Through City Open Space (2a) or City Water Utility Service Road (2b).
- **Alternative 3**: Los Peñasquitos Canyon Preserve to Mercy Road Underground, a 5.9-mile underground routing alternative along the Proposed Project route that would avoid the northern portion of Segment A and all of Segments B and C.
- **Alternative 4**: Segment D 69 kV Partial Underground Alignment, a 3.1-mile routing alternative along the Proposed Project route that would eliminate new pole installation along 2.8 miles of Segment D.
- **Alternative 5**: Pomerado Road to Miramar Area North Combination Underground/Overhead. This alternative would underground the majority of the transmission line described as part of the Proposed Project along a new route, with the east and west ends, where the transmission line would be in an overhead position, within existing SDG&E ROWs. This alternative would install 11.5 miles of underground transmission line and 2.8 miles of overhead transmission line.

VI. Route Combinations of Alternatives and Proposed Project Segments

Section ES.8.2 of the FEIR, *Identify Environmentally Superior Alternative* [at ES-62], ranks eight alternatives, which include various combinations of the alternatives listed in ES.5.2 and/or Segments of the Proposed Project. The eight ranked alternatives include options for rankings 4 and 7, resulting in a total of ten alternatives, including the "No Project Alternative." Table ES.8-1 of the FEIR, *Summary of Alternatives Analyzed* [at ES-64], provides a summary of how the alternatives would or could be combined with other alternatives.

Table 1 below provides a description of the FEIR route combinations derived from ES.8.2 (other than the No Project Alternative).

Table 1. Routes by Alternative Ranking

Route	Route Composition (UG = Underground, OH = Overhead)
#1	• Alternative 5, 230 kV Underground – Pomerado Road to Miramar Area North • Alternative 5, 230 kV Overhead – Miramar Area North • Proposed Project in Segment A between the Sycamore Canyon Substation and Stonecroft Trail

Table 1. Routes by Alternative Ranking	
Route	**Route Composition (UG = Underground, OH = Overhead)**
#2	• Alternative 2, Eastern Cable Pole at P40 and UG Alignment through City Open Space (Option 2a) • Alternative 4, Segment D 69 kV Partial UG Alignment • Proposed Project Segments A, B, C and Segment D (230 kV only)
#3	• Alternative 1, Cable Pole at Carmel Valley Road • Alternative 4, Segment D 69 kV Partial UG Alignment • Proposed Project Segments A, B, C and Segment D (230 kV only)
#4A	• Alternative 4, Segment D 69 kV Partial UG Alignment • Proposed Project Segments A, B, C and Segment D (230 kV only)
#4B	• Alternative 4, Segment D 69 kV Partial UG Alignment • Alternative 3, Los Peñasquitos Canyon Preserve to Mercy Road 230 kV UG • Proposed Project in OH Segment A (Sycamore Canyon Substation to Ivy Hill Dr.) • Proposed Project OH Segment D (230 kV only)
#5	• Alternative 2, Eastern Cable Pole at Pole P40 and UG Alignment Through City Open Space (Option 2a) or City Water Utility Service Road (Option 2b) • Proposed Project in all other locations
#6	• Alternative 1, Eastern Cable Pole at Carmel Valley Road (Option 1b) • Proposed Project in all other locations
#7A	Proposed Project
#7B	• Alternative 3, Los Peñasquitos Canyon Preserve to Mercy Road 230 kV UG • Proposed Project in OH Segment A (Sycamore Canyon Substation to Ivy Hill Dr.) • Proposed Project OH Segment D

VII. Magnetic Field Reduction Measures Adopted or Rejected

Per SDG&E's Guidelines, the following magnetic field reduction measures were considered for the routes identified in Table 1, for those portions of power lines TL 675, TL 6906, TL 6920, TL 13804, TL 13811, TL 13820, and transmission lines TL 23001, TL 23004, and proposed TL 230XX, within scope of the routes.

