6.0 ELECTRICAL TRANSMISSION

6.1 INTRODUCTION

Section 6 discusses the transmission interconnection between the proposed Russell City Energy Center (RCEC) and the existing electrical grid and the anticipated impacts that operation of the facility will have on the flow of electrical power in this region of California. To better understand the impacts of the proposed energy center on the regional transmission system and power flows, the analysis presented in this section focuses on the following issues: the existing electrical transmission system in the immediate area of the RCEC; the proposed electrical interconnection between the RCEC and the electrical grid; the proposed electrical transmission line route; and the impacts of the electrical interconnection on the existing transmission grid. Alternatives to the proposed interconnection and line alignments are discussed in Section 9. Additional discussions focus on potential nuisances (electrical, magnetic, audible noise, and corona effects), safety of the interconnection, and a description of applicable laws, ordinances, regulations, and standards (LORS).

The site for the proposed RCEC was selected, in part, for its proximity to the anticipated load and to Pacific Gas & Electric Company's (PG&E) Eastshore Substation, which is located approximately 1.1 miles to the southeast. Figure 6.1-1 shows the proposed location of the RCEC in relationship to the Eastshore Substation and the existing regional transmission facilities. Figure 6.1-1 also shows that the proposed RCEC site is approximately 600 feet from the existing Eastshore-Grant 115-kV double circuit transmission line, which will allow for the use of the Eastshore-Grant transmission corridor for the 230-kV interconnecting transmission line between the proposed RCEC and the Eastshore Substation.

The high-voltage transmission lines in the vicinity of the proposed RCEC are part of PG&E's East Bay (Mission Division) operating region. This existing transmission system will deliver the power generated at the RCEC to the California electric grid. Figure 6.1-1 illustrates the existing transmission system in the immediate area of the proposed RCEC project.

The initial examination of the local transmission system concentrated on the anticipated RCEC power flows, the capacity and location of existing transmission lines, the availability of substation capacity, and the physical distances involved with the anticipated electrical interconnection. The interconnection feasibility study considered both radially connecting the RCEC to the existing transmission system at the Eastshore Substation and looping one of the existing 230-kV electrical transmission lines in the area into the proposed RCEC switchyard. As a result of the nominal 620 MW maximum generating capacity of the RCEC and the proximity of existing 230-kV lines, system analyses concentrated on the existing 230-kV transmission network.

The proposed electrical interconnection will connect the RCEC to the regional power grid, employing a radial connection. The connection will involve a double-circuit 230-kV line approximately 1.1 mile long connecting the RCEC switchyard to the 230-kV bus at the Eastshore Substation. The proposed connection will share new towers in the existing corridor with the existing Eastshore-Grant 115-kV transmission line. Figure 6.1-2 (in map pocket at back of section) illustrates the alignment of the proposed radial connection in relationship to the proposed RCEC site, the Eastshore-Grant 115kV transmission line, and the existing Eastshore Substation. In Figure 6.1-2, these features are superimposed on an aerial photograph of a portion of Hayward that allows the reader to compare the proposed components (plant site, connection corridor, and Eastshore Substation) with geographic features and recent commercial development of the area.

The proximity of the Eastshore Substation to the RCEC project allowed different conceptual interconnections to be considered with respect to their feasibility and anticipated impact on the existing transmission system and power flows. Primary consideration in the analysis was given to the ability of the existing transmission lines to carry the anticipated output of the RCEC. Additional aspects considered included environmental effects of building and maintaining the new interconnecting transmission line, right-of-way modification and/or acquisition, and engineering constraints. Alternative interconnection options were identified after analyses of these data and review of the PG&E operating diagram for this operating region of their service area. From these alternatives, the proposed transmission line alignment, interconnection configuration, and construction techniques were selected.

Figure 6.1-3 (in map pocket at back of section) is the operating diagram for PG&E's East Bay operating region. It should be noted that the Eastshore Substation has been completely rebuilt since the publication this enclosed operating diagram. The new configuration of the Eastshore Substation does not alter the conclusions of the analyses presented in this section. Further analysis based on the Generator Interconnection Data Sheet (Appendix 6-A) and discussion of the proposed interconnection and its alignment are presented in Sections 6.2 and 6.3.

6.2 TRANSMISSION INTERCONNECTION ENGINEERING

Preliminary engineering of the proposed transmission interconnection was completed based on the results of the interconnection feasibility studies performed. This section discusses the existing transmission facilities in the vicinity of the RCEC project and other associated electrical facilities, as well as the proposed transmission interconnection.

6.2.1 Existing Electrical Transmission Facilities

The proposed RCEC site is located approximately 1.1 miles northwest of PG&E's Eastshore Substation at the extreme western edge of Alameda County in Hayward, California. The Eastshore Substation is located just south of State Route 92 near the Clawiter Road-Eden Landing interchange.

An inventory and assessment of the transmission facilities in the immediate geographic area of the RCEC project were conducted. The regional transmission line assessment focused on the number of electrical transmission lines, the rating of each line, the existing loads, and the ability of the existing transmission grid to safely and reliably transmit the anticipated maximum nominal 620 MW capacity of the RCEC.

Based on the System Impact Study Plan base case provided by PG&E (Appendix 6-B), which is based on the 2001-series Transmission Assessment summer peak load case for 2003, the portion of the East Bay area that the RCEC might readily impact[1] has a peak load 3,530 megawatts (MW) and 955 MW of existing generation.[2] The transmission system in the vicinity consists of 230-kV and 115-kV transmission lines. These and other lines are shown geographically in Figure 6.1-1. Local 230-kV line ratings are typically 362 to 396 MVA. Typical ratings for local 115-kV lines are 139 to 162 MVA. Table 6.2-1 lists the ratings and conductor types for selected lines.

To evaluate the rated exit capability of the Eastshore Substation, an approach called the "first contingency rated exit capability," or FCREC, was used. The evaluation started with the Study Plan

[1] PG&E Mission (zones 316 and 346), Peninsula (zones 310 and 340), and San Francisco (zones 309 and 339) zones used to approximate this area.
[2] This represents the total generation modeled as running in the power flow case. An additional amount of roughly 1,200 MW of generation is proposed but not approved.

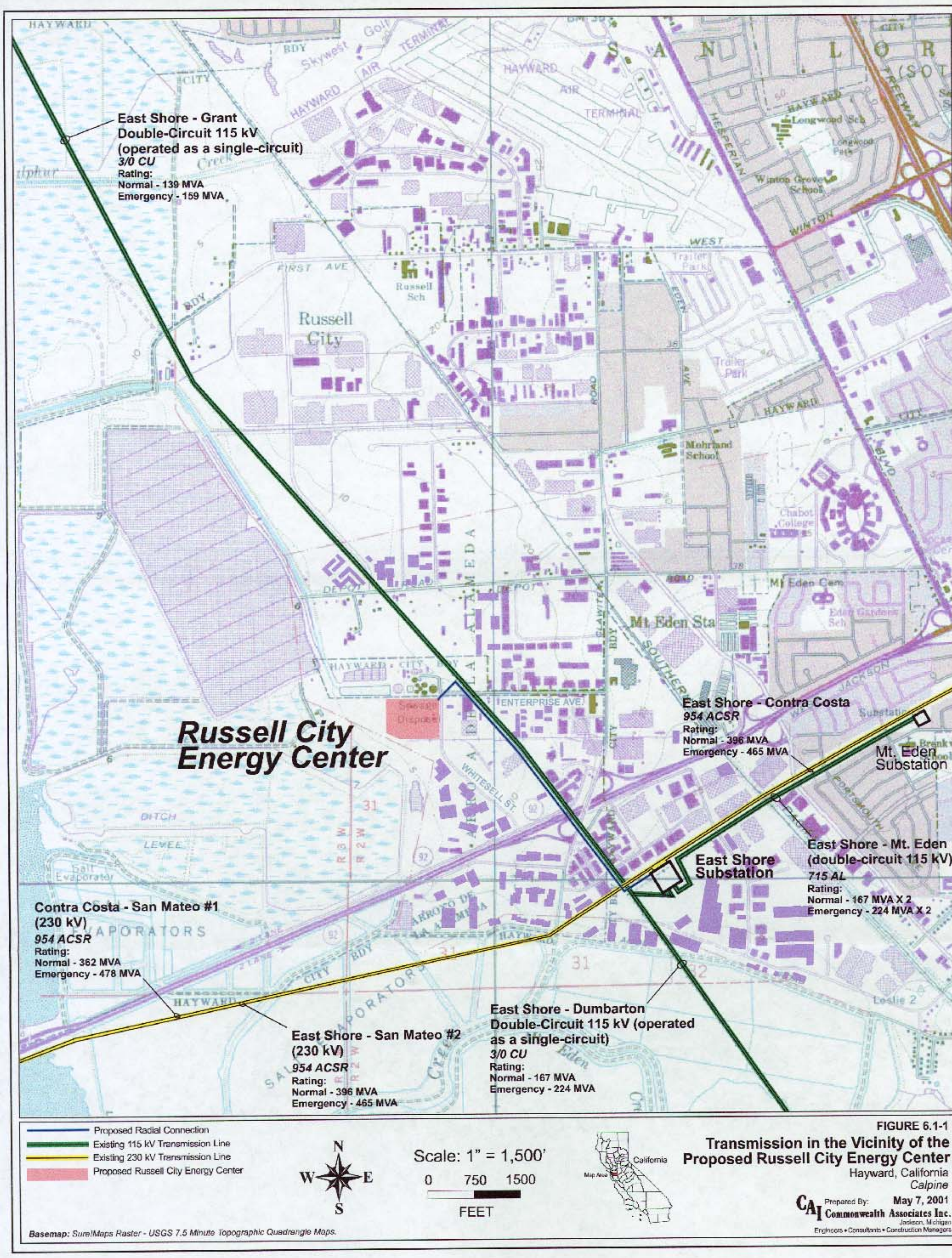


FIGURE 6.1-1
Transmission in the Vicinity of the Proposed Russell City Energy Center
Hayward, California
Calpine
Prepared By: Commonwealth Associates Inc., Jackson, Michigan
Engineers • Consultants • Construction Managers
May 7, 2001

Table 6.2-1. Capabilities of lines in the vicinity of the Eastshore Substation.

