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PACIFIC GAS AND ELECTRIC COMPANY

EXHIBIT D
PRELIMINARY EMF FIELD MANAGEMENT PLAN

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MORAGA-OAKLAND X 115 KV LINE REBUILD PROJECT PRELIMINARY TRANSMISSION MAGNETIC FIELD MANAGEMENT PLAN

I. General Description of Project

Project Lead:
Project Manager, Electric Transmission Maintenance and Construction

Transmission Lines:
Moraga-Oakland X 115 kV line

Distribution Line Underbuild:
None

Scope of Work:

- Approximately 4 miles of the existing Moraga-Oakland X 115 kV lines is proposed to be rebuilt in place, including reconductoring and replacement of towers, from Moraga Substation to Corpus Christi School
- Approximately 1.2 miles of Moraga-Oakland X 115 kV lines is proposed to be placed underground from Corpus Christi School to Oakland X Substation along Park Boulevard.
- Remove approximately 1 mile of existing double circuit lines and structures after Moraga-Oakland X 115 kv lines are replaced underground.

The ultimate objective of the project is to provide lifecycle updates to the double circuit, four-line path by removing and replacing four circuits to avoid future reliability issues while maintaining safe operations.

The estimated total cost of the proposed project is approximately *$440,000,000.*[1] Four percent of this estimated total cost is *$17,600,000.*

II. Background: CPUC Decision 93-11-013 and Decision D.06-01-042

On January 15, 1991, the CPUC initiated an investigation to consider its role in mitigating the health effects, if any, of electric and magnetic fields ("EMF") from utility facilities and power lines. A working group of interested parties, called the California EMF Consensus Group, was created by the CPUC to advise it on this issue. It consisted of 17 stakeholders representing citizens groups, consumer groups, environmental groups, state agencies, unions, and utilities. The Consensus Group's fact-finding process was open to the public, and its report incorporated concerns expressed by the public. The Consensus Group's recommendations were filed with the Commission in March 1992.

[1] $440 million represents the "worst case" for total project cost.

In August 2004 the CPUC began a proceeding known as a "rulemaking" (R.04-08-020) to explore whether changes should be made to existing CPUC policies and rules concerning EMF from electric transmission lines and other utility facilities.

Through a series of hearings and conferences, the Commission evaluated the results of its existing EMF mitigation policies and addressed possible improvements in implementation of these policies. The CPUC also explored whether new policies were warranted in light of recent scientific findings on the possible health effects of EMF exposure.

The CPUC completed the EMF rulemaking in January 2006 and presented these conclusions in Decision D.06-01-042:

- The CPUC affirmed its existing policy of requiring no cost and low-cost mitigation measures to reduce EMF levels from new utility transmission lines and substation projects.

- The CPUC adopted rules and policies to improve utility design guidelines for reducing EMF and established a utility workshop to implement these policies and standardize design guidelines.

- Despite numerous studies, including one ordered by the Commission and conducted by the California Department of Health Services, the CPUC stated "we are unable to determine whether there is a significant scientifically verifiable relationship between EMF exposure and negative health consequences."

- The CPUC said it will "remain vigilant" regarding new scientific studies on EMF, and if these studies indicate negative EMF health impacts, the Commission will reconsider its EMF policies and open a new rulemaking if necessary.

In response to a situation of scientific uncertainty and public concern, the decision specifically requires utilities to consider "no-cost" and "low-cost" measures, where feasible, to reduce exposure from new or upgraded utility facilities. It directs that no-cost mitigation measures be undertaken, and that low-cost options, when they meet certain guidelines for field reduction and cost, be adopted through the project certification process. PG&E was directed to develop, submit, and follow EMF guidelines to implement the CPUC decision. According to the guidelines, four percent of total project budgeted cost is the benchmark used to determine "low-cost" in implementing EMF mitigation, and mitigation measures should achieve incremental magnetic field reductions of at least 15% at the edge of right-of-way ("ROW").

