MF Issues Management: Precaution & New Facility Siting

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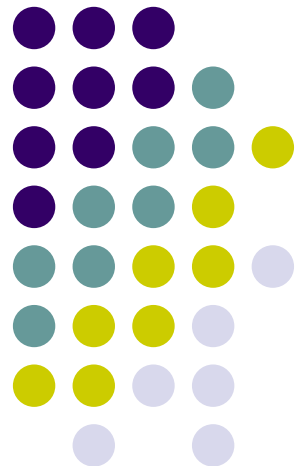


Southern California EDISON

Prologue

‘Chesire-Puss,’ she began rather timidly, ‘would you tell me, please, which way I ought to go from here?’ ‘That depends a good deal on where you want to get to,’ said the cat. ‘I don’t much care where—,’ said Alice. ‘Then it doesn’t matter which way you go,’ said the cat.

Lewis Carroll, Alice in Wonderland, 1864

Precaution: *n.* Care taken in advance; a measure taken beforehand to prevent harm or secure good

Prudent: *adj.* Characterized by, arising from, or showing prudence: as marked by wisdom or judiciousness; shrewd in the management of practical affairs; and marked by circumspection

Reasonable: *adj.* Being in accordance with reason; not extreme or excessive; having the faculty reason; possessing sound judgment

Regret: *v.* To mourn the loss or death of; to miss very much; to be very sorry for

Sensible: *adj.* Perceiving through the senses or mind; emotionally aware and responsive; having, containing, or indicative of good sense or reason

Merriam-Webster's Collegiate Dictionary, 2001

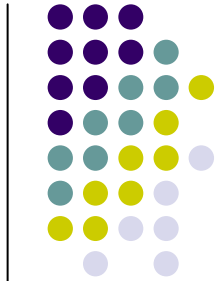
Current Business Environment

- Demand for electricity will continue to grow;
- New generation will be needed quickly;
- New transmission lines will be needed:
  - Environmental Protection – GHG (RPS)
  - Interconnection
  - Dispatch
  - Reliability
- Existing T/L will have increased average and peak line loads;
- EMF issues impact our ability to provide new generation and new transmission facilities, and the cost and timeliness of those facilities.

Basis For Policy Development

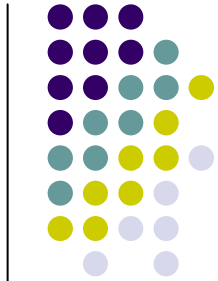
1. Science-based
   - Risk Assessment
   - Dialogue
   - Risk Management (e.g., numeric standards)
2. Fundamental Public Health Concepts
   - Precaution-based approaches

Precautionary Approaches Are Not New



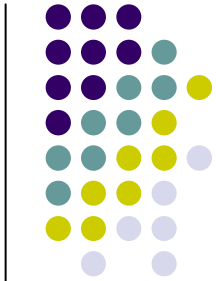
- A important new way of discussing the existing set of ‘Good Business Practices’
- Help to bridge the gap between research, education, and science-based ‘risk management’

Public Health cautionary approaches have value when they help to:



- Implement timely and cost-effective actions for emerging health issues;
- Prioritize allocation of limited public health resources;
- Encourage investments in focused scientific research;
- Provide flexibility to change programs in response to improved scientific understanding;
- Encourages meaningful dialogue between key stakeholders;
- Establish framework for introducing new products or siting new facilities.

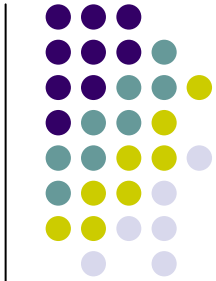
Guidelines for Application of the Precautionary Principle



- Proportionality
- Nondiscrimination
- Consistency
- Examination of the benefits and costs of action or lack of action
- Examination of scientific developments

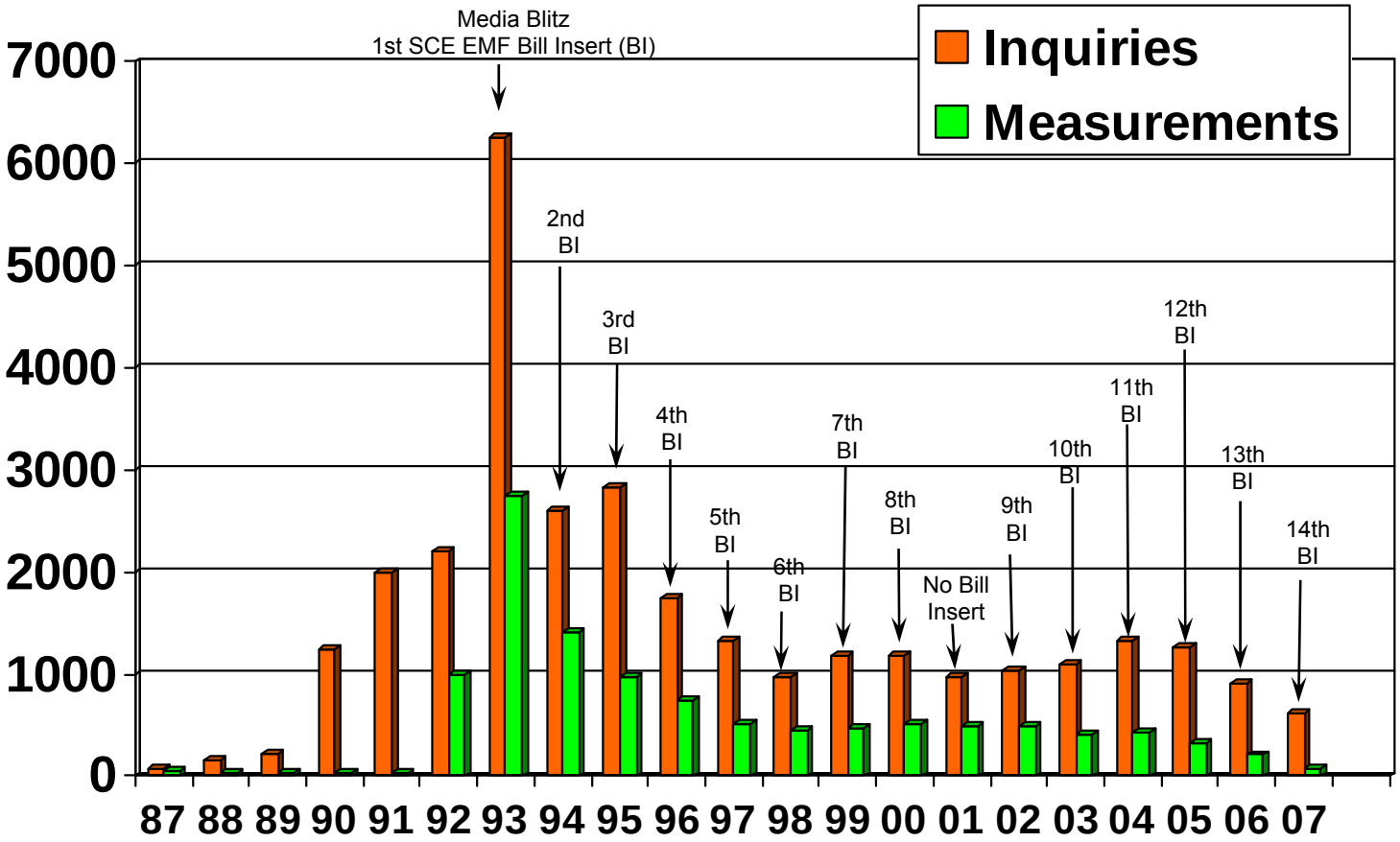
Commission of the European Communities: *Communication fro m the Commission on the Precautionary Principle*, February 2, 2000