From	To	Ckt. No.	Description	Volt.	Normal Rate (MVA)	Emerg Rate (MVA)	Conductor
Eastshore	San Mateo	1	One circuit of a Double-circuit	230	396	465	954 ACSR
Eastshore	Pittsburg[1]	1	One circuit of a Double-circuit	230	433	465	477 ACSS
Pittsburg	San Mateo[2]	1	One circuit of a Double-circuit	230	398	478	954 ACSR
Eastshore	Mt. Eden	1	One circuit of a Double-circuit	115	167	224	715 AL
Eastshore	Mt. Eden	2	One circuit of a Double-circuit	115	167	224	715 AL
Eastshore	Dumbarton	1	Double-circuit (operated as a single circuit)	115	167	224	3/0 Copper
Eastshore	Grant	1	Double-Circuit (operated as a single circuit)	115	139	159	3/0 Copper

[1] One element of the Delta Energy Center (DEC) mitigation scheme is to swap the Contra Costa to Eastshore and San Mateo 230-kV lines with the Pittsburg to Moraga 230-kV lines. Since the DEC is currently projected to be on line before the RCEC, the swap is assumed to be in place for purposes of evaluating the RCEC.

[2] Looping this circuit into the Eastshore substation will result in two lines, each rated at 398 MVA.

case provided by PG&E. This information was supplemented with connection information and line ratings from the East Bay Region (East Bay Division, Sheet 3) Operating Diagram (Figure 6.1-3), taken from PG&E's Form 715 filing previously submitted to the Federal Energy Regulatory Commission (FERC). From this database, an inventory of substation buses, generation, load, and line capacities was developed for the Eastshore Substation. This inventory, starting with the substation itself, served as a starting point for the FCREC method of evaluation. To find the rated exit capability, the following steps were undertaken:

1. Add the rating of all lines leaving, or exiting, the group;
2. Subtract the rating of all generators attached to any bus within the group; and
3. Add the rating of all loads attached to any bus within the group.

The sum of Steps 1, 2, and 3, above, yields a number called the "normal total rated exit capability," or NTREC, for the group. The group of buses may also be called a "cut set." The NTREC represents the maximum possible additional generation that can be accommodated at the cut-set location under the best of conditions. This is an optimistic number, but it can be refined easily using standard power flow methodology.

The FCREC is the refined estimate of capacity. This number takes into account the most severe single contingency, or line outage. It provides a more realistic limit for added generation than does the NTREC found as a result of Steps 1, 2, and 3 above. To calculate the FCREC, or the final estimate of system capability, step 4 is added to the process:

4. Subtract the rating of the line exiting the cut set that has the highest rating.

The FCREC gives the maximum possible export that might be expected without implementing system improvements. Detailed estimates of the system impact will be determined in a System Impact Study conducted by PG&E in accordance with the study plan developed for the RCEC.

Table 6.2-1 gives the ratings for the elements in the vicinity of the Eastshore Substation. Since there is no load and no generation at the Eastshore Substation, the NTREC for the substation is 2,265 MVA. The FCREC is 1,832 MVA, which is the maximum amount of generation that one might expect to add to the Eastshore Substation without implementing system improvements. Based on this abbreviated analysis, the addition of new generation near the Eastshore Substation will result in minimal transmission impacts. A more accurate estimate of system impacts is presented in the section on system impacts below.

6.2.2 Proposed Transmission Interconnection System

The proposed interconnection between the RCEC and the Eastshore Substation will consist of the following major facilities:

- New 230-kV double-circuit overhead lines extending approximately 1.1 miles from the RCEC switchyard to radially connect into the Eastshore Substation reconfigured 230-kV bus
- A new 230-kV on-site switchyard at the RCEC using a ring-bus configuration
- Modifications in the Eastshore Substation to enlarge the 230-kV bus into an eight breaker ring-bus configuration to accommodate the two RCEC lines as well as the new incoming and outgoing connections of the existing Pittsburg to San Mateo 230-kV line

The transmission interconnection will exit the RCEC switchyard at the pull-off structure in a northeast direction and will span approximately 600 feet to the existing Eastshore-Grant 115-kV transmission corridor. From that point the line will be overbuilt over the Eastshore-Grant line and will extend approximately 1.1 mile in the existing right-of-way, until it leaves the right-of-way and enters the Eastshore Substation. Figure 6.1-2 shows the direction of the proposed electrical interconnection alignment in relation to the proposed RCEC, the Eastshore-Grant 115-kV transmission line, and the Eastshore Substation. It is anticipated that the new segment of the transmission corridor from the RCEC to the existing Eastshore-Grant corridor will occupy a right-of-way approximately 100 feet wide.

6.2.2.1 Russell City Energy Center 230-kV Switchyard Characteristics

The proposed RCEC 230-kV switchyard will consist of five 230-kV air-insulated circuit breakers. A ring-bus arrangement will be used in the switchyard to obtain a high level of service reliability. An electrical one-line diagram of the proposed RCEC switchyard arrangement appears in Figure 6.2-1. The switchyard layout is shown in Figure 6.2-2.

The switchyard and all equipment will be designed for a 63 kA interrupting capacity. The main buses, as well as the bays, will be designed for 3,000 A continuous current. As depicted in Figure 6.2-1, each generator will be provided with an independent tie to the switchyard. The RCEC ring bus will be connected to the existing transmission grid through a double-circuit radial connection at the 230-kV bus in the Eastshore Substation. The radial connection will require modifications at the Eastshore Substation, discussed in Section 6.2.2.2 below. Three line exits allow removal of a single circuit without limiting plant output. Redundant 18/13.8 kV Unit Auxiliary Transformers connected between CTG generator breakers 13 and 14 and the respective step-up transformers will provide power to start up the plant and provide power for all auxiliary loads within the RCEC facility. Auxiliary controls and protective relay systems for the 230-kV switchyard will be located in a control building separate from the power plant.

6.2.2.2 Interconnection and Mitigative Changes at the Eastshore Substation

The existing Eastshore Substation consists of three 230-kV circuit breakers, two 230-kV line exits, and two transformer feeds to the 115-kV network. The radial connection of the RCEC to the Eastshore Substation will necessitate changes at the Substation to meet the applicable system reliability criteria.

The 230-kV bus in the substation will be expanded to accommodate the two additional RCEC connections. In addition, the Pittsburg to San Mateo 230-kV transmission line, which now passes the substation, will be routed to the Eastshore bus to increase the total transmission capability across the San Francisco Bay to the Peninsula. It is proposed that the existing 230-kV switching arrangement be converted into an eight breaker ring bus to accommodate termination of the two new lines from the RCEC and the looping of the existing Pittsburg (Contra Costa) to San Mateo 230-kV line into Eastshore. Figure 6.2-1 is a one-line diagram that shows the proposed RCEC switchyard and Figure 6.2-2 illustrates the proposed expansion of the Eastshore Substation. Figure 6.2-3 is a plan view of the proposed expansion. Control house expansion and changes to the auxiliary AC and DC supplies will be a part of the final design.

An alternative 12-breaker, breaker-and-one half configuration is also being evaluated by PG&E. Although this alternative configuration would likely require development of more of the available land surrounding the existing substation, the incremental environmental impacts would be minimal. Adoption of a breaker-and-one-half configuration would not alter the conclusions of the analyses presented herein.

6.2.2.3 Overhead Transmission Line Characteristics

The proximity of the existing Eastshore-Grant 115-kV transmission corridor will permit the interconnecting line to be aligned along the existing right-of-way. The proposed line will exit the RCEC switchyard in a northeast direction for approximately 600 feet, where it will intersect the existing Eastshore-Grant 115-kV line. At that point the interconnecting line will follow the existing Eastshore-Grant right-of-way and will be overbuilt on new structures above the two 115-kV circuits. The two lines will remain in the H-frame configuration for approximately 4,500 feet to the southeast, where the interconnecting line will exit the Eastshore-Grant right-of-way to the northeast. From there, it will enter the Eastshore Substation approximately 500 feet to the northeast. Along this segment of the alignment, the interconnecting line will parallel the existing two 230-kV circuits of the San Mateo-Contra Costa (Eastshore) lines. Figure 6.2-2 illustrates the interconnection alignment in relation to the existing transmission resources and commercial development. The two interconnecting circuits will employ bundled conductors. The recommended conductor type is 1272 kcmil, 45/7 ACSR "Bittern." This is a standard conductor type used by PG&E.

The proposed interconnecting transmission line will be built as an overhead double-circuit 230-kV line between the RCEC switchyward and the expanded Eastshore Substation 230-kV bus. The proposed line will exit the RCEC switchyard in a slack span configuration to a pull-off (or dead-end) structure located in the northeast corner of the RCEC site (Figure 6.1-2). Figures 6.2-4 (elevation) and 6.2-5 (plan) illustrate the design of the dead-end structure, which will support the double-circuit 230-kV lines. The dead-end structure will be 108 feet tall.

The first span will be approximately 600 feet in length and will connect the pull-off structure to a new heavy angle structure to be constructed on the vacant parcel that lies immediately east of the City of Hayward's Water Pollution Control Facility (Figure 6.1-2). The heavy angle structure will be constructed within the existing Eastshore-Grant right-of-way to accommodate the 90 degree turn of the two 230-kV circuits as they enter the right-of-way approximately 220 feet southeast of Structure 13/86 of the Eastshore-Grant 115-kV line. Figures 6.2-6 (elevation) and 6.2-7 (plan) illustrate the design of the heavy angle structure, which will be 115 feet tall.

The proposed overhead transmission line will require that five of the existing tangent lattice steel towers (Structures 12/81 through 12/86) along the Eastshore-Grant corridor be replaced with new self-supporting tubular steel poles in a modified H-frame design to hold the conductors. Each structure will support the two new 230-kV interconnection circuits and the two existing 115-kV circuits in an overbuild configuration. Figure 6.2-8 illustrates the typical tangent structure proposed for the shared right of way and Figure 6.1-2 shows the approximate locations of the new tangent structures. The tangent towers are anticipated to be approximately 110 feet tall. Final tower placement locations and dimensions will depend on the final choices for design, layout, and the existing conditions in the field.