A. Increase conductor height by increasing structure height
B. Locate power lines closer to the centerline of the corridor
C. Phase circuits to reduce magnetic fields.
D. Reduce conductor (phase) spacing.
E. Increase trench depth.

Tables 2 through 10 below provide a summary of magnetic field reduction methods adopted or rejected for each of the nine route combinations in Table 1 above.

Table 2: Route Combination #1

Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
Partial A and **Alt. 5, 230 kV OH – Miramar Area North**	Within existing ROW and franchise	1, 2, 3, 4, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing.	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
Partial A	Within existing ROW and franchise	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
Alt. 5, 230 kV OH – Miramar Area North	Within existing ROW and franchise	1, 2, 3, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
Alt. 5, 230 kV UG – Pomerado Road to Miramar Area North	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 3: Route Combination #2
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, C, D (230 kV only) and **Alt. 2 Cable Pole**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
A, D (230 kV only) and **Alt. 2 Cable Pole**	Within existing ROW	1, 2, 3, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW and franchise	1, 2, 3, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway
Alt. 2 UG Options		4, 6	Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
Alt. 4 - Segment D 69 kV Partial UG Alignment			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
		1, 2, 3, 6	Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 4: Route Combination #3

Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, C, D (230 kV only) and **Alt. 1**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
A, D (230 kV only) and **Alt. 1**	Within existing ROW	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW and franchise	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B **Alt. 4 - Segment D 69 kV Partial UG Alignment**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 5: Route Combination #4A
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use [3]	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, D (230 kV only)	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Increase structure height (increase conductor height from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW and franchise	1, 2, 3, 6	Increase structure height (increase conductor height from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B **Alt. 4 - Segment D 69 kV Partial UG Alignment**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 6: Route Combination #4B
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, D (230 kV only)	Within existing ROW and franchise	1, 2, 3, 4, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Increase structure height (increase the height of the conductor from ground level)	No-Cost Low-cost	Yes No	N/A Not 15% or more reduction
			Reduce conductor (phase) spacing.	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
Alt 3 - Los Peñasquitos Canyon Preserve to Mercy Road 230 kV UG and **Alt. 4 - Segment D 69 kV Partial UG Alignment**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 7: Route Combination #5
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, C, D and **Alt. 2 Cable Pole**	Within existing ROW and franchise	1, 2, 3, 4, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
A, D and **Alt. 2 Cable Pole**	Within existing ROW	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW and franchise	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B **Alt. 4 - Segment D 69 kV Partial UG Alignment** **Alt. 2 UG Options**	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 8: Route Combination #6
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, C, D and **Alt. 1 Cable Pole**	Within existing ROW and franchise	1, 2, 3, 4, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
A, D and **Alt. 1 Cable Pole**	Within existing ROW	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost Low-cost	Yes No	N/A Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost Low-cost	No No	Design uses existing structures Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 9: Route Combination #7A

Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, C, D	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
A, D	Within existing ROW	1, 2, 3, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
C	Within existing ROW	1, 2, 3, 4, 6	Increase structure height (increase the height of the conductor from ground level)	No-Cost	No	Design uses existing structures
				Low-cost	No	Not 15% or more reduction
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
B	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway and separation requirements
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

Table 10: Route Combination #7B
Magnetic Field Reduction Measures Adopted or Rejected

Segment(s)	Location	Adjacent Land Use	Reduction Measure	Estimated Cost to Adopt	Measure Adopted? (Yes/No)	Reason(s) if not adopted
A, D	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	No	Prevented by other tie lines within the corridor and separation requirements
			Increase structure height (increase the height of the conductor from ground level)	No-Cost	Yes	N/A
				Low-cost	No	Not 15% or more reduction
			Reduce conductor (phase) spacing	No-Cost	No	Design uses optimum phase spacing
			Phase circuits to reduce magnetic fields	No-Cost	No	Design uses optimum phasing
Alt. 3 - Los Peñasquitos Canyon Preserve to Mercy Road 230 kV UG	Within existing ROW and franchise	1, 2, 3, 6	Locate power lines closer to center of the utility corridor to extent possible	No-Cost	Yes, as possible	Dependent on location of other utilities within the roadway
			Phase circuits to reduce magnetic fields	No-Cost	Yes	N/A
			Increase trench depth	Low-Cost	No	Modeling for additional 3 feet of depth showed necessary 15% reduction could not be achieved