Theoretical Business Risks From These Approaches

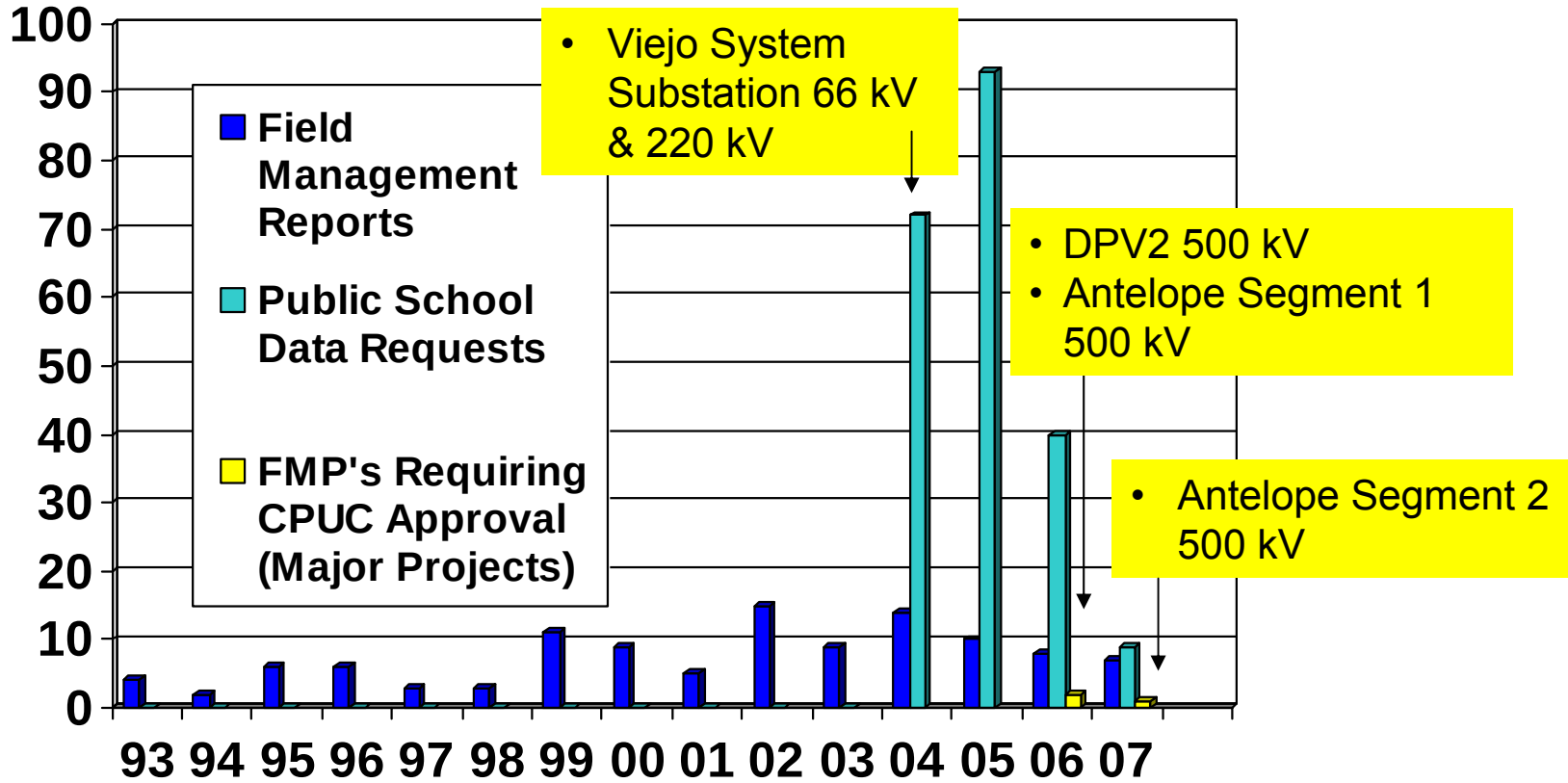


- Perceived to add weight to the causal argument
- Creates an “industry standard of care”
- Inconsistent applications within organization
- Creates a new “standard of care” for other EH&S issues
- Makes it harder to defend against a personal injury claim

EMF Customer Communications: Inquiries, Measurements & Bill Insert

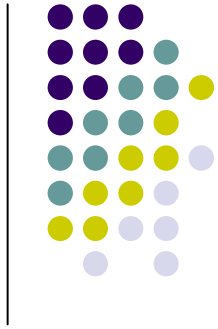


MF Field Management Plans - Electric Utility & Public School Facilities



Detailed FMP Projects Awaiting CPUC Approval : Tehachapi Renewable Transmission Project, Devers-Mirage 115 kV System Split Project, Port of Long Beach "Pier-G", Ritter Ranch 66kV Substation, San Joaquin Cross Valley Loop 230 kV, Wild Life System 230 kV Project, Trinton 115 kV Substation, Solar One Project, Vulcan/Green Borders ,

California EMF Design Guidelines

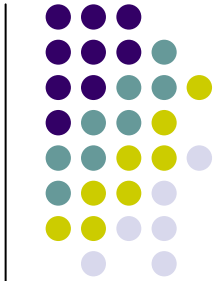


1. Policy Alignment and Implementation: Scientific Assessments, California Electric Utilities Actions, and California Department of Education Siting of New Schools
2. Use Actual And Standardized Mitigation Techniques
3. Standardized “No-cost And Low-cost” Evaluation Table
4. Customer Prioritization For Application 0f 4% Rule
5. Make explicit decision-making criteria
6. Clearly present alternatives and recommendations

Purpose of Field Management Plan

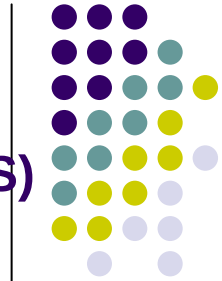
The purpose of FMP is to inform the public, the California Public Utilities Commission (CPUC), and others about SCE's evaluation of "no-cost" and "low-cost" magnetic field (MF) reduction measures and SCE's proposed plan to apply these measures for new transmission, substation, and distribution projects in accordance with CPUC Decisions No. 93-11-013 and No. 06-01-042.

FMP Guidelines for Magnetic Field Reduction Measures



- Design & construction of all electric power systems must comply with all applicable federal, state, and local regulations, applicable safety codes, and SCE design standards;
- ~4% of Total Project Cost is allocated for EMF Reduction Measures;
- Targetted 15% or more Magnetic Field Reduction for Option;
- MF reduction measures are not based upon any numeric values or limits.

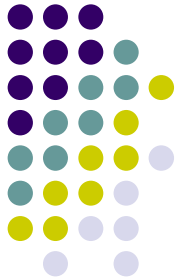
FIELD MANAGEMENT PLANS (FMP'S)



- FMP Based Upon EMF Design Guidelines
  - T & D Project Managers initiates required FMP by contacting EMF Field Specialist.
  - EMF Specialist works with project team members to gather necessary information.
  - EMF Specialist is responsible for completing FMP on the deadline established by project manager.