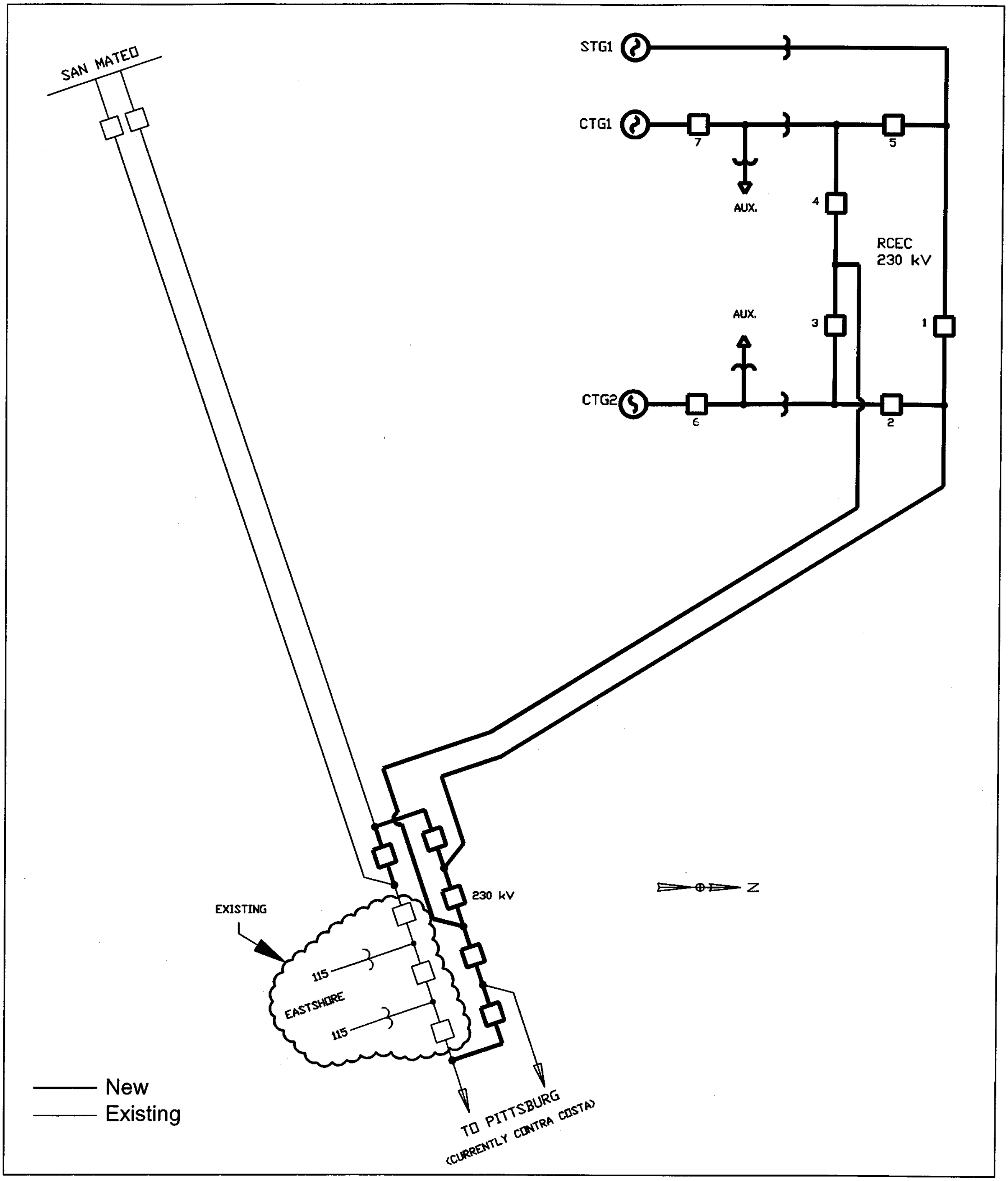
The overbuild configuration of the proposed transmission line will extend approximately 4,500 feet to a point approximately 150 feet northwest of Structure 12/80 (Figure 6.1-2). At this location, a second heavy angle structure will be constructed to accommodate the 90 degree turn of the RCEC 230-kV double circuits as they exit the Eastshore-Grant right-of-way and turn northeast to enter the Eastshore Substation property, parallel to the existing two 230-kV circuits of the San Mateo-Contra Costa (Eastshore) lines. Figure 6.1-2 illustrates the interconnection alignment in relation to the existing transmission resources and commercial development.

6.3 INTERCONNECTION STUDY

Interconnection studies are performed to assess the impacts of proposed new generation on the integrated transmission grid. Interconnection studies include analysis of power flow, short circuit, transient stability, and other factors. The Generator Interconnection Data Sheet for the RCEC is included in Appendix 6-A. After submitting an Interconnection Study request, Calpine/Bechtel initiated a System Impact Study. In accord with PG&E's regulatory filings, Calpine/Bechtel, PG&E, and the California Independent System Operator (Cal-ISO) subsequently developed a mutually agreeable Study Plan. A copy of this System Impact Study Plan is included as Appendix 6-B. These documents are included for information and to record the chronological development of the system impact studies to date.

Based on the Study Plan, PG&E's System Impact Study will be completed by August 6, 2001. In order to advance the schedule for the RCEC expeditiously, provide generation to meet California's needs, and offer the transmission benefits associated with the RCEC's location, and after consulting with the California Energy Commission (CEC), PG&E, and the Cal-ISO, it was agreed that for purposes of AFC filing Calpine/Bechtel could complete a system impact study for PG&E.[3] Using the Study Plan

[3] Item A, Paragraph 3, Section 2022.b, Article 7, Chapter 5, Title 20, California Code of Regulations requires "an interconnection study identifying the electrical system impacts and a discussion of the mitigation measures considered and those proposed to maintain conformance with NERC, WSCC, Cal-ISO or other applicable reliability or planning criteria based on load flow (sic), post transient, transient, and fault studies performed by or for the transmission owner in accordance with all applicable Cal-ISO or other interconnection authority's tariffs operating agreements, and scheduling protocols…"



One-Line Schematic of the Proposed RCEC 230 kV Interconnection

Figure 6.2-1

May 7, 2001

Russell City Energy Center - Calpine/Bechtel

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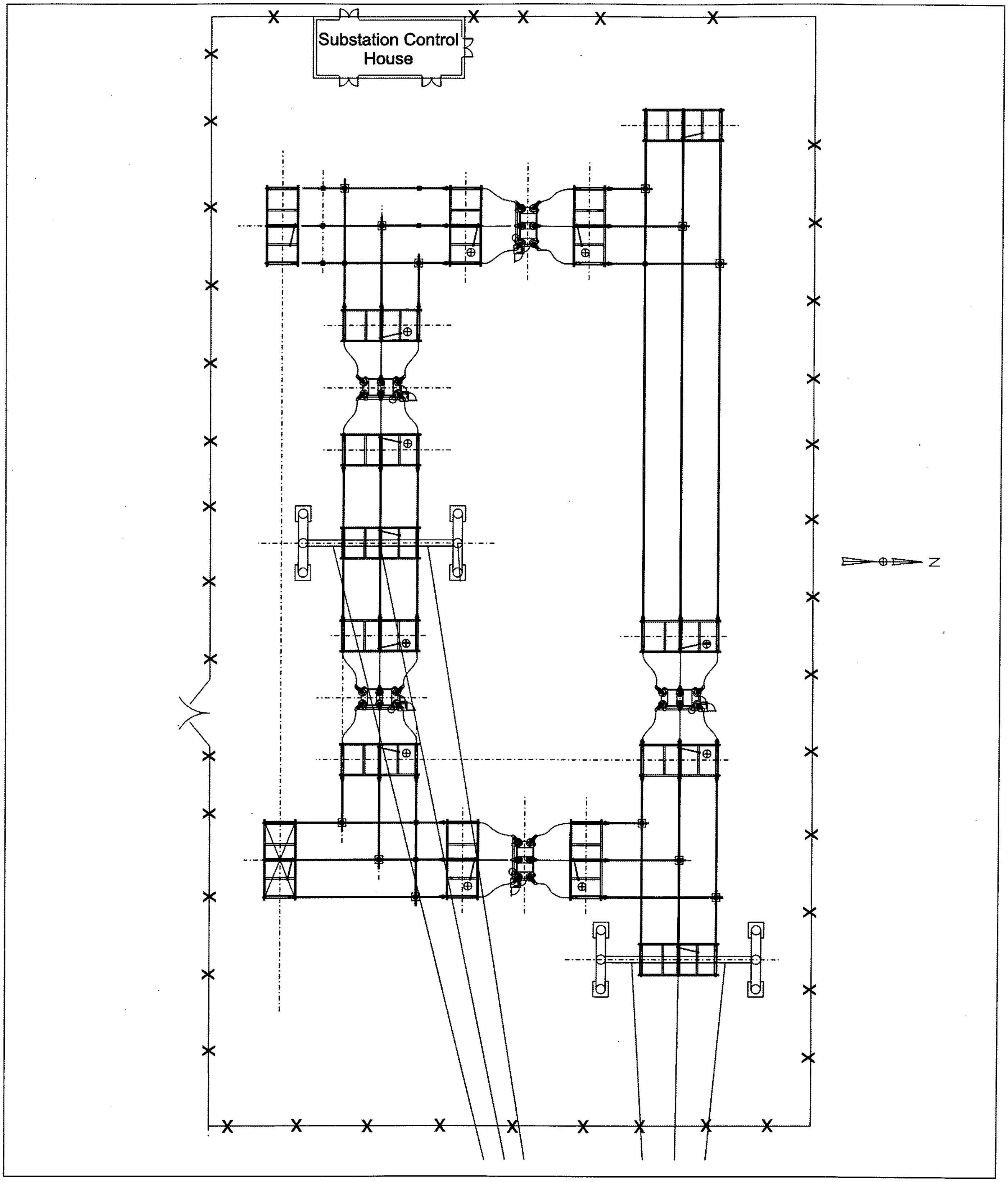