Numbered land use categories are: (1) Schools, licensed day care and hospitals; (2) Residential; (3) Commercial/Industrial; (4) Recreational; (5) Agricultural; (6) Undeveloped land

VIII. Summary of Magnetic Field Reduction Measures Adopted or Rejected

As identified in Section VII, several no-cost magnetic field reduction measures were recommended for the Proposed Project segments and the FEIR Alternatives. No low-cost measures were recommended.

Table 11 below identifies those "no-cost" and "low-cost" measures which were appropriate to consider for the Alternatives and the Proposed Project segment, and whether the measures were adopted.

Table 12 below provides the rationale for adoption or rejection of those measures which were considered.

Table 11. Magnetic Field Reduction Measures Considered

Segment or Alternative	Reduction Measure Considered	Measure Adopted?	Est. Cost to Adopt
Alternative 1, Eastern Cable Pole at Carmel Valley Road (Option 1b) **Alternative 2**, Eastern Cable Pole at Pole P40	Locate power lines closer to center of the utility corridor to extent possible	No	N/A
	Increase conductor height by increasing structure height	Yes	No-cost
	Phase circuits to reduce magnetic fields	No	N/A
	Reduce conductor (phase) spacing	No	N/A
Alternative 2 Underground Options 2a or 2b, Eastern Cable Pole at Pole P40 **Alternative 3**, Los Peñasquitos Canyon Preserve to Mercy Road Underground **Alternative 4**, Segment D 69 kV Partial Underground Alignment **Alternative 5 Underground**, Pomerado Road to Miramar Area North	Locate power lines closer to center of the utility corridor to extent possible	As possible	No-cost
	Phase circuits to reduce magnetic fields	Yes	No-cost
	Increase trench depth	No	N/A
Alternative 5 Overhead, Miramar Area North	Locate power lines closer to center of the utility corridor to extent possible	No	N/A
	Increase conductor height by increasing structure height	No	N/A
	Increase conductor height by increasing structure height	No	N/A
	Phase circuits to reduce magnetic fields	No	N/A
	Reduce conductor (phase) spacing	No	N/A
Proposed Project Segment A (Overhead)	Locate power lines closer to center of the utility corridor to extent possible	No	N/A
	Increase conductor height by increasing structure height	Yes	No-cost
	Phase circuits to reduce magnetic fields	No	N/A
	Reduce conductor (phase) spacing	No	N/A

Table 11. Magnetic Field Reduction Measures Considered			
Segment or Alternative	**Reduction Measure Considered**	**Measure Adopted?**	**Est. Cost to Adopt**
Proposed Project Segment B (Underground)	Locate power lines closer to center of the utility corridor to extent possible	As possible	No-cost
	Phase circuits to reduce magnetic fields	Yes	No-cost
	Increase trench depth	No	N/A
Proposed Project Segment C (Overhead)	Locate power lines closer to center of the utility corridor to extent possible	No	N/A
	Increase conductor height by increasing structure height	No	N/A
	Phase circuits to reduce magnetic fields	No	N/A
	Reduce conductor (phase) spacing	No	N/A
Proposed Project Segment D (Overhead)	Locate power lines closer to center of the utility corridor to extent possible	No	N/A
	Increase conductor height	Yes	No-cost
	Phase circuits to reduce magnetic fields	No	N/A
	Reduce conductor (phase) spacing	No	N/A