EMF DESIGN GUIDELINES

- CPUC and changing conditions require periodic reviews of guidelines
- The original SCE guidelines were published in 1990
- First CPUC Version in 1994; Minor modifications made in 1998
- Complete re-write 2004 (Draft for Approval)



SCE System Planning/Project Management

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EMF Manager

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EMF Engineers

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FMP DEVELOPEMENT

No & Low Cost Evaluations & Modeling →

Engineering Data →

← **Site Survey & Analysis**
1. Schools
2. Hospitals
3. Residential
4. Commercial

← **Project Management Team Meetings**

↓

Draft FMP

Management Review ←

Legal Review ←

Engineering Review ←

Regulatory Review ←

Public Involvement
- Open House
- Measurements
- On-going Dialogue

→ **Review Process May Go Back & Forth**

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FMP Added to Project Application

↓

Filed With CPUC

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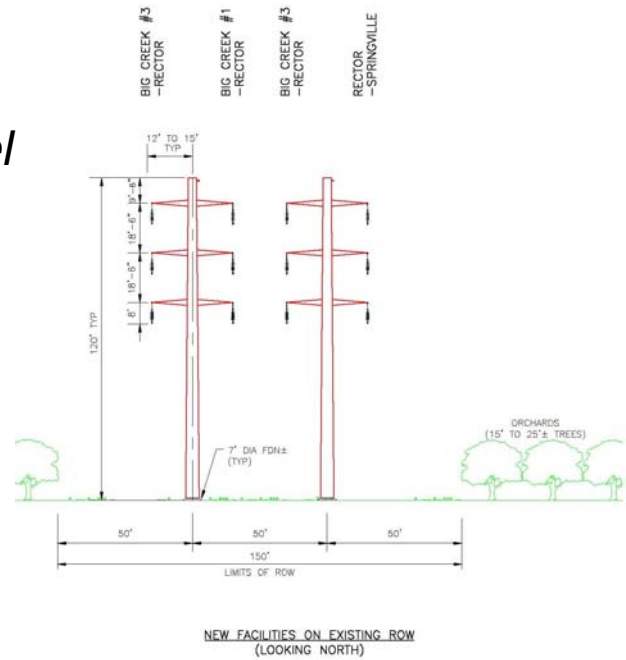
Follow-Up
- Data Requests from CPUC
- Testimony
- Verification of Mitigation

Information Needed to Create Models

- **Modeling Information needed for all distribution, subtransmission, and transmission lines**

Detailed Profile Drawing of Powerlines to be Model

Height of conductor at support,
conductor spacing
Depth of UG conductors
Circuit names
Phasing of circuits,
Distance between structures

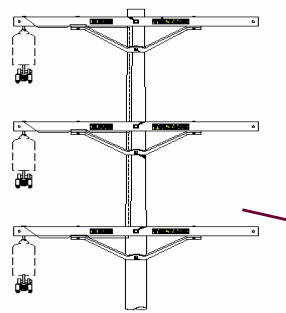


Load Data

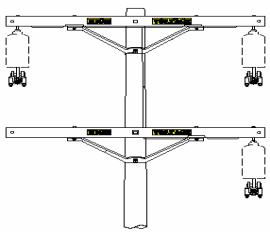
Estimated Maximum loads for all transmission and distribution circuits.

Predominant Direction of Power Flow for all transmission and distribution circuits

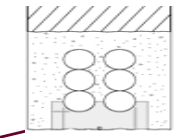
DIFFERENT POLE HEAD CONFIGURATIONS



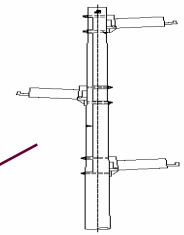
Base Case



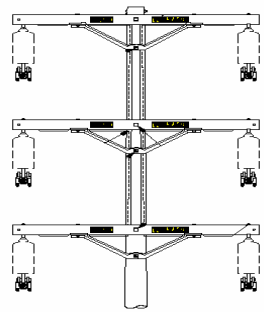
Case 1



Case UG



Case 2



Case 3

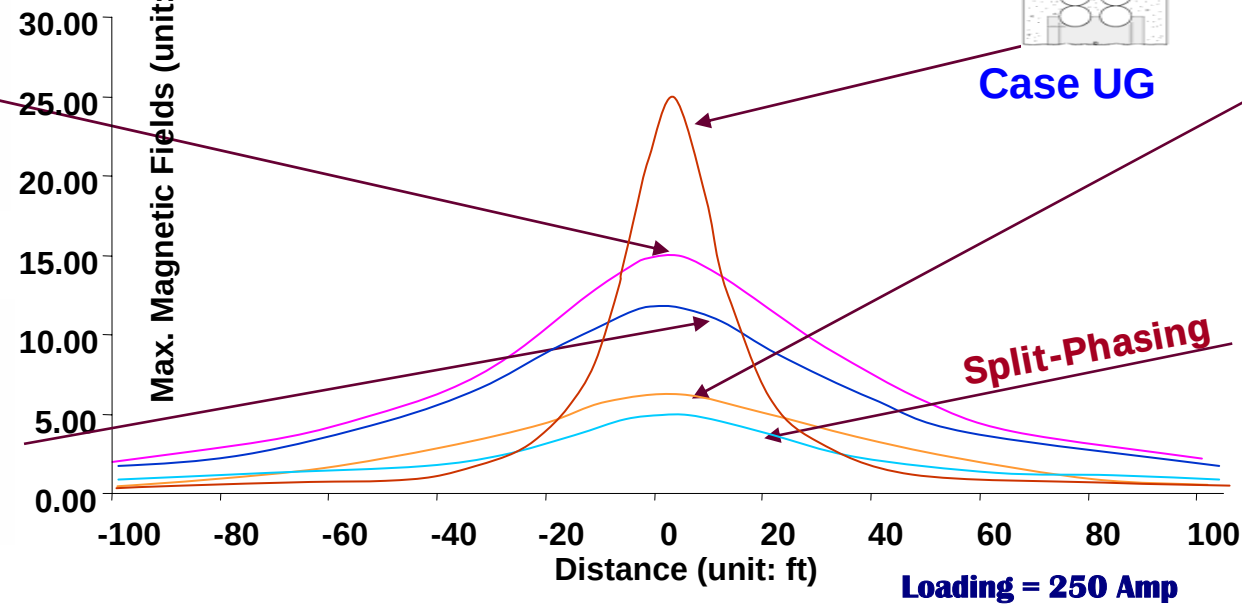
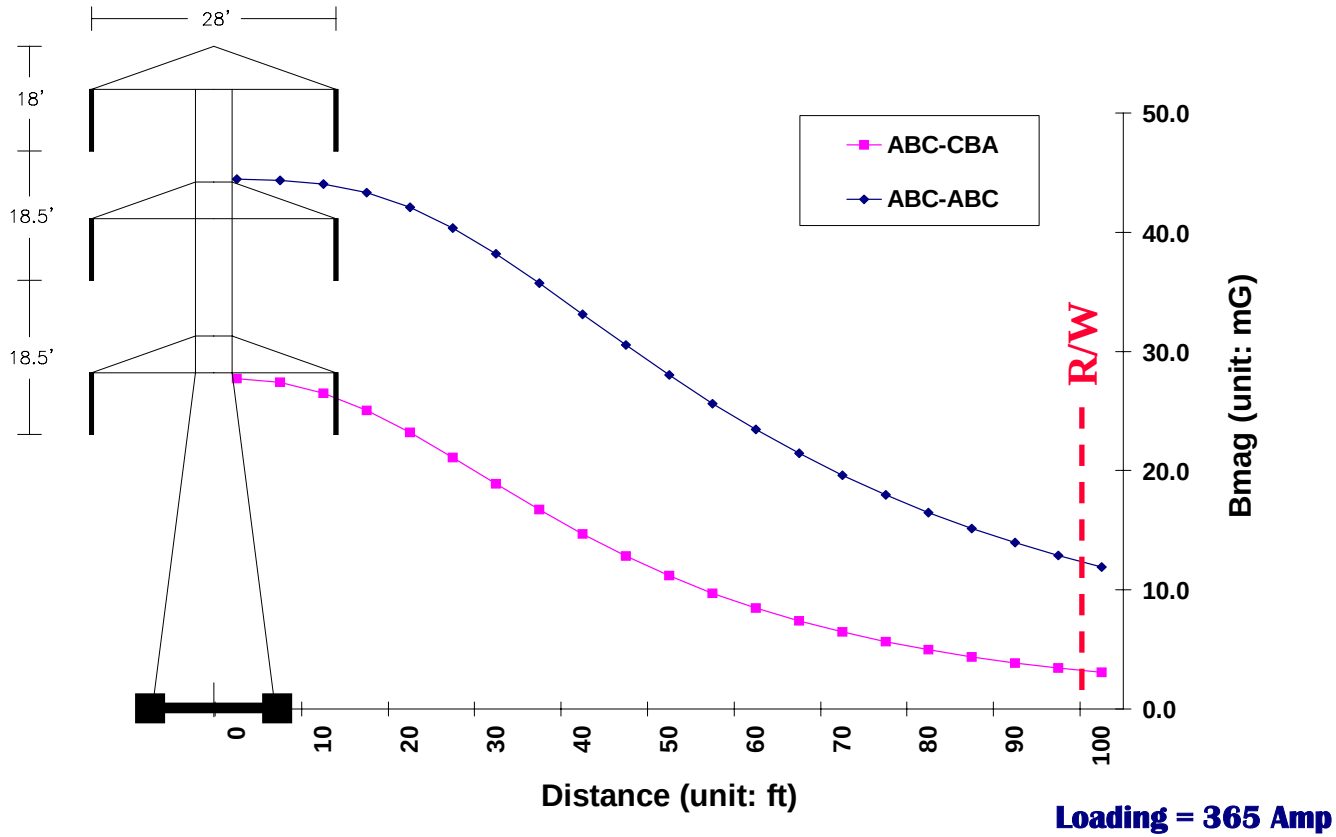