The California Department of Education ("CDE") evaluates potential school sites under a range of criteria, including environmental and safety issues. Proximity to high-voltage power transmission lines[2] is one of the criteria. As directed by the CPUC in Decision 06-01-042, the California investor-owned utilities worked with the CDE to align EMF Design Guidelines with the CDE's policies to the extent those policies were consistent with the CPUC's EMF Policy as stated in its Decision 06-01-042. This collaboration resulted in the updated power line setback

[2] *School Site Selection and Approval Guide*, California Department of Education (2000)

exemption guidelines issued in May 2006. In revising its precautionary EMF approach, the CDE stated:

> "The proposed guidance acknowledges the scientific uncertainty of the health effects of EMFs, the lack of any state or nationally established standard for EMF exposure, and the PUC's recently reconfirmed reliance upon no/low-cost measures targeted to only reduce fields from new power transmission lines." [3]

For underground power lines rated 50 kV and above, the CDE's setback distances are as follows:

- 25 feet for 50-133 kV line (interpreted by CDE up to 200 kV)
- 37.5 feet for 220-230 kV line
- 87.5 feet for 500-550 kV line

III. General Description of Surrounding Land Uses

Land Uses Adjacent to Project Route

Schools or Daycare:

School: Corpus Christi
Daycares: Gan Moh Tov Preschool, Duck Pond Preschool, Les Petites Francophones

Overhead Rebuild: Four structures.
Undergrounding: Approximately .11 underground miles.

Residential:

Overhead Rebuild: Thirty-Two structures.
Undergrounding: Approximately .96 underground miles.

Commercial/Industrial:

Overhead Rebuild: No structures.
Undergrounding: Approximately .08 underground miles.

Recreational:

Overhead Rebuild: Six structures

Agricultural, Rural, and Undeveloped Land:

Overhead Rebuild: Fourteen structures.
Undergrounding: Approximately .12 underground miles

[3] "Power Line Setback Exemption Guidance - May 2006" by the California Department of Education

IV. No-Cost and Low-Cost Magnetic Field Mitigation

A. No-Cost Magnetic Field Reduction Options

1. Overhead Rebuild

Optimal phase configurations can be used as a field cancellation technique. The phases from one circuit of a multi-circuit line can be used to reduce the field from another circuit, thereby reducing the total magnetic field strength. For this reason, multi-circuit lines may have lower magnetic fields than single circuit lines. Double circuit tower lines in the school and residential land use areas considered for optimal phasing:

Moraga-Oakland X 115 kV Rebuild

	Base Case Phasing	**Proposed Optimal Phasing**
From Structure 0/1 to Structure 3/29		
Moraga-Oakland X 115kV #1	(T,M,B) = ABC	(T,M,B) = **CBA**
Moraga-Oakland X 115kV #2	(T,M,B) = ABC	(T,M,B) = ABC
From Structure 0/1 to Structure 3/31		
Moraga-Oakland X 115kV #3	(T,M,B) = BCA	(T,M,B) = **ACB**
Moraga-Oakland X 115kV #4	(T,M,B) = BCA	(T,M,B) = BCA

Optimally Phase Overhead Circuits

The phases of the Moraga-Oakland X 115 kV #1 and Moraga-Oakland 115 kV X #2 lines can be arranged for minimum magnetic field level at the edge of the ROW. This FMP proposes to arrange Moraga-Oakland X 115 kV #1 phasing from ABC (top, middle, bottom) to CBA (top, middle, bottom). The phases of the Moraga-Oakland X 115 kV #3 and Moraga-Oakland X 115 kV #4 lines can be arranged for minimum magnetic field level at the edge of the ROW. This FMP proposes to arrange Moraga-Oakland X 115 kV #3 phasing from BCA (top, middle, bottom) to ACB (top, middle, bottom).