Layout of the Proposed RCEC 230 kV Switchyard

Figure 6.2-2

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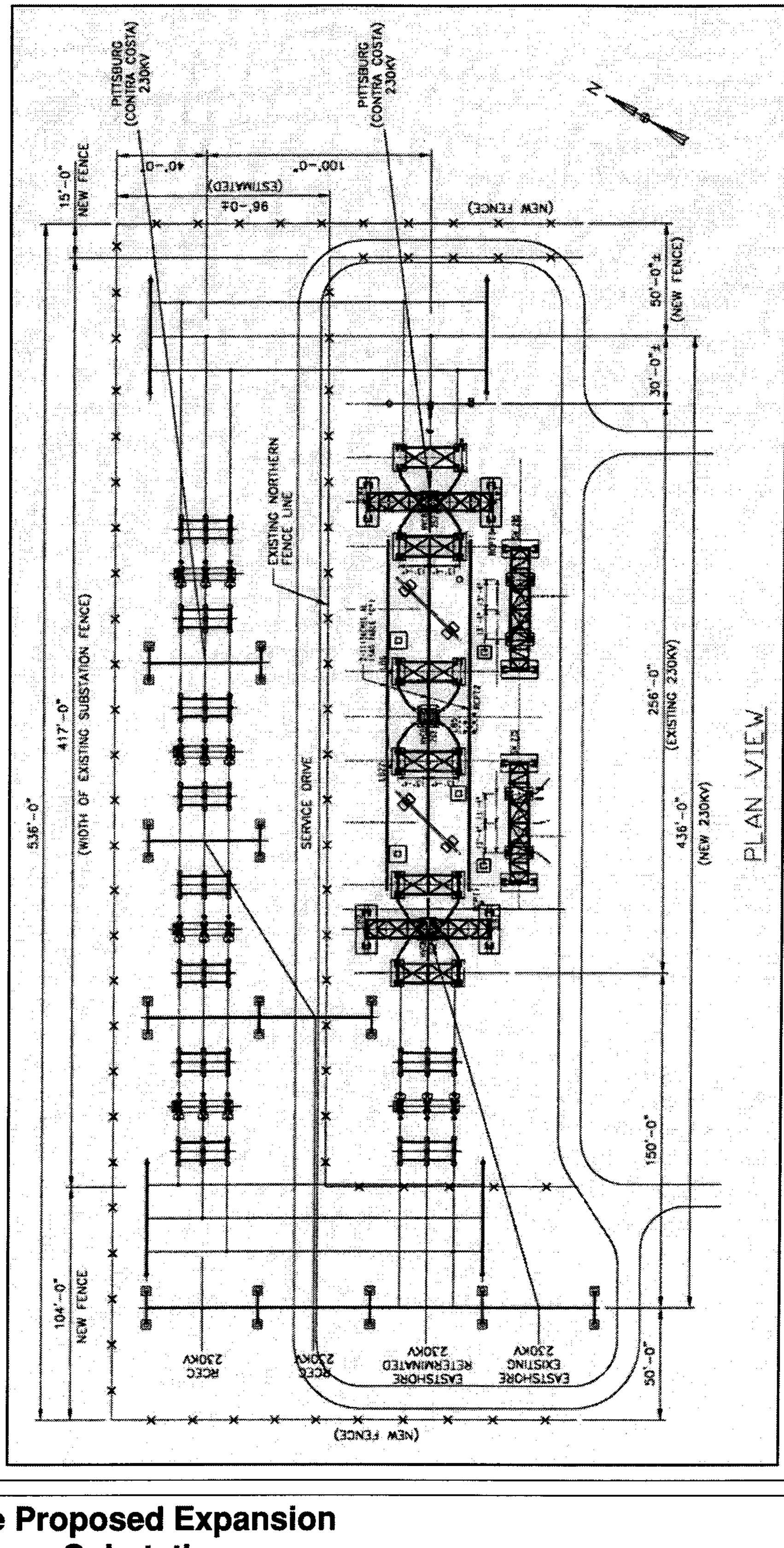

Layout of the Proposed Expansion at the Eastshore Substation

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Figure 6.2-3

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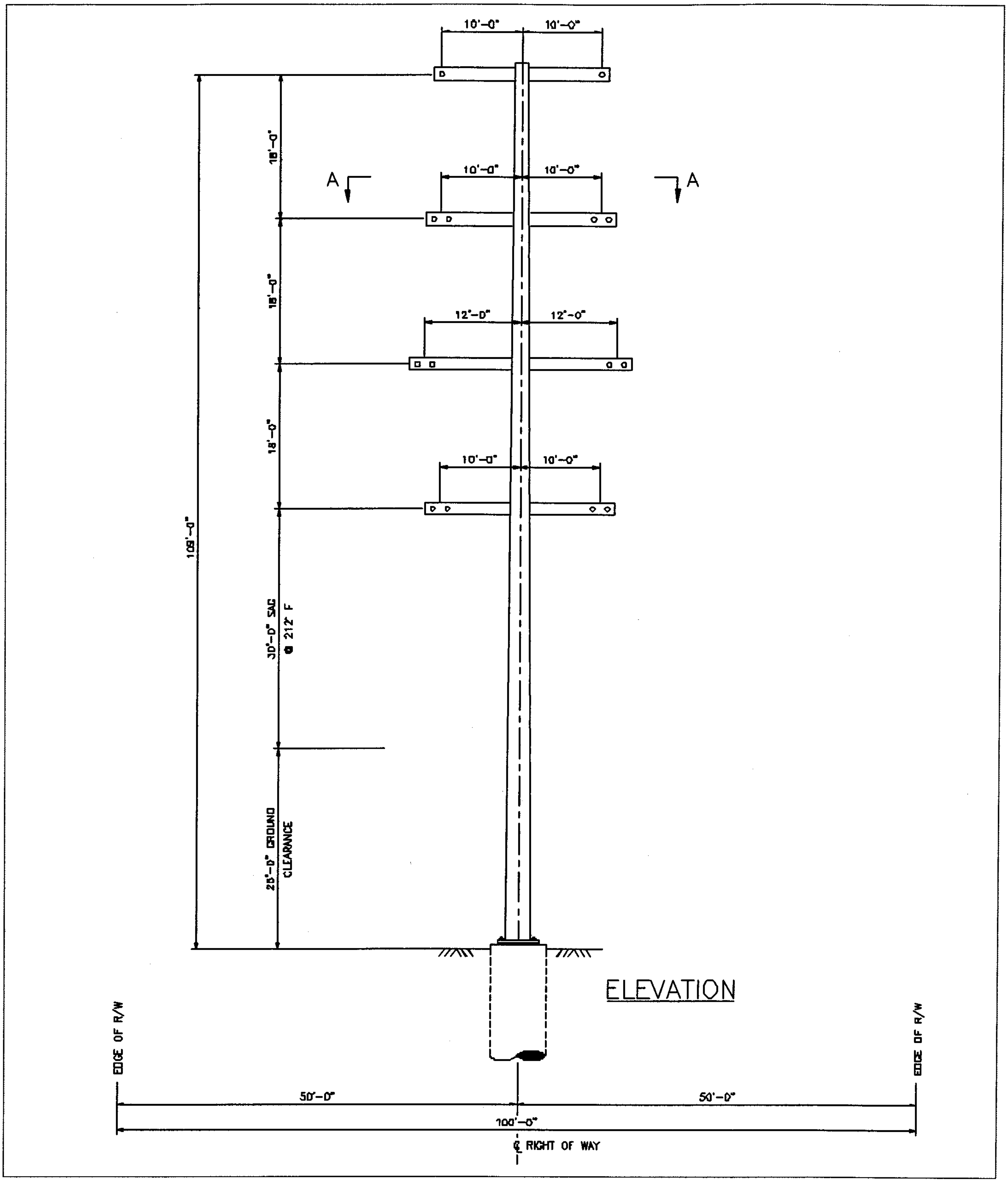

230 kV Transmission Line Double-Circuit Dead-End in RCEC Switchyard

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Figure 6.2-4

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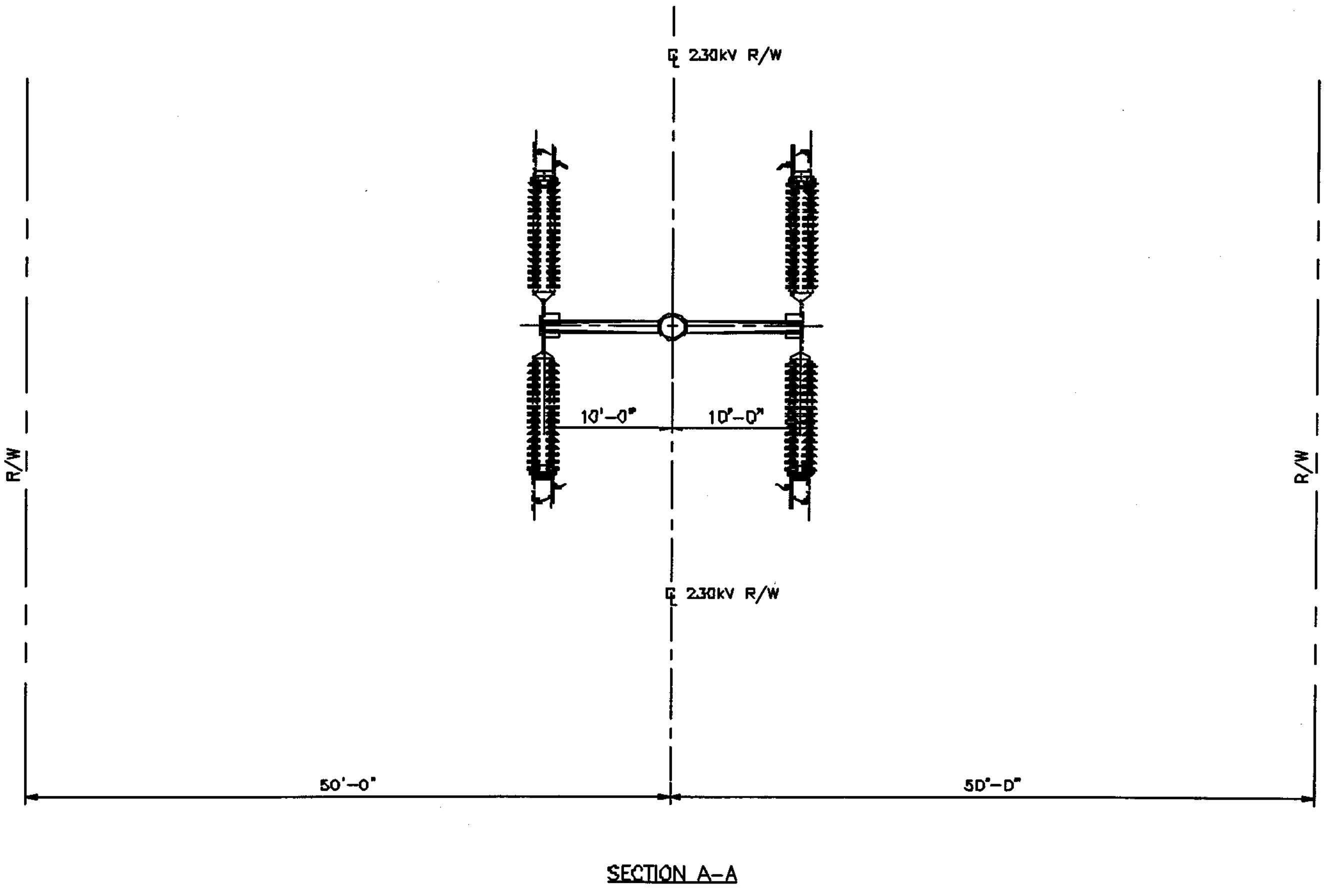