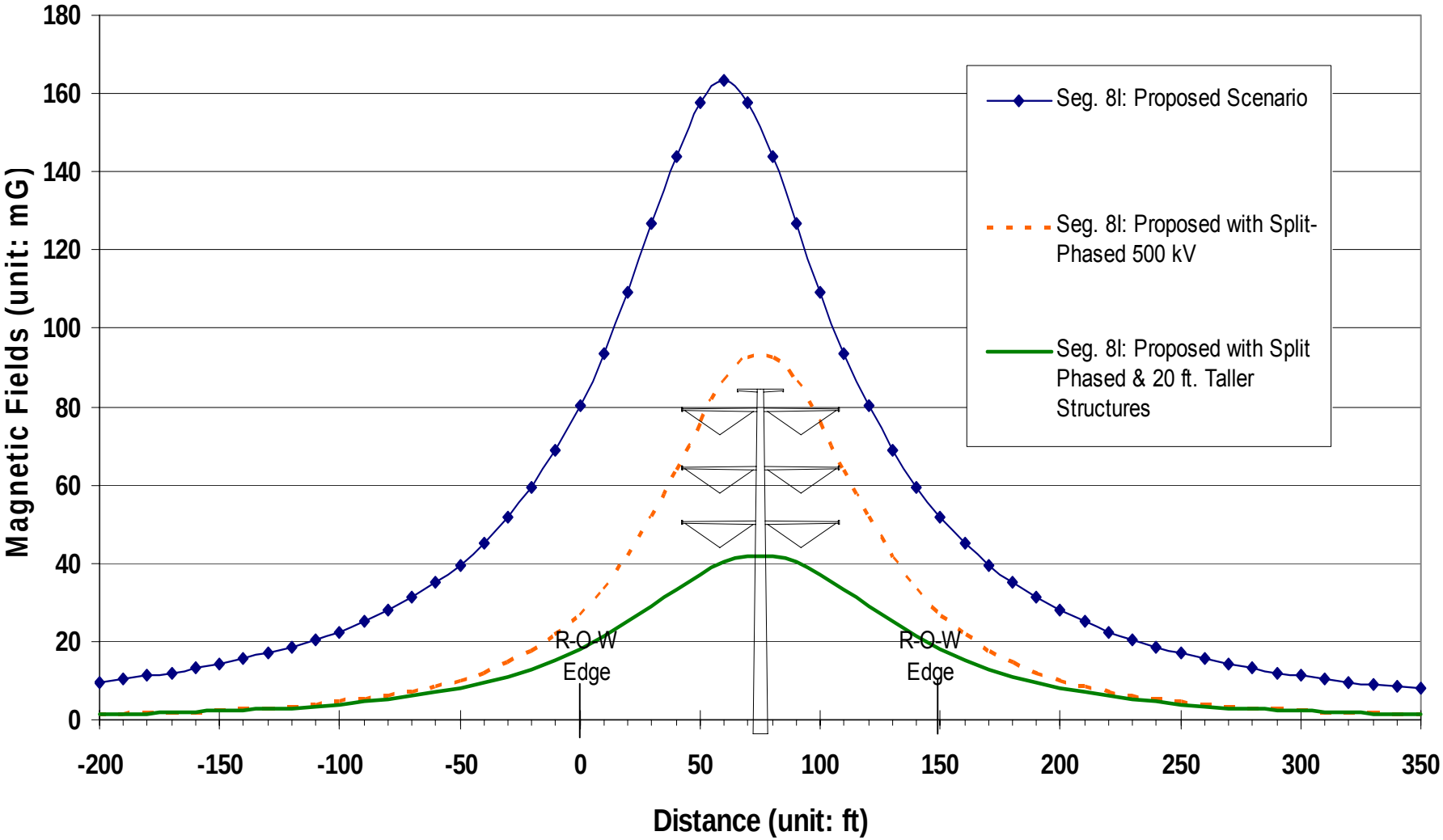
Table: % Magnetic Field Reduction from the base case

	0 ft	10 ft	20 ft	30 ft	40 ft	50 ft
Case 1	13.4	12.8	11.3	9.4	7.4	5.4
Case 2	48.0	47.8	47.4	46.7	46.2	45.5
Case 3	80.5	80.9	81.9	83.1	84.5	85.9
Case - UG	-259.9	-20.3	55.7	75.5	83.0	86.5