Table 12. Reasons Magnetic Field Reduction Measures Were Adopted or Rejected		
Reduction Measure Rejected	**Segments Where Considered**	**Reason(s) Reduction Measure Was Adopted or Rejected**
Locate power lines closer to center of the utility corridor to extent possible	All	For overhead Segments A, C and D and the overhead portion of Alternative 5, this measure was rejected as both a no-cost and a low-cost magnetic field reduction solution due to other structures and tie lines within the corridor and separation requirements. For underground Segment B and Alternatives 3 and 4, and the underground portions of Alternatives 2 and 5, this no-cost measure would be adopted to the extent possible dependent on location of other utilities within the roadway and separation requirements.
Increase conductor height by increasing structure height	OH Segments A, C, D and Alternatives 1, 2 and 5	For overhead Segments A and D, this measure was adopted as a no-cost magnetic field reduction solution since the proposed design height above ground for the new structures in these segments averages an increase of 11 feet (to 41 ft. from 30 ft.) to be consistent with the heights of the existing structures. For Alternatives 1 and 2, this measure was adopted as a no-cost magnetic field reduction solution since the cable poles would be taller than the Proposed Project cable pole. For overhead Segment C and the overhead portion of Alternative 5, this measure was rejected as a no-cost magnetic field reduction solution because the design uses existing structures, and was rejected as a low-cost magnetic field reduction solution because it would not achieve a minimum 15% reduction at the edges of ROW.

Table 12. Reasons Magnetic Field Reduction Measures Were Adopted or Rejected		
Reduction Measure Rejected	**Segments Where Considered**	**Reason(s) Reduction Measure Was Adopted or Rejected**
Phase circuits to reduce magnetic fields	All	For overhead Segments A and D, the overhead portion of Alternative 5, and the Alternative 1 and 2 cable poles, this measure was rejected as both a no-cost and a low-cost magnetic field reduction solution because the design provides lowest milligauss values at the edges of ROW compared with other phasing arrangements. For underground Segment B, the phases of the two 69 kV circuits can "reversed" to achieve reduction at the edges of ROW as a no-cost reduction measure. For Alternatives 3 and 4 and the underground portions of Alternatives 2 and 5, the bundled phases of the single 230 kV circuit can be split and "reversed" to achieve reduction at the edges of ROW as a no-cost reduction measure. For overhead Segment C, the new 230 kV circuit can be phased the same as the existing 230 kV circuit since the power flows are in opposite directions; this no-cost measure would be adopted since it would achieve reduction at the edges of ROW.
Reduce conductor (phase) spacing	All	This measure was rejected as both a no-cost and a low-cost magnetic field reduction solution for all segments and alternatives, since the circuit design for all overhead and underground uses optimum phase spacing based on SDG&E construction standards.
Increase trench depth	UG Segment B and Alternatives 2, 3, 4 and 5	For 230 kV underground Segment B, Alternative 3, and the underground portions of Alternatives 2 and 5, calculations show that the adopted no-cost measure of reverse-phasing already reduces magnetic field values at the edge of ROW by 91% to 98%. For 69 kV underground Alternative 4, calculations show that the adopted no-cost measure of reverse-phasing already reduces magnetic field values at the edge of ROW by 55% to 65%. Increasing trench depth was considered as a possible low-cost magnetic field reduction solution. For the underground segments and alternatives, modeling for an additional three feet of depth showed that the necessary 15% reduction to qualify as a possible low-cost measure could not be achieved at both edges of ROW. Therefore, this measure was rejected as a low-cost solution. As noted above for these underground segments and alternatives, SDG&E would, to the extent possible, locate power lines closer to center of the road ROWs, dependent on location of other utilities within the roadway and separation requirements. This no-cost measure is often more effective in reducing fields at the near edge of ROW than increasing trench depth. The CPUC noted in D.06-01-042 that: 1) "placing a transmission line underground should normally provide sufficient mitigation" [at 12]; 2) "underground transmission lines typically reduce magnetic fields in comparison to overhead line construction [at 12];" 3) "underground lines are usually more costly than overhead line construction [at 12]; and 4) "[N]on-routine mitigation measures should only be considered under unique circumstances." [at 18]