Location of Calculation

Calculations are based on standard 1100 amp current flow and a minimum conductor height of twenty-eight feet at midspan. Below are the calculations for proposed optimal phasing:

Table 1. Magnetic Field Reduction for Phase Optimization

Phasing Calculations	Base Case		Optimal phase		Reduction	
Segment	North ROW	South ROW	North ROW	South ROW	North ROW	South ROW
Oakland-Moraga #1, #2, #3 and #4 115kV Lines	118.1 mG	118.1 mG	51.6 mG	51.6 mG	56.0%	56.0%

The purpose of magnetic field modeling is to evaluate relative effectiveness of various magnetic field reduction measures, not to predict magnetic field levels.

2. Undergrounding

Base Case Triangular Underground Configuration

The magnetic field strength at ground level is a result of the addition of the magnetic field vectors of the various current carrying conductors. As the phases are moved closer together, there is increased phase-to-phase cancellation of the magnetic field and the total resultant field strength decreases. Therefore, compact spacing designs can result in a lower magnetic field strength than larger, more spread-out designs. Horizontal or vertical configurations typically have a larger phase spacing and hence, produce higher fields under the line than triangular or delta configurations.

Proposed Twisted Triangular Underground Configuration

Twisting cable produces lower magnetic field levels than three individual conductors sharing the same conduit because the twisted cable maintains a uniform, compact and concentric configuration that increases phase-to-phase cancellation of the magnetic field. Three phase conductors sharing the same conduit will lose concentricity depending on fill percentage of the conduit.

Table 2. Magnetic Field Reduction for Typical Configuration vs Twisted Cable (Triplex)

Configuration Calculations	Base Case		Triplex Configuration		Reduction	
Segment	North ROW	South ROW	North ROW	South ROW	North ROW	South ROW
Oakland-Moraga #1, #2, #3 and #4 115kV Lines	27.1 mG	27.1 mG	8.6 mG	8.6 mG	68.3%	68.3%

The purpose of magnetic field modeling is to evaluate relative effectiveness of various magnetic field reduction measures, not to predict magnetic field levels.

This FMP proposes to use twisted cable technology underground to further reduce magnetic field levels at no cost.

Strategic Line Placement

The strength of the magnetic field decreases as the distance from the conductors increases. Therefore, one method of reducing the magnetic field strength at a particular location is to increase the distance of the conductors from the location of interest. For electric transmission lines, this location most commonly is the edge of the ROW. The underground configurations will be placed within the ROW to reduce magnetic field exposure to buildings along the entire route, except where the location of existing underground utilities prevent strategic line placement.

B. Low-Cost Magnetic Field Reduction Options

Reducing magnetic field strength by increasing the distance from the source can be accomplished either by increasing the height or depth of the conductor from ground level. Furthermore, locating the power lines as far away from the edge of the ROW or as close to centerline as possible will result in lower field levels at the edge of the ROW at thirty feet.

1. Overhead Rebuild

Thirty-six structures are located school and residential land use areas and are considered for magnetic field reduction.
Calculations are based on 1100 amp current flow and a minimum conductor height of thirty-one feet at midspan. Below are the calculations for proposed the proposed structure raises:

Table 3. Magnetic Field Reduction for raising height of structures ten feet

Raising Calculations	Base Case		Raise 10 Feet		Reduction	
Segment	North ROW	South ROW	North ROW	South ROW	North ROW	South ROW
Oakland-Moraga #1, #2, #3 and #4 115kV Lines	51.6 mG	51.6 mG	31.8 mG	31.8 mG	38.5%	38.5%

The purpose of magnetic field modeling is to evaluate relative effectiveness of various magnetic field reduction measures, not to predict magnetic field levels.

Table 4. Estimated Cost for raising height of structures ten feet

Oakland-Moraga #1, #2, #3 and #4 115kV Overhead Lines						
Project Segment (Pole/Tower ID #)	Location (Street, Area)	Adjacent Land Use	Reduction Measure Considered	Measure Adopted?	Reason(s) if not adopted	Estimated Cost to Adopt
0/1 -1/10	Moraga Substation	Undeveloped				
1/11 - 3/27	Manzanita Dr to Estates Dr	Residential	Raise Conductor 10 Ft	Yes		$320,000
3/27 - 3/28	Corpus Cristi	School	Raise Conductor 10 Ft	Yes		$40,000

This FMP proposes to raise the height of thirty-six structures in the residential and school land use areas by ten feet taller than required for meeting clearance requirements. The estimated cost of this mitigation is $3,492,000.