230 kV Transmission Line Double-Circuit Dead-End in RCEC Switchyard

Figure 6.2-5

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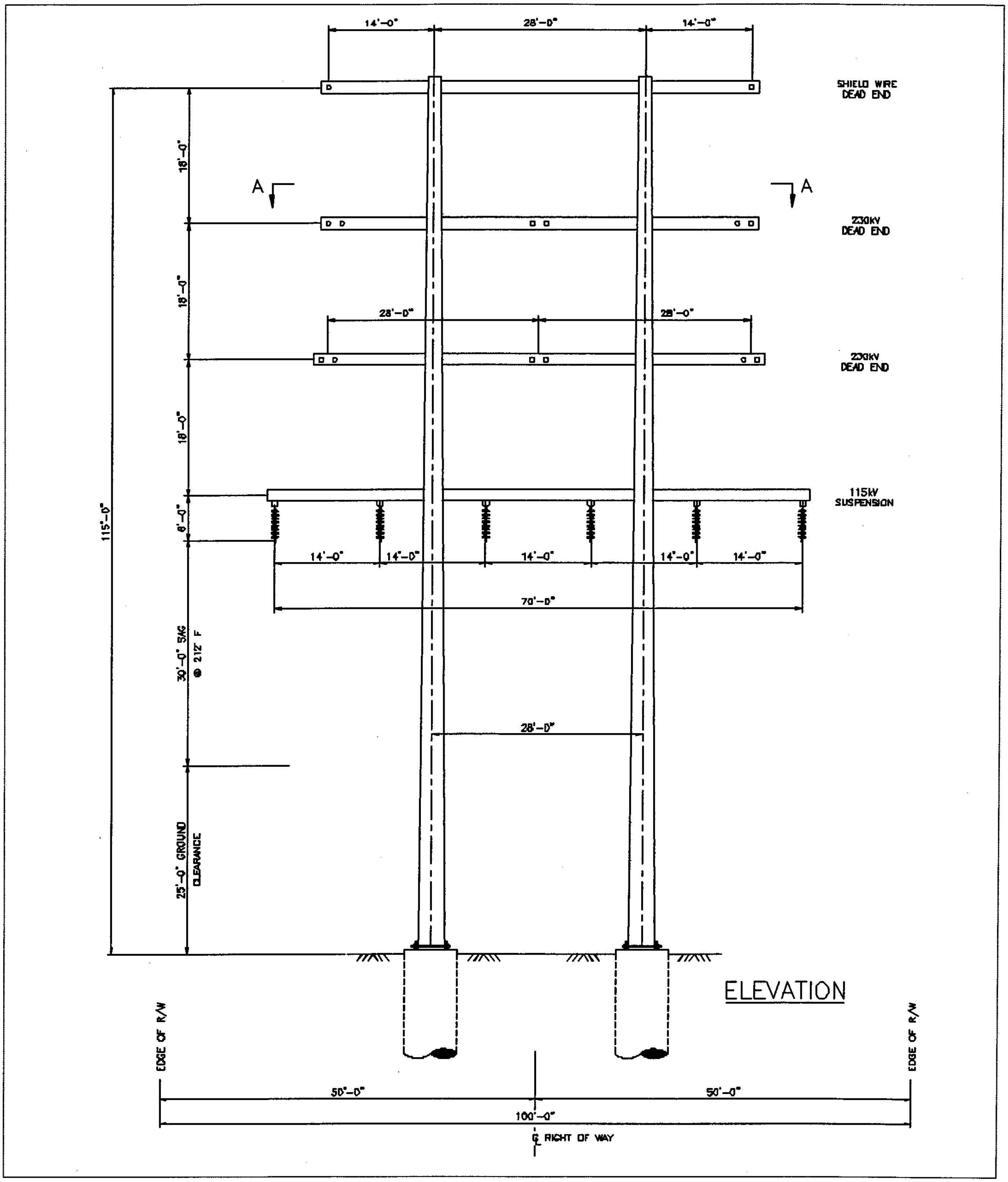

115/230 kV Heavy Angle Structure

Russell City Energy Center - Calpine/Bechtel

Figure 6.2-6

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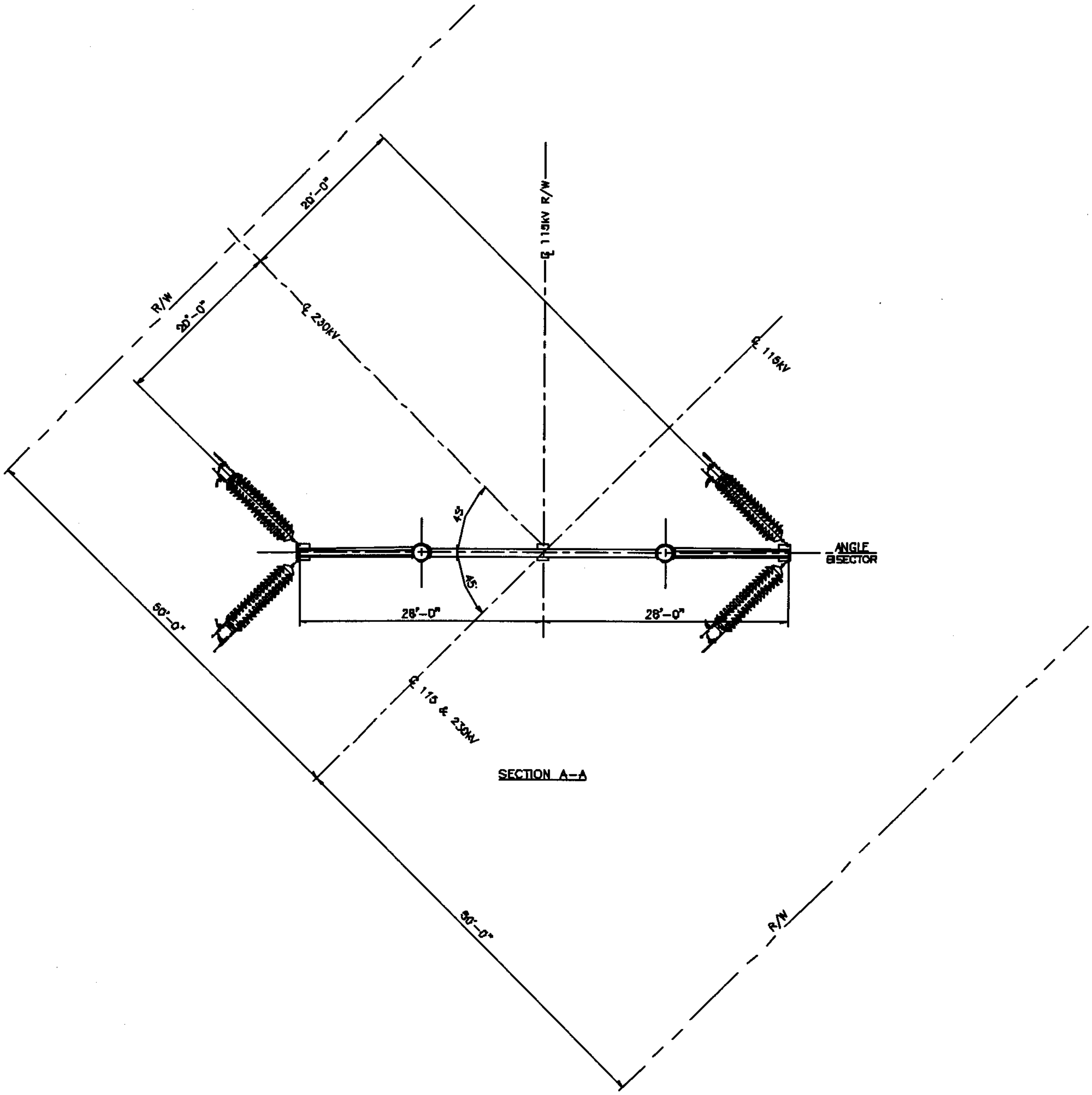

115/230 kV Heavy Angle Structure
Plan View

Figure 6.2-7

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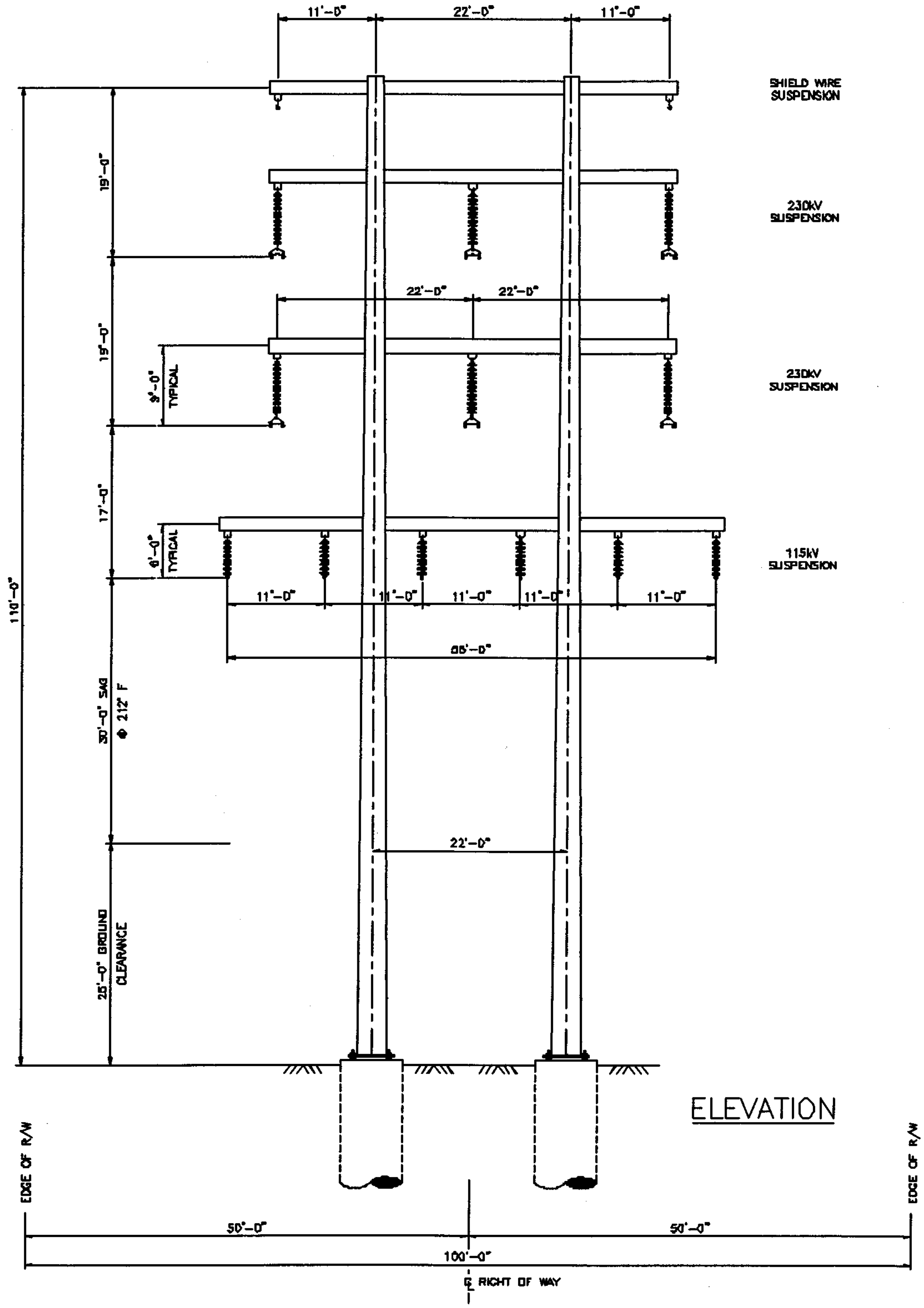

115/230 kV Transmission Line Tangent Structure

Figure 6.2-8

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Russell City Energy Center AFC

May 2001

referenced above and developed jointly by Calpine/Bechtel, PG&E, and Cal-ISO, Calpine/Bechtel completed a study conforming to NERC, WSCC, Cal-ISO, PG&E, and other standard electrical transmission engineering practices. This section summarizes the results of this study and concludes that the project will not cause any significant adverse impact on the electrical system.