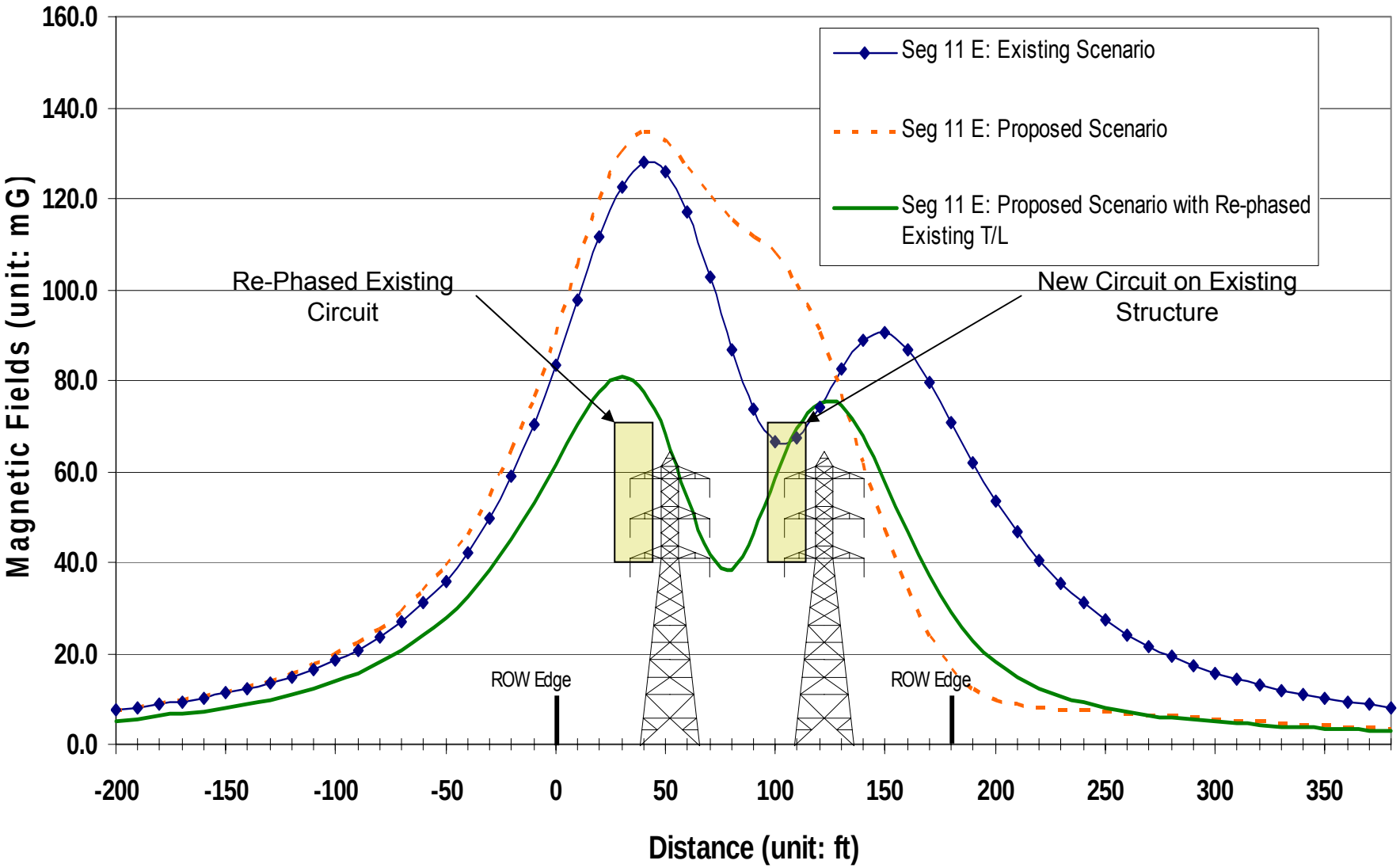
OPTIMAL PHASING



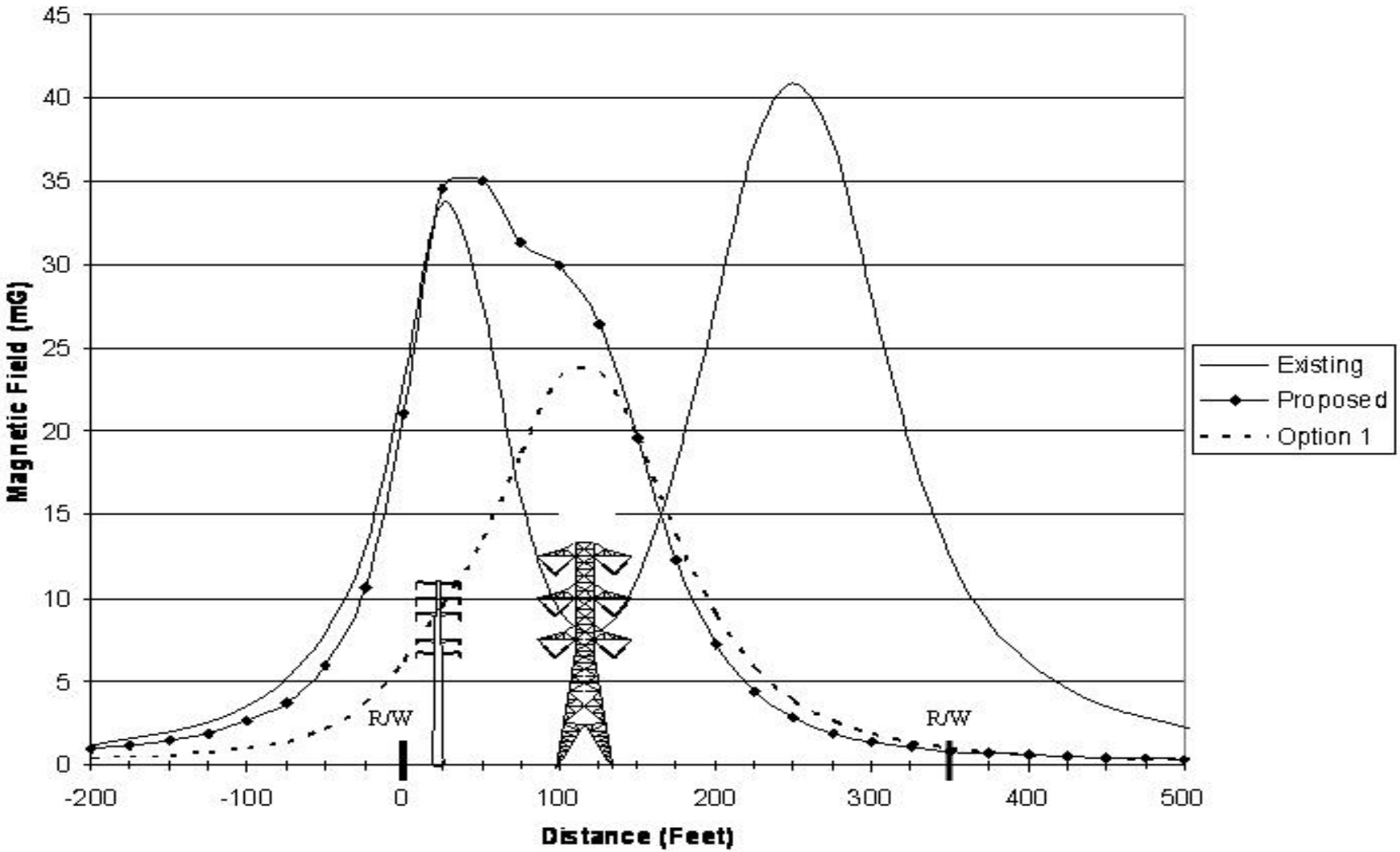
Examples…
Split-Phasing using a Future Circuit