2. Undergrounding

The magnetic field is calculated three feet above the ground at the edge of the ROW. The magnetic field strength depends upon the location along the line at which it is calculated. Calculations for the underground cable are based on 1100 amp current flow and a conductor depth of three feet and ROW at twenty feet. Below are the calculations for lowering the trench:

Table 5. Magnetic Field Reduction for lowering depth of conductors additional five feet

Lowering Calculations	Base Case		Lower 5 Feet		Reduction	
Segment	North ROW	South ROW	North ROW	South ROW	North ROW	South ROW
Oakland-Moraga #1, #2, #3 and #4 115kV Lines	8.6 mG	8.6 mG	7.1 mG	7.1 mG	17.3%	17.3%

The purpose of magnetic field modeling is to evaluate relative effectiveness of various magnetic field reduction measures, not to predict magnetic field levels.

Table 6. Estimated costs for lowering depth of conductors additional five feet

Oakland-Moraga #1, #2, #3 and #4 115kV Underground Lines						
Project Segment (Distance, Miles)	Location (Street, Area)	Adjacent Land Use	Reduction Measure Considered	Measure Adopted?	Reason(s) if not adopted	Estimated Cost to Adopt
.00 - .11	Corpus Cristi School	School	Lower Trench 5 Ft	Yes		$396,000
.11 - .22	St James Dr to Hollywood Av	Residential	Lower Trench 5 Ft	Yes		$396,000
.22 - .34	Hollywood Av to Dolores Av	Undeveloped				
.34 - .44	Dolores Av to El Centro Av	Residential	Lower Trench 5 Ft	No	Setback > 30 ft, field reduction < 15%	
.44 - .66	El Centro Av to Edgewood Av	Residential	Lower Trench 5 Ft	Yes		$792,000
.66 - .74	Edgewood Av to 4174 Park	Commercial				
.74 - 1.10	4174 Park to Greenwood Av	Residential	Lower Trench 5 Ft	Yes		$1,296,000
1.10 - 1.27	Greenwood Av to Oakland X	Residential	Lower Trench 5 Ft	Yes		$612,000

This FMP proposes to lower the depth of the trench in the school and residential land use areas 5 feet lower than the base case design. The estimated cost of this mitigation is $3,492,000.

The total estimated cost of mitigation is $3,852,000.

V. Conclusion - Field Reduction Options Selected

This FMP proposes to arrange Moraga-Oakland X 115 kV #1 phasing from ABC (top, middle, bottom) to CBA (top, middle, bottom). This FMP proposes to arrange Moraga-Oakland X 115 kV #3 phasing from BCA (top, middle, bottom) to ACB (top, middle, bottom).

This FMP proposes to use twisted cable technology underground to further reduce magnetic field levels at no cost.

This FMP proposes to raise the height of approximately thirty-six structures in the residential and school land use areas by ten feet taller than required for meeting clearance requirements.

This FMP proposes to lower the depth of the trench in the school and residential land use areas 5 feet lower than the base case design.

The estimated cost of this mitigation is approximately $3,852,000.

VI. References

California Public Utilities Commission. 1993. Order instituting investigation on the Commission's own motion to develop policies and procedures for addressing the potential health effects of electric and magnetic fields of utility facilities. Decision 93-11-013. November 2.

California Public Utilities Commission. 2006. Order Instituting Rulemaking to update the Commission's policies and procedures related to electromagnetic fields emanating from regulated utility facilities. Decision 06-01-042 January 26.

Pacific Gas & Electric Company. 2006. EMF Design Guidelines for Electrical Facilities.