The analysis is divided into four parts relating to the power flow (load flow), post transient, transient, and fault duty analysis as mandated above.

6.3.1 Power Flow Analysis

Using the assumptions stated in the PG&E *System Impact Study—Study Plan for the Calpine/Bechtel Joint Development Russell City Energy Center* dated April 6, 2001 (Appendix 6-B) and the base case provided by PG&E for the study, the effects of adding the RCEC to the PG&E transmission system were evaluated as described in the study plan. This study is intended to identify any adverse impacts caused solely by the addition of the RCEC and further, system reinforcement necessary to mitigate any adverse impacts identified.

6.3.1.1 Study Assumptions

This study started with the PG&E's 2003 Summer Peak Full Loop Base Case (in General Electric ".epc" Power Flow format). This base case was developed from PG&E's 2001 base case series and has a 1-in-10 year extreme weather load level for the Greater Bay Area. Table 6.3-1 lists the major approved PG&E transmission projects that are included in the study.

Using PG&E's generation project queue as a guide (as implied in the study plan), the generation projects listed in Table 6.3-2 were included in the study. These projects are grouped by whether or not they are in the vicinity of the RCEC project or are located remote from the project. Projects remote from the RCEC are listed, although not necessarily at full output, since it is assumed that they have a relatively minor impact on the study area.

Table 6.3-1. PG&E transmission projects included in base case.

1.	Install a third 500/230-kV, 1120-MVA transformer at Tesla Substation
2.	Install a second 500/230-kV, 850-MVA transformer at Tracy Substation
3.	Install a third 500/230-kV, 1120-MVA transformer at Metcalf Substation
4.	A new Tesla – Newark 230-kV line
5.	Newark – San Mateo 230-kV line loop into Ravenswood Substation
6.	Static Capacitors (350 MVAR) at Metcalf 500 kV
7.	Static Capacitors (150 MVAR) at Martin 115-kV
8.	Newark Substation Bank #7, 9, and 11 TCAP
9.	Grant-Eastshore 115-kV Transmission Project
10.	Los Esteros Substation Project
11.	Tri-Valley Project—Phase I
13.	Pittsburg – Tassajara 230-kV Line Reconductoring
14.	Newark 230-kV—100 to 200 MVAR Static VAR Compensator

Table 6.3-2. Generation projects.

Bay Area Generation Projects
Calpine/Bechtel—880 MW Delta Energy Center (DEC), interconnecting with the 230-kV bus at the Pittsburg Power Plant switchyard.
Calpine/Bechtel—600 MW Metcalf Energy Center (MEC), interconnecting with the Metcalf – Monta Vista #4 230-kV line, through the MEC switchyard.
Calpine—500 MW Los Medanos Energy Center (LMEC), interconnecting with the 115-kV bus at the Pittsburg Power Plant switchyard.
Duke Energy North America Corporation (DENA)—1080 MW Moss Landing project (MLPP), interconnecting with the existing 230-kV bus at the Moss Landing Power Plant.
Southern Energy Company of California—530 MW Contra Costa Power Plant Capacity Increase Project, interconnecting to Contra Costa PP 230-kV bus.
United Golden Gate PP—595 MW generating facilities, interconnecting with the San Mateo – Martin #5 and #6 115-kV lines.
Project A—692 MW Tesla Generation Project, interconnecting near Tesla Substation.
Project B—580 MW Fremont Generating Project interconnecting to the 230-kV bus at Newark Substation.
Project C—581 MW Los Esteros Generating Project interconnecting to the 115-kV bus at Los Esteros Substation.
Mirant—600 MW Potrero Unit 7 Project, interconnecting Potrero and Hunters Point Switching Stations.
FPLE—150 MW High Wind, tapping off the Vaca –Contra Costa #2 230-kV line.
Panda—150 MW West 1-3, interconnecting with Vaca Dixon – Contra Costa #1 230-kV line.
Generation Project Outside the Study Area[1]
PG&E NEG—La Paloma generation facility interconnecting at Midway 230-kV bus section D; La Paloma generation facility will be will be modeled at 1110 MW in summer and 1160 MW in spring and winter.
Texaco—338 MW Sunrise Generation Facility interconnecting at La Paloma Switching Station. Connected.
Three Mountain Power Company—530 MW project interconnecting to PG&E's Pit 1 – Pit 3 and Pit 1 – Cottonwood 230-kV lines.
GWF—130 MW Hanford, interconnecting to Kingsburg – Henrietta 115-kV line in Fresno area.
Midway-Sunset generation facility—500 MW in summer, 540 MW in spring, and 540 MW winter. Midway-Sunset generation facility will be interconnected at Midway 230-kV bus section E.
Sempra—500 MW Elk Hills Power Project, interconnecting at Midway 230-kV bus.
Wellhead Electric—22 MW Stockton Cogen Project, interconnecting with Newark Sierra Paper Board 60-kV Tap on the Stockton "A" #1 60-kV line.
Morro Bay Modernization Project replacing the existing Morro Bay Power Plant with 1,200 MW of generation.
Calpine Corporation—500 MW Sutter facility, interconnecting with WAPA's Elverta - Olinda and Elverta - Keswick 230-kV.
FPLE —560 MW Elverta Project, interconnecting with WAPA system.
Calpine—1,070 MW East Altamont Generating Project interconnecting at loop the Tracy - Westley 230-kV circuit near Tracy Substation.
Project D—1000 MW in the Fresno area.
Project E—630 MW in Glenn and Colusa counties.

[1]Project F— which is a proposed (and queued) 1350 MW facility in Solano County, was originally included in PG&E's study plan, but was eliminated from this study at PG&E's recommendation because of the level of uncertainty as to whether the project will actually materialize.

The base analysis involves comparing cases with and without the proposed RCEC project:

- The Study Plan Case: This case includes the RCEC modeled as a 2x1 configuration at 635 MW with a 15 MW power plant load and connected to the Eastshore 230-kV or bus by two 230-kV lines. The output of each gas turbine was taken to be 190 MW, and the steam unit was assumed to produce 255 MW. Each turbine/generator unit will have a dedicated 15/230-kV, 18/230kV step-up transformer connecting the unit to the RCEC Switchyard. The RCEC will be connected at the 230-kV voltage level to the PG&E transmission grid via two new 230-kV generation tie lines into the Eastshore 230-kV bus. In addition, the Pittsburg to San Mateo 230-kV line is looped into the Eastshore Substation so that Eastshore Substation is modeled with six 230-kV lines (two from San Mateo, two from Pittsburg, and two from the RCEC).
- The base case: This case removes the RCEC and the loop into Eastshore Substation to assess system conditions without the RCEC. Generation balance for this case was maintained by increasing generation at Moss Landing Unit 6. This is the case to which all other cases were compared to assess system impacts.

Approximately 300 contingencies were studied. A list of the power flow contingencies is given in Appendix 6-C. These contingencies were derived from the contingencies provided by PG&E for the DEC and MEC Detailed Facilities Studies. Additional contingencies were generated to account for generation and transmission projects that were included in the base case as well as for the addition of the RCEC. For the normal conditions, the line and transformer ratings were assumed to be the first rating in the power flow data (Rate 1). This is assumed to be the Summer Normal Rating. For emergency conditions, the second rating in the power flow data was used (Rate 2). While not used, the third rating (Rate 3) is presumed to be the Winter Normal Rating. The set monitored for overloads included facilities with a base voltage greater than 100 kV in the Bay Area as well as facilities immediately adjacent to the Bay Area.

For the normal condition, all power flow controls were assumed to be active. For the emergency condition area, interchange controls and transformer taps were assumed to be inactive to simulate the situation a few seconds following the contingency.

For each scenario, three different reports were prepared. The first is a Case Summary Report, which identifies and confirms the study parameters for each scenario evaluated. The second is an Overload Summary Report showing all the overloaded facilities along with their base voltage, interchange area, zone, normal flow, and percentage overload for the worst contingency. The third report gives the results for the base case (Appendix 6-D) and the study plan scenarios (Appendix 6-E).

6.3.1.2 Loop of Pittsburg (Contra Costa) to San Mateo 230-kV into Eastshore

The simplest configuration for interconnection of the RCEC would be to loop into either the Eastshore-to-San Mateo or the Pittsburg-(Contra Costa)-to-San Mateo 230-kV circuits. However, such a connection would clearly cause an emergency overload on the remaining circuit if one of the circuits leaving the RCEC are lost. Radial connection of the RCEC to the Eastshore bus mitigates this by insuring that local load and the 115-kV system are available for loss of one of the 230-kV circuits. However, without looping the Pittsburg (Contra Costa) to San Mateo 230-kV circuit into Eastshore as well, system overloads of the remaining 230-kV circuit, the 230/115-kV transformers, or the 115-kV lines exiting Eastshore to Grant or Dumbarton will occur.

Consequently, the project contemplates looping the Pittsburg (Contra Costa) to San Mateo 230 circuit into the Eastshore Substation. This modification will insure that there will always be at least three 230-kV exits under all single-contingencies.

6.3.1.3 Analysis of the Base Results

Table 6.3-3 shows potential impacts based on the study plan scenario. Under this configuration, there are two impacts that result from the addition of the RCEC to the system. These potential impacts are overloads on the two Eastshore to San Mateo 230-kV circuits, which both overload to up to 106% of the emergency rating of the line under overlapping contingencies, and the Eastshore 230/115-kV transformers, which are overloaded prior to the addition of the RCEC. The overloads and contingencies causing each overload are summarized in Table 6.3-3.