Rephasing an Existing Circuit



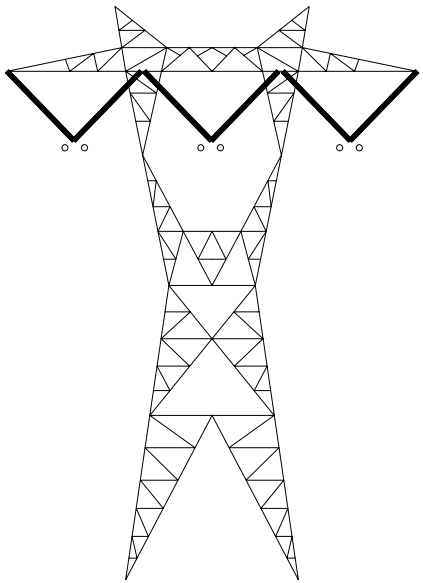
Use of Double-Circuit Construction



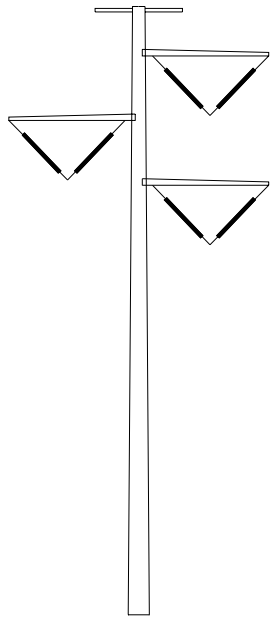
Compact Design – TSP's

Antelope Transmission Project Segment 3
Calculated Magnetic Fields at the R-O-W Edges for Proposed Scenario: Segment Three

Scenario	Proposed East Edge of R-O-W	Proposed West Edge of R-O-W
500 kV Lattice Steel Towers	15.5 mG	15.5 mG
500 kV Tubular Steel Poles	8.5 mG	9.5 mG