IX. Calculated Magnetic Field Values for Segments and Alternatives

Each of the nine combined routes identified in Section V is a combination of one or more of the Proposed Project Segments A, B, C and D (to one extent or another) and alternative segments identified in the FEIR. The segments evaluated for magnetic field reduction are:

1) Proposed Project Overhead Segment A (partial or complete)
2) Proposed Project Underground Segment B
3) Proposed Project Overhead Segment C
4) Proposed Project Overhead Segment D (with and without 69 kV)
5) Alternative 2, Underground options related to relocation of the Cable Pole at Pole P40
6) Alternative 3, Los Peñasquitos Canyon Preserve to Mercy Road 230 kV Underground
7) Alternative 4, Segment D 69 kV Partial Underground Alignment
8) Alternative 5, 230 kV Underground (Pomerado Road to Miramar Area North)
9) Alternative 5, 230 kV Overhead (Miramar Area North)

Unlike possible low-cost measures for which a minimum reduction of 15% at the edge of ROW must be demonstrated, no-cost measures are applied, where feasible, as long as some percent reduction can be achieved.

The tables in this section show calculated magnetic field values in milligauss at the edges of ROW or edges of easement for the segments associated with these nine ranked alternative routes. Calculations were performed for power and transmission lines only, and exclude all electric distribution lines, whether stand-alone, underbuilt on poles or underground.

No calculations were performed for the Alternative 1 and 2 cable pole relocations due to their limited scope.

As noted previously, the design status of the alternative routes is preliminary. In particular, SDG&E has not yet finalized locations for the underground duct packages in the roadways. For the underground segments, calculated milligauss values are provided at "Near Edge" and "Far Edge" for road ROW widths ranging from 60 feet to 120 feet for Alternatives 2, 3 and 5, and from 70 feet to 108 feet for Alternative 4, based on the center of the duct package being 20 feet from the "Near Edge ROW."

Proposed Project Segments A, B, C and D

The calculated milligauss values in the tables below are reproduced for Segments A, B and C from the FMP for the Proposed Project, and for Segment D from SDG&E's response to Energy Division Data Request #18 for overhead Segment D.

Calculated Magnetic Field Values* for Proposed Project Overhead Segment A					
Standard Design Height Above Ground, 30 feet		Initial Design Height Above Ground, 41 feet		Percent Reduction Standard Hgt. vs Design Hgt.	
West	**East**	**West**	**East**	**West**	**East**
59.4	46.3	48.9	46.5	18%	0%
Calculated Magnetic Field Values* for Proposed Project Underground Segment B					
UG, Standard 3-foot cover, Phasing ABC/ABC		UG, Standard 3-foot cover, Phasing ABC/CBA		Percent Reduction ABC/ABC vs ABC/CBA	
South	**North**	**South**	**North**	**South**	**North**
8.4	4.4	0.3	0.1	96%	98%

Calculated Magnetic Field Values* for Proposed Project Overhead Segment C					
Initial Phasing ABC/CBA		Reverse Phasing ABC/ABC		Percent Reduction ABC/CBA vs ABC/ABC	
West	**East**	**West**	**East**	**West**	**East**
140.9	142.4	122.3	91.0	13%	36%
Calculated Magnetic Field Values* for Proposed Project Overhead Segment D					
Initial Design with 69 kV Overhead		Alternative Design without 69 kV Overhead		Percent Reduction w/69 kV vs w/o 69 kV	
South	**North**	**South**	**North**	**South**	**North**
1.8	71.8	3.3	79.1	-82%	-10%

Note: A minus percent reduction indicates an increase in magnetic field value.

* Calculated values are for design comparison only and not meant to predict actual magnetic field levels.