Eastshore 230/115-kV Transformers

While these transformers overload in the study plan, they are also overloaded in the base case. Consequently, they are not an impact that can be attributed to the RCEC. The 115-kV system serving Mount Eden, Grant, and Dumbarton is supplied by the two 230/115-kV transformers at Eastshore and the Newark to Dumbarton 115-kV line. The transformers and the 115-kV line have emergency ratings of 144 and 189 MVA, respectively. Assuming loss of the Newark to Dumbarton 115-kV line, which is the highest rated element, the maximum emergency supply is 288 MVA. Based on the power flow case the loads total to 287 MVA. Thus, with line and transformer losses, it is easy to see that the system has to overload. This is an existing problem that must be addressed and therefore it is not an impact attributable to the RCEC.

Table 6.3-3. System overloads with the RCEC.

Facility	Caused by Contingency	Flow (MVA)	%Emergency Rating
Eastshore to San Mateo #1 230-kV	Overlapping Contingency—Loss of Potrero 7C and Eastshore to San Mateo #2	477	106
	Overlapping Contingency—Loss of UGGPP P4 and Eastshore to San Mateo #2	463	102
Eastshore to San Mateo #2 230-kV	Overlapping Contingency—Loss of Potrero 7C and Eastshore to San Mateo #1	477	106
	Overlapping Contingency—Loss of UGGPP P4 and Eastshore to San Mateo #1	463	102
Eastshore 230/115-kV transformer #1	Loss of 230/115-kV #2	190	132
	Loss of Dumbarton to Newark 115-kV	151	105
Eastshore 230/115-kV transformer #2	Loss of 230/115-kV #1	189	131
	Loss of Dumbarton to Newark 115-kV	150	104

Eastshore to San Mateo 230-kV

The Eastshore to San Mateo 230-kV overloads are based on the 396 MVA normal and 449 MVA emergency ratings on these lines as specified in the Study Plan. All analysis was conducted using these ratings. Since these lines are in PG&E's coastal zone and are generally subject to higher average winds, it has been determined that 4 ft/sec line ratings may be used on these lines. The appropriate 4 ft/sec line ratings for these lines are 433 MVA normal and 481 MVA emergency. Examination of the third column of Table 6.3-3 shows that the Eastshore to San Mateo 230-kV lines exceed neither their normal nor emergency ratings if 4 ft/sec ratings are used.

6.3.1.4 Power Flow Analysis Conclusions

The System Impact Study shows that the addition of the loop of the Pittsburg (Contra Costa) 230-kV line into Eastshore Substation mitigates all potential transmission impacts attributable directly to operation of the RCEC. Consequently, operation of the RCEC would cause no unmitigated negative impacts to the transmission system beyond the first point of interconnection of the project.

6.3.2 Post Transient Analysis

The transmission owner (PG&E), the Cal-ISO, and the CEC staff have agreed that a post-transient analysis is not required for Data Adequacy. This conclusion was based on the opinion of the experts that the addition of the RCEC to the grid would not likely result in post-transient stability problems. Since synchronous generators such as those proposed provide voltage support to the system, and the interconnection is designed so that no single contingency can remove the generator from the system, it was the consensus of the experts that the impact of the RCEC on system post-transient performance is likely to be only positive.

6.3.3 Transient Analysis

In accordance with the Study Plan, a transient stability analysis was performed to determine whether the RCEC project would cause criteria violations sufficient to require transmission system modifications beyond those identified in the engineering and power flow analysis. The assumptions and results of this analysis follow.

6.3.3.1 Dynamic Stability Study Conclusions

During summer peak hours, no system dynamic or transient instability was identified due to addition of the project.

6.3.3.2 Dynamic Stability Study Base Case Assumptions

The dynamic stability study was conducted using the same PG&E Summer Peak Full Loop Case used in the load flow analysis, in conjunction with a ‘full loop’ system dynamics data file provided by PG&E, modified to include other generation projects assumed on-line for this system study. The dynamics modeling data for the project was translated into General Electric’s Positive Sequence Dynamics Simulation program format.

6.3.3.3 Dynamic Stability Analysis Results

Five contingencies were tested for system dynamic stability response with addition of the RCEC project. Table 6.3-4 shows the contingencies tested and the resulting stable system responses for the tested contingencies.

Table 6.3-4. RCEC project summer peak transient stability summary.

	3-Phase Bus Fault	Component Outage	Clearing Time (cycles)	Summer w/ Project Stable/ Unstable	Summer w/o Project[1] Stable/ Unstable
1.	RCEC 230-kV	Full Load Project Generation Rejection	6	Stable	
2.	RCEC 230-kV	'B' RCEC-Eastshore #1 230-kV	6	Stable	---
3.	Eastshore 230-kV	'B' Eastshore-San Mateo #1 230-kV	6	Stable	---
4.	Eastshore 230-kV	'B' Eastshore-Pittsburg #12 230-kV	6	Stable	---
5.	Pittsburg 230-kV	'C' Pittsburg 230-kV bus section (bus1 section E)	6	Stable	---

[1] 'Without Project' analysis performed only if 'With Project' case is unstable.

Appendix 6.3-F provides the dynamic data for the project in GE format. Appendix 6-G contain sets of plots illustrating various system performance parameters for modeled monitoring points at the project, within PG&E's system, and remote locations on the greater WSCC system. There are five sets of plots corresponding to each of the outage cases used in the dynamic stability analysis. Appendix 6-H provides the execution control files for the five tested contingencies.

6.3.4 Fault Analysis

Using power flow data and other publicly available data, a short circuit data case was constructed that is sufficient to reasonably simulate the response of the transmission system to operation of the RCEC. PG&E's confidential short-circuit data will be used for its System Impact Study.

6.3.4.1 Short-Circuit Assumptions

While the power flow and transient stability data that has been employed to create the short-circuit model include sufficient information to evaluate three-phase faults, the lack of zero sequence and transformer connection data makes the calculation of single-line-to-ground faults impossible. However, since a single-line-to-ground fault current can be readily limited to the three-phase fault current value by the addition of neutral impedances, the three-phase fault current is sufficient for determining overall system impacts.

It can also be said that the computed increment in three-phase fault current due to a generator addition is exact. Since short-circuit calculations are linear, assuming that the power flow network model is accurate, the increase in flows throughout the network due to the generator addition will also be exact. However, the base case short circuits depend on the generators modeled throughout the system.

Western Loop

A full power flow model of the entire WSCC was initially selected because associated dynamic data were available with this case. The selected case is the 2003 Heavy Summer "Must Run" case developed in 1998 (1997 data). However, the dynamic data turned out to be unnecessary because it was determined that the generator sub-transient impedances were included in the power flow case. To fit the case within the existing dimensions of the Short Circuit program, this power flow case was reduced slightly by eliminating buses in areas remote from California.

Results from the converted case were compared to known fault currents computed by PG&E in various Detailed Facilities Studies. While these results compared well enough for the purpose outlined here, we were unable to continue with this case because significant detail on the low-voltage system was missing. This analysis will be completed in PG&E's System Impact Study.

PG&E Case

To produce a model that includes sufficient detail for accurate calculation of short-circuit currents at the RCEC, a PG&E Planning Assessment case, as modified for use in the Delta Energy Center (DEC) Detailed Facilities Study, was used. However, GE (.epc) format data cases such as this one do not include the generator sub-transient impedances necessary to perform a short-circuit calculation. This data was retrieved from the PG&E loop case. Since the bus numbers are not the same in both cases, they needed to be matched to allow the dynamic data to be included in the new model.

For the majority of cases, a match was possible. However, there are three instances where a match was not possible. First, the loop case did not have models of most of the new generators that are being added to the system. Second, in some instances generators were not modeled in the reduced loop model. Finally, even when they were modeled, occasionally the loop model inexplicably lumped generation. For example, some of the older Pittsburg units were lumped together. Whenever possible, these instances were resolved. The impact of missing generation always has the effect of lowering the predicted fault levels. However, when the fault-current levels were compared to known values, the values predicted by the model matched known values closely enough for purposes of the study. If detailed engineering is to be accomplished using these data, then careful review of the model, particularly in the vicinity of the study area, is necessary.

PG&E's planning assessment cases are a truncated model of the system with a fictitious injection of power at the tie points at Malin and Vincent. The fault contributions at these tie points were computed from the full loop case as shown in Table 6.3-5.

Table 6.3-5. Fault contributions.

Location	Contribution	Magnitude	Angle	Resistance	Reactance
Malin	Malin	7.0372	-85.633	0.0108	0.1417
	Malin	34.656	-84.416	0.0028	0.0287
	Grizzly	23.591	-85.044	0.0037	0.0422
Vincent	Lugo 1	48.295	-87.532	0.0009	0.0207
	Lugo 2	48.295	-87.532	0.0009	0.0207
	Vincent 1	35.662	-85.346	0.0023	0.0279
	Vincent 2	33.763	-85.002	0.0026	0.0295
	Vincent 3	33.513	-85.069	0.0026	0.0297

RCEC Plant Interconnection

The sub-transient reactances for the generators at the RCEC were obtained from the transient stability data provided for the project. For the RCEC steam turbine-generator "xd" is 0.2848 (311 MVA Base), and "xd" for the combustion turbine-generators is 0.1917 (226 MVA Base). These values yield admittance values of –7.935 pu and –11.79 pu, respectively, on the system base of 100 MVA. A number of generation projects in the Bay Area that are expected to be on-line ahead of the RCEC were also included in the analysis. These projects include DEC, LMEC, Fremont Generating Project, Los Esteros Generating Project, United Golden Gate Power Project, Potrero Expansion Project, and SECAL. In the absence of dynamic data for these projects, the steam and combustion units for these projects were assumed to have the same admittance values as the RCEC generators.

6.3.4.2 Short Circuit Conclusions

Table 6.3-6 shows the fault duties at the buses near the Eastshore Substation.

Table 6.3-6. Short circuit duties near Eastshore Substation.

		Short Circuit Currents (kA)			
Station	**kV**	**LMEC, DEC, No RCEC**	**LMEC, DEC, AND RCEC**	**New Bay Generators, No RCEC**	**New Bay Generators AND RCEC**
Eastshore 230-kV	230	14.0	21.6	14.2	22.1
Eastshore 115-kV	230	16.9	18.7	17.3	19.1
Grant	115	11.7	12.5	11.9	12.7
Mt. Eden	115	15.3	16.7	15.6	17.0
Dumbarton	115	19.5	20.3	20.0	20.9
Newark 230-kV	115	33.4	33.8	36.3	36.7
Newark 115-kV	115	45.9	46.6	49.5	50.2
San Mateo	230	22.2	23.4	22.2	23.8
San Mateo	115	30.0	30.7	38.7	40.8
Contra Costa PP	230	35.4	35.5	35.8	35.8
Pittsburg 230-kV	230	51.4	52.2	52.1	52.9
Pittsburg 115-kV	230	55.1	55.2	55.3	55.4

The column showing results for the current system with the Los Medanos Energy Center (LMEC) and Delta Energy Center (DEC) attached provide both the base for this study and model validation. The fault currents for the Contra Costa PP and Pittsburg 230-kV and the Pittsburg 115-kV buses compare favorably to those calculated in previous studies (35.4, 51.4, 55.1 versus 33.1, 53.6, 51.2 kA, respectively).