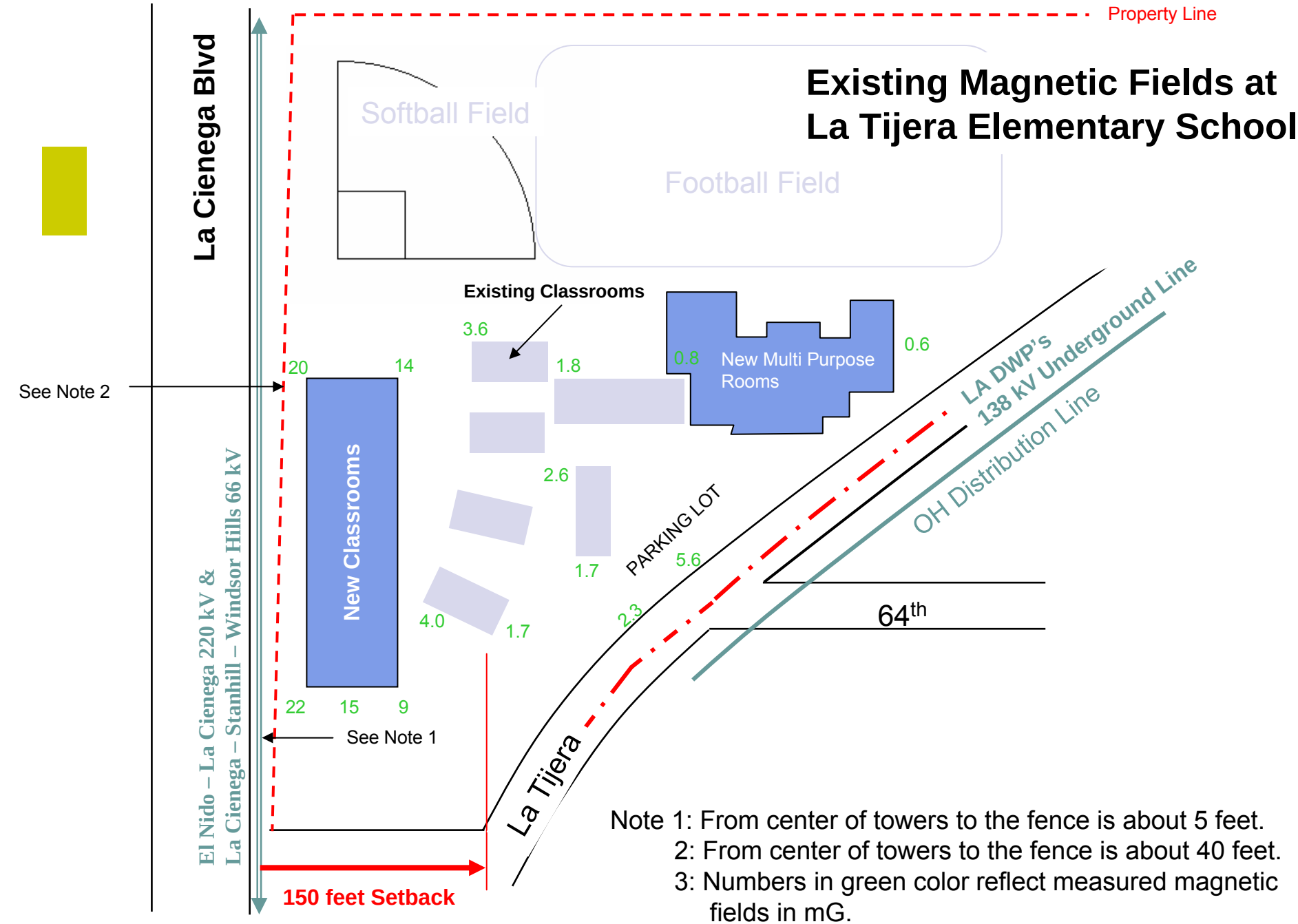


LST



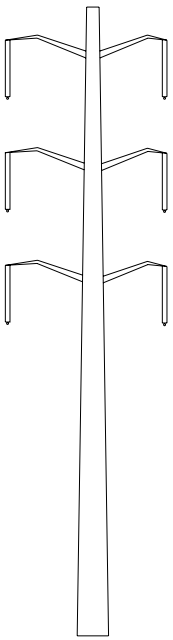
TSP

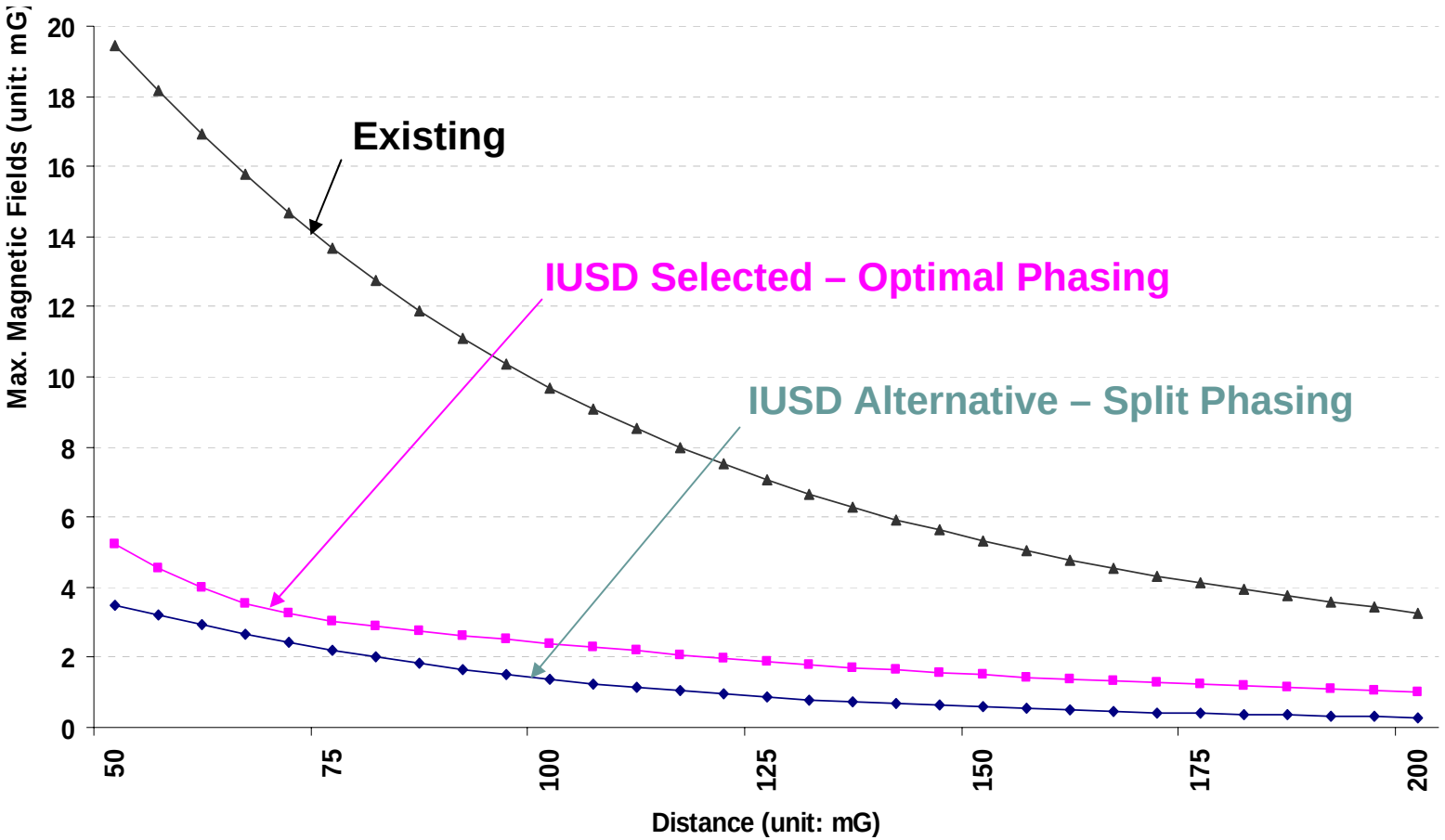
Existing Magnetic Fields at La Tijera Elementary School



Note 1: From center of towers to the fence is about 5 feet.
2: From center of towers to the fence is about 40 feet.
3: Numbers in green color reflect measured magnetic fields in mG.

CALCULATED MAGNETIC FIELDS AT 95%-TILE LOADING





Back-Up Slides

Southern California Edison EMF Policy

There are many sources of power frequency electric and magnetic fields, including internal household or building wiring, electrical appliances and electric power transmission and distribution facilities. There have been numerous scientific studies about the potential health effects of EMF. Interest in a potential link between long-term exposures to EMF and certain diseases is based on the combination of this scientific research and public concern.

After 30 years of research a health hazard has not been established to exist. Many of the questions about specific diseases have been successfully resolved due to an aggressive international research program. Potentially important pubic health questions remain about whether there is a link between EMF exposures in homes or work and some diseases, including childhood leukemia and a variety of other adult diseases (e.g., adult cancers and miscarriages). Because of this research some health authorities have identified magnetic field exposures as a possible human carcinogen.

While scientific research is continuing on a wide range of questions relating to exposures at both work and in our communities, a quick resolution of the remaining scientific uncertainties is not expected.

SCE is aware that there is concern about the potential health effects of power-frequency electric and magnetic fields. Notwithstanding the health, safety, and economic benefits of electricity,

Southern California Edison EMF Policy (cont.)

SCE recognizes and takes seriously its responsibility to help address these EMF concerns. In order to better understand EMF and to respond to the current uncertainty, SCE will continue to:

- Assist the California Public Utilities Commission (CPUC) and other appropriate local, state, and federal governmental agencies in the development and implementation of reasonable, uniform regulatory guidance.
- Provide balanced, accurate information to our employees, customers and public agencies, including EMF measurements and consultation to our customers upon request.
- Take appropriate no-cost and low-cost steps to minimize field exposures from new facilities and continue to consult and advise our customers with respect to existing facilities, subject to CPUC guidance.
- Support appropriate research programs to resolve the key scientific questions about EMF.
- Research and evaluate occupational health implications and provide employees who work near energized facilities with timely, accurate information about field exposures in their work environment.

SCE EMF Team

Jon Sirugo
Manager

Ann Almonte
EMF Specialist

- 1st Point of Contact (1-800)
- Customer Info Packets
- Customer EMF Surveys
- Basic FMP's
- Office Support

Charles Kim
Sr. EMF Engineer

- Detailed FMP's
- Special Projects

Glenn Sias
EMF Specialist

- Detailed FMP's
- Special Projects
- Customer EMF Surveys

Brian Thorson
EMF Specialist

- EMF Workshops
- Special Projects
- Customer EMF Surveys

How to Determine if a FMP or Basic FMP is Needed

Transmission Line (rated 50 kV and above)

Table 6-1 Criteria to Determine Whether an FMP is Required

FMP Type Required	Type of Work	FMP Criteria
Detailed FMP Note: A Detailed FMP will be used for transmission line projects requiring permitting under GO 131-D.	**New Transmission Line**: The construction of a new transmission line, if the construction requires permitting under GO 131-D. **Major Upgrade**: Major upgrade (including replacement of a significant number of existing structures) on an existing transmission line, if the upgrade requires permitting under GO 131-D.	The construction of a new transmission line will incorporate no-cost and low-cost magnetic field reduction measures. Magnetic field model is required. All major upgrades of existing transmission lines will require no-cost and low-cost magnetic field reduction measures unless otherwise exempted under § 6.4. If permitting under GO 131-D is not required, a Basic FMP may be used, and magnetic field modeling is not required.

Transmission Line (rated 50 kV and above)

Continued

FMP Type Required	Type of Work	FMP Criteria
Basic FMP Note: A Basic FMP will be used unless the transmission line project requires permitting under GO 131-D.	**Rule 20 Conversions**: Direct replacement of overhead transmission lines with underground transmission lines under Rule 20.	The transmission line route generally is pre-established for Rule 20 conversions. Phase spacing and depth are set by SCE standards. Thus, phase arrangement is the only magnetic field reduction measure available to the designer. Therefore, the Basic FMP will be restricted to an evaluation of phase arrangement. Magnetic field modeling is not required.
	Relocation more than 2000 ft: Relocation of poles and/or towers involving more than 2000 feet of transmission line.	Relocation of existing transmission lines generally does not provide for alternative transmission line routes. Available options are typically limited to minor changes in pole and/or tower height, minor changes in pole-head[1] configuration, or phase arrangement. The Basic FMP will normally cover these options only. Magnetic field modeling is not required.
	Pole-head Reconfiguration more than 2000 ft: Pole-head reconfiguration involving more than 2000 feet of transmission line. The complete replacement of an existing pole-head configuration with a new design.	Pole-head replacement is limited in scope; thus, magnetic field reduction options are generally restricted to selecting the pole-head configuration and phase arrangement. In most cases, the new pole-head configuration must be consistent with the remainder of the line. The Basic FMP will be limited to an assessment of alternative pole-head configurations and will not require magnetic field modeling.
	Reconductoring more than 2000 ft.: Replacement only of existing conductors and/or insulators with new conductors and/or insulators.	In most cases, replacement of existing transmission conductors is limited in scope; therefore, the Basic FMP will be limited to an assessment of phase arrangement for reconductor activity involving more than 2000 transmission circuit feet. Magnetic field modeling is not required.