Alternative 2 UG, Alternative 3 UG and **Alternative 5 UG**

Ranges in predominant ROW width: Alternative 3, 60' to 157'; Alternative 5, 70' to 120'

Calculated Magnetic Field Values* for Alternatives 2, 3 and 5						
	UG, Standard 3-foot cover, Phasing ABC/ABC		UG, Standard 3-foot cover, Phasing ABC/CBA		Percent Reduction ABC/ABC vs ABC/CBA	
Street Width (ft.)	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**
60	46.4	13.0	3.9	0.6	91.5%	95.5%
70	46.4	8.4	3.9	0.3	91.5%	96.4%
80	46.4	5.9	3.9	0.2	91.5%	96.9%
100	46.4	3.3	3.9	0.1	91.5%	97.6%
120	46.4	2.2	3.9	0.0	91.5%	98.1%

* Calculated values are for design comparison only and not meant to predict actual magnetic field levels.

Alternative 4, 69 kV Partial Underground Alignment for Segment D

Ranges in predominant ROW width: East Ocean Air Dr., 70 ' to 108'; Carmel Mountain Rd., 98' to 108'

Calculated Magnetic Field Values* for Alternative 4						
If duct package placed on north or west side of street						
	UG, Standard 3-foot cover, Phasing ABC/ABC		UG, Standard 3-foot cover, Phasing ABC/CBA		Percent Reduction ABC/ABC vs ABC/CBA	
Street Width (ft.)	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**
70	18.5	3.2	8.3	1.2	55.2%	62.7%
98	18.5	1.4	8.3	0.5	55.2%	61.8%
108	18.5	1.1	8.3	0.4	55.2%	61.7%
If duct package placed on south or east side of street						
	UG, Standard 3-foot cover Phasing ABC/ABC		UG, Standard 3-foot cover Phasing ABC/CBA		Percent Reduction ABC/ABC vs ABC/CBA	
Street Width (ft.)	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**	**Near Edge ROW**	**Far Edge ROW**
70	17.6	3.3	6.1	1.4	65.5%	58.0%
98	17.6	1.4	6.1	0.6	65.5%	58.4%
108	17.6	1.1	6.1	0.5	65.5%	58.3%

* Calculated values are for design comparison only and not meant to predict actual magnetic field levels.

Alternative 5, OH

The Alternative 5 overhead 230 kV segment is divided into these four sub-segments based on varying cross-sectional circuit placement:

1) Carroll Canyon Road to Mira Sorrento Place
2) Mira Sorrento Place to Wateridge Circle
3) Wateridge Circle to Sorrento Valley Blvd
4) Sorrento Valley Blvd to Peñasquitos Substation