The increased fault duties are well within the capabilities of existing circuit breakers, so there is no impact that cannot be mitigated by a breaker replacement. In all cases, the increases in fault currents are moderate, making any breaker replacements to correct interrupting duty problems unlikely. Breaker duties for breakers in the vicinity of the RCEC are included in Appendix 6-I.

6.4 TRANSMISSION LINE SAFETY AND NUISANCES

This section discusses safety and nuisance issues associated with the proposed electrical interconnection of the RCEC. Construction and operation of the proposed overhead transmission line will be undertaken in a manner to ensure the safety of the public as well as maintenance and right-of-way crews, while supplying power with minimal electrical interference.

6.4.1 Electrical Clearances

Typical high-voltage overhead transmission lines are composed of bare conductors connected to supporting structures by means of porcelain, glass, or plastic insulators. The air surrounding the energized conductor acts as the insulating medium. Maintaining sufficient clearances, or air space, around the conductors to protect the public and utility workers is paramount to safe operation of the line. The safety clearance required around the conductors is determined by: normal operating voltages, conductor temperatures, short-term abnormal voltages, wind-blown swinging conductors, contamination of the insulators, clearances for workers, and clearances for public safety. Minimum clearances are specified in the National Electric Safety Code (NESC). Electric utilities, state regulators, and local ordinances may specify additional (more restrictive) clearances. Typically, clearances are specified for:

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

The proposed RCEC transmission interconnection will be designed to meet all national, state, and local code clearance requirements. Since the designer must take into consideration many different situations, the generalized dimensions provided in the figures of this section should be regarded as reference for the electric and magnetic field calculations only and not absolute. The minimum ground clearance for 115-kV transmission per the NESC is 20.1 feet, based on the road-crossing minimum. The minimum ground clearance for 230-kV transmission per the NESC is 22.4 feet, based on the road-crossing minimum. These are the design clearances for the maximum operating temperature of the line. Under normal conditions, the line operates well below maximum conductor temperature, and thus the average clearance is much greater than the minimum. The electrical effects calculations are based on a 30-foot clearance for 115-kV and 230-kV lines per Pacific Gas and Electric Company ("PG&E") guidelines. The final design value will be consistent with General Order 95 (GO-95) of the California Public Utilities Commission and PG&E's guidelines for electric and magnetic field (EMF) reduction.

6.4.2 Electrical Effects

The electrical effects of high-voltage transmission lines fall into two broad categories: corona effects and field effects. Corona is the ionization of the air that occurs at the surface of the energized conductor and suspension hardware due to very high electric field strength at the surface of the metal during certain conditions. Corona may result in radio and television reception interference, audible noise, light, and production of ozone. This study includes audible noise considerations only. Field effects are the voltages and currents that may be induced in nearby conducting objects. The transmission line's 60 hertz (Hz) electric and magnetic fields cause these effects.

6.4.2.1 Electric and Magnetic Fields

Operating power lines, like the energized components of electrical motors, home wiring, lighting, and all other electrical appliances, produce electric and magnetic fields, commonly referred to as EMF. The EMF produced by the alternating current electrical power system in the United States has a frequency of 60 Hz, meaning that the intensity and orientation of the field changes 60 times per second.

The 60 Hz power line fields are considered to be extremely low frequency. Other common frequencies are AM radio, which operates up to 1,600,000 Hz (1,600 kHz); television, 890,000,000 Hz (890 MHz); cellular telephones, 900,000,000 Hz (900 MHz); microwave ovens, 2,450,000,000 Hz (2.4 GHz); and X-rays, about 1 billion (10^{18}) hertz. Higher frequency fields have shorter wavelengths and greater energy in the field. Microwave wavelengths are a few inches long and have enough energy to cause heating in conducting objects. Higher frequencies, such as X-rays, have enough energy to cause ionization (breaking of molecular bonds). At the 60 Hz frequency associated with electric power transmission, the electric and magnetic fields have a wavelength of 3,100 miles and have very low energy that does not cause heating or ionization. Unlike radio-frequency (RF) fields, the 60 Hz fields do not radiate.

Electric fields around transmission lines are produced by electrical charges on the energized conductor. Electric field strength is directly proportional to the line's voltage; that is, increased voltage produces a stronger electric field. The electric field is inversely proportional to the distance from the conductors, so that the electric field strength declines as the distance from the conductor increases. The strength of the electric field is measured in units of kilovolts per meter (kV/m). The electric field around a transmission line remains practically steady and is not affected by the common daily and seasonal fluctuations in usage of electricity by customers.

Magnetic fields around transmission lines are produced by the level of current flow, measured in terms of amperes, through the conductors. The magnetic field strength also is directly proportional to the current; that is, increased amperes produce a stronger magnetic field. The magnetic field is inversely proportional to the distance from the conductors. Thus, like the electric field, the magnetic field strength declines as the distance from the conductor increases. Magnetic fields are expressed in units of milligauss (mG). The amperes and, therefore the magnetic field around a transmission line, fluctuate daily and seasonally as the usage of electricity varies.

Considerable research has been conducted over the last 30 years on the possible biological effects and human health effects from EMF. This research has produced many studies that offer no uniform conclusions about whether long-term exposure to EMF is harmful or not. In the absence of conclusive or evocative evidence, some states, California in particular, have chosen not to specify maximum acceptable levels of EMF. Instead, these states mandate a program of prudent avoidance whereby EMF exposure to the public would be minimized by encouraging electric utilities to use low-cost techniques to reduce the levels of EMF. Additional information on EMF is provided in Appendix 6-J.

6.4.2.2 Audible Noise

Corona is a function of the voltage of the line, the diameter of the conductor, and the condition of the conductor and suspension hardware. The electric field gradient is the rate at which the electric field changes and is directly related to the line voltage.

The electric field gradient is greatest at the surface of the conductor. Large-diameter conductors have lower electric field gradients at the conductor surface and, hence, lower corona than smaller conductors, everything else being equal. Also, irregularities (such as nicks and scrapes on the conductor surface) or sharp edges on suspension hardware concentrate the electric field at these locations and, thus, increase corona at these spots. Similarly, contamination on the conductor surface, such as dust or insects, can cause irregularities that are a source for corona. Raindrops, snow, fog, and condensation are also sources of irregularities. Corona typically becomes a design concern for transmission lines having voltages of 345 kV and above.

6.4.2.3 EMF and Audible Noise Assumptions

It is important that any discussion of EMF and audible noise include the assumptions used to calculate these values and to remember that EMF and audible noise in the vicinity of the power lines vary with regard to line design, line loading, distance from the line, and other factors.

Both the electric field and audible noise depend upon line voltage, which remains nearly constant for a transmission line during normal operation. A worst-case voltage of 121 kV (115 + 5%) will be used in the EMF calculations for the 115-kV lines, and 242 kV (230-kV + 5%) will be used in the EMF calculations for the 230-kV lines.

The magnetic field is proportional to line loading (amperes), which varies as power plant generation is changed by the system operators to meet increases or decreases in demand for electrical power. Line loading values assumed for the EMF studies were based on PG&E's 2003 Summer Peak Full-Loop Base Case, which was developed from PG&E's 2001 base case series. The RCEC plant was assumed to be operating at a maximum nominal net generation of 620 megawatts (MW). The power will be transmitted from the power plant toward the Eastshore Substation. A power flow study was conducted, as described below, to calculate how the power is expected to distribute over the Eastshore outgoing circuits. The calculated power flow values used in the EMF calculations are presented in Table 6.4-1.

Another important parameter for these studies is the phase arrangement of the lines, both existing and after the RCEC is interconnected to the grid. The phasing (i.e., relative positions of A, B, and C phases) on a multi-circuit structure may offer some field cancellation, which results in reduced magnetic field values at the right-of-way edge. Studies have shown that cross-phasing double-circuit lines provides magnetic field reduction when both circuits are carrying power in the same direction. In cross-phasing, the circuit on one side of the structure is configured, for example, with phases A, B, and C arranged from top to bottom, while the other circuit is configured C, B, A from top to bottom. In this particular study the existing lines already incorporate cross-phasing. The data used for the EMF and audible noise studies can be noted from the discussions contained in the following paragraphs and the figures included in the following pages.

Figure 6.4-1 illustrates the plan view of the specific transmission lines represented by the four cross-sections (A1, A2, B, and C) that were included in the EMF studies. Cross-section A1 represents the corridor for EMF values calculated without the RCEC and is the existing Eastshore-Grant line. Cross-section A2 represents the same corridor for the EMF values calculated with the RCEC. Though the

Table 6.4-1. Normal flows out of Eastshore Substation at peak.

Line	Normal Rating (Amps)	PG&E 2003 Summer Peak (RCEC Study) Case Line Flow (Amps) *Base Case	*Study Plan	Low San Francisco Generation	Low Newark Generation	Low San Francisco and Newark Generation	High Pittsburg Generation
Eastshore to RCEC #1 230-kV	***	N/A	-746	-750	-752	-756	-750
Eastshore to RCEC #2 230-kV	***	N/A	-746	-750	-752	-756	-750
Eastshore to San Mateo #1 230-kV	994	-220	595	944	749	1075	933
Eastshore to San Mateo #2 230-kV	994	376**	595	944	749	1075	933
Eastshore to Grant #1 115-kV	346	140	140	140	140	139	140
Eastshore to Grant #2 115-kV	346	140	140	140	140	139	140
Eastshore to Dumbarton 115-kV****	838	86	479	287	629	443	763

NOTE: All flows are referenced from the Eastshore Substation so that a negative sign indicates flow into Eastshore and a positive number indicates flow out of Eastshore.

* EMF calculations were based on Base Case and Study Plan line flows

** Construction of the RCEC entails looping the Pittsburg to San Mateo 230-kV line into the Eastshore Substation, thereby creating Eastshore to San Mateo #2 and Eastshore to Pittsburg #2. The 376 Amp value in the base case column represents the flow on the original Pittsburg to San Mateo line, where current flow is from Pittsburg to San Mateo.