[1] It can also be referred to as “pole-top.”

Transmission Line (rated 50 kV and above)

Continued

FMP Type Required	Type of Work	FMP Criteria
None (see exemptions § 6.4)	**Relocation less than 2000 ft**: Relocation of poles and/or towers involving less than 2000 feet of transmission line(s).	Minor relocation of facilities is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Reconductoring less than 2000 ft.: Replacement only of existing conductors and/or insulators with new conductors and/or insulators.	Replacement of existing transmission line conductors involving 2000 ft or less is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Pole-head Re-Configuration less than 2000 ft.: Pole-head reconfiguration involving 2000 feet or less of a transmission line(s) will not require a FMP.	Pole-head reconfiguration involving 2000 feet or less of a transmission line(s) will not require a FMP.
	Maintenance: All maintenance work that does not materially change the design or overall capacity of the transmission line, including the one-for-one replacement of hardware, equipment, poles or towers.	Maintenance work is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Safety and Protective Devices: The addition of current transformers, potential transformers, switches, power factor correction, fuses, etc. to existing overhead, pad-mount, or underground circuits.	The addition of protective equipment or power factor correction to existing transmission circuits is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Emergency Repairs: All emergency work required to restore service or prevent danger to life and property.	This work is performed on existing facilities under emergency conditions and does not involve redesign.

Substation
(Rated 50 kV and above)

FMP Type Required	Type of Work	FMP Criteria
Checklist FMP	**New Substations:** The construction of a new substation having a rated high side voltage of 50kV or above. **Major Upgrade with GO 131-D**: Major reconstruction of an existing substation that involves the installation of additional transformers to achieve an increased rated capacity and that requires permitting under GO 131-D. **Major Upgrade without GO 131-D**: Major upgrade of an existing substation that involves the installation of additional transformers to achieve an increased rated capacity and that does not require permitting under GO 131-D.	The construction of a new substation will incorporate no-cost and low-cost magnetic field reduction measures as outlined in § 8. A no-cost and low-cost checklist[1] will be used as a part of the FMP. All major upgrade of existing substations will require evaluations of no-cost and low-cost magnetic field reduction measures as outlined in § 8, unless otherwise exempted under § 6.4. A no-cost and low-cost check list may be used. Major substation upgrade projects involving the addition of new transformers but not requiring GO 131-D permitting may use a no-cost and low-cost check list only. The no-cost and low-cost will be limited to an evaluation of magnetic field reduction measures applicable to the transmission get-away[2] and to the location of the new transformers so as to maximize the distance from the transformers to the substation fence.

[1] See § 8 for more information about no-cost and low-cost check lists for substation projects.
[2] This can be a part of Transmission FMP.

Substation (Rated 50 kV and above)

Continued

FMP Type Required	Type of Work	FMP Criteria
None (see exemptions § 6.4)	**Reconstruction without installation of additional transformers**: This includes, for example, the installation of additional switchgear, line or bank positions, power factor correction capacitors, underground circuits and overhead circuits.	The addition of switchgear or other apparatus is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Direct Replacement: The direct replacement of substation equipment, even if the new equipment has a different capacity rating.	The direct replacement of substation equipment is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Maintenance: All maintenance work that does not materially change the design of the substation.	Maintenance work is limited in scope and does not provide significant opportunity to implement magnetic field reduction measures.
	Emergency Repairs: All emergency work required to restore service or prevent danger to life and property.	This work is performed on existing facilities under emergency conditions and does not involve redesign.
Distribution Project (Rated less than 50 kV)		
None	Construction or reconstruction of distribution lines with voltages less than 50 kV.	SCE's DDS incorporates magnetic field reduction measures for distribution lines.

Consideration For New And Future Transmission Line and Substation Designs

- **New Designs Allow Us To Upgrade In The Future**
  a. Upgrading 230 kV to 345 kV
  b. Consider using 500 kV System for new projects (due to limited right-of-way)
  c. Consider HVDC for interstate connecting transmission lines to increase reliability and stability
  d. Secure existing ROW
  e. Reserve sufficient spaces within the substation for future installation of high-current caring devices away from the substation property line as extent as possible
- **Cost/Benefit Effective Design**
  a. Raising 230/500 kV towers 10 ft vs. 40 ft ground clearance by increasing conductor tension
  b. New technology (compact tower designs, composite material conductors, etc)

FMP Review and Approval Process

- **Design Engineer** gives preliminary project design to **EMF Specialists**
- The **EMF Specialist** makes “no-cost and low-cost” magnetic field reduction recommendations for the project.
  - FMP may take 30 days to several months to complete depending on the size of the project
  - Manpower required typically evolves one or two EMF Specialist but can require additional assistance depending on the size and deadlines for filing.
- The **Design Engineer** and **Project Manager** review and approve/reject the recommendations.
  - The **Design Engineer** needs to provide the reason or rationale for any of the recommendations that are rejected.
- The assigned **EMF Specialist** will then draft the FMP to be filed with the project application.

Types of FMP

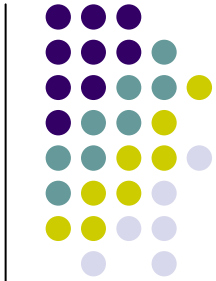
- There are two types of FMP for transmission line projects, a “Basic FMP” and a “Detailed FMP,” and a “Checklist FMP” for substation projects.
  - A **Basic FMP** is sufficient to document no-cost and low-cost magnetic field reduction measures. The Basic FMP consists of a transmission line project description, applicable no-cost and low-cost magnetic field reduction measures without magnetic field model(s), and recommendations.
  - The **Detailed FMP** consists of a transmission line project description, evaluation of no-cost and low-cost magnetic field reduction measures, magnetic field models, and recommendations.
  - For **Substation Projects**, a checklist FMP, showing an evaluation of magnetic field reduction measures adopted or rejected.

Difference Between a Basic FMP and Detailed FMP

- A Basic FMP is sufficient to document no-cost and low-cost magnetic field reduction measures. The Basic FMP consists of a transmission line project description, applicable no-cost and low-cost magnetic field reduction measures without magnetic field model(s), and recommendations.

- The Detailed FMP consists of a transmission line project description, evaluation of no-cost and low-cost magnetic field reduction measures, magnetic field models, and recommendations.

Process: Field Management Plan



- The Field Management Plan (FMP) documents the consideration of no-cost and low-cost magnetic field reduction measures for new or significantly reconstructed power lines and substations rated 50 kV and above. FMPs are not prepared for any distribution projects.

- Project requiring a permit under GO 131-D, the FMP will be incorporated as a part of the GO 131-D filing.

- Basic elements of the FMP include:
  - A project description
  - An evaluation of no-cost and low-cost magnetic field reduction measures
  - Specific recommendations regarding magnetic field reduction measures to be incorporated into the transmission line and substation design

“Fields” Program

SCE has developed a two-dimensional (2D) computation software called “Fields.” It can be used for evaluating various magnetic field reduction measures. Estimates of magnetic field levels are calculated based on a specific set of conditions. Therefore, it is important to make logical assumptions as to what these conditions will be and to keep these calculation conditions consistent when comparing two or more different cases.