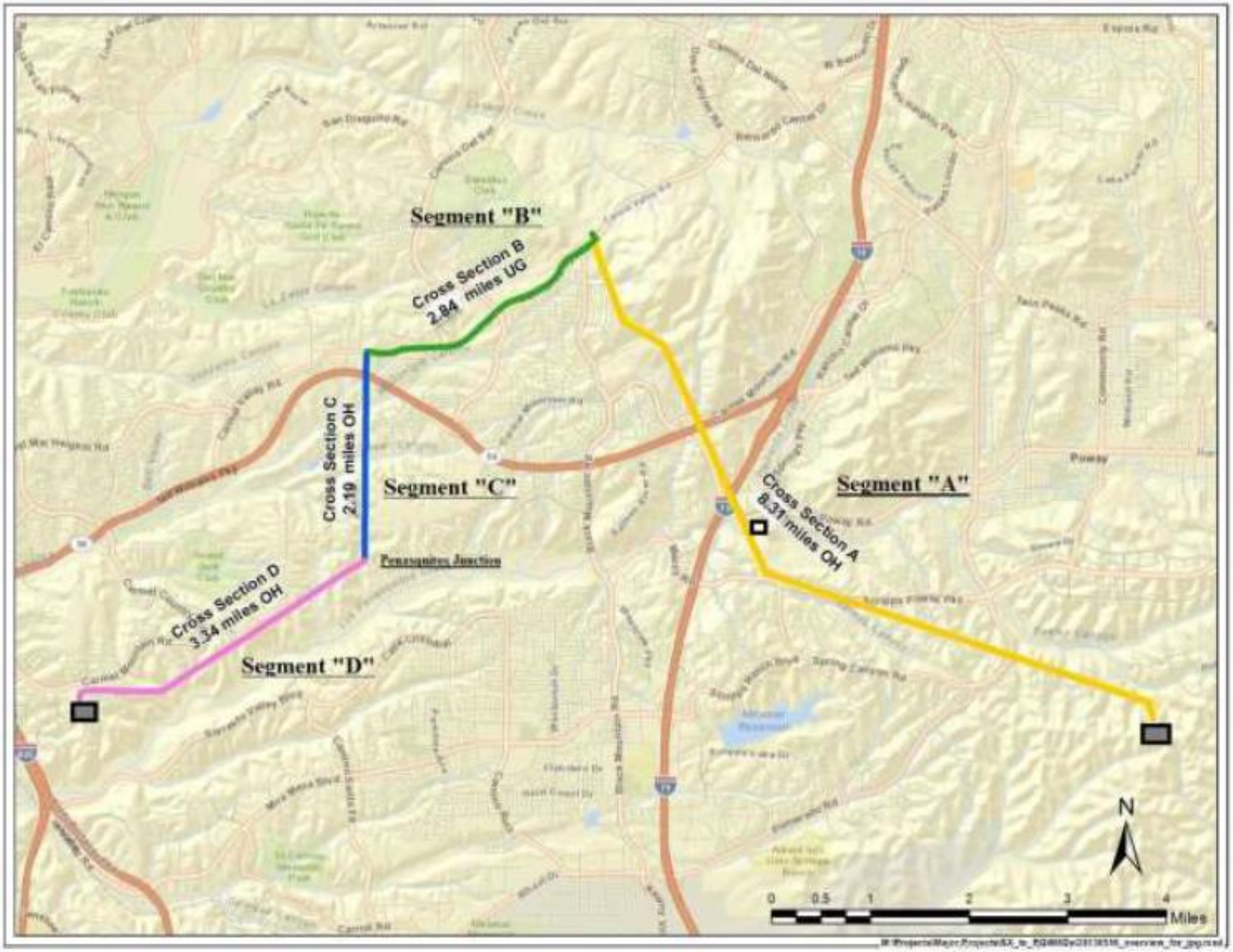
Calculated Magnetic Field Values* for Alternative 5						
	New 230 kV, Standard Phasing ABC/ABC		New 230 kV, Reverse Phasing ABC/CBA		Percent Reduction ABC/ABC vs ABC/CBA	
Sub-segment	**West**	**East**	**West**	**East**	**West**	**East**
1	23.5	79.1	25.0	46.3	-6.3%	41.4%
2	35.4	61.8	58.6	59.6	-65.5%	3.5%
3	41.0	65.4	12.3	55.8	70.0%	14.6%
4	35.4	62.5	43.0	58.3	-21.4%	6.7%

Note: A minus percent reduction indicates an increase in magnetic field value.

* Calculated values are for design comparison only and not meant to predict actual magnetic field levels.

Maps of the Routes Retained in the FEIR for the Project

Proposed Route



Alternatives 3, 4 and 5 (reproduced from FEIR, Panorama Environmental, Inc.)

Figure ES.5-2 Routing Alternatives Retained for EIR Analysis (Alternatives 3, 4, and 5)

SOURCES: Esri 2015, SDG&E 2015, and Panorama Environmental, Inc. 2015

Scale: 1:50,000

LEGEND

- Proposed Alignment (overhead)
- Proposed Alignment (underground)
- Alternative 3: Los Penasquitos Canyon Preserve - Mercy Road Underground Alternative
- Alternative 4: Segment D 69kV Partial Underground Alignment
- Alternative 5: Pomerado Road to Miramar Area North Combination Underground/Overhead Alternative (overhead)
- Alternative 5: Pomerado Road to Miramar Area North Combination Underground/Overhead Alternative (underground)
- City Boundary

Cable Pole Alternatives (reproduced from FEIR, Panorama Environmental, Inc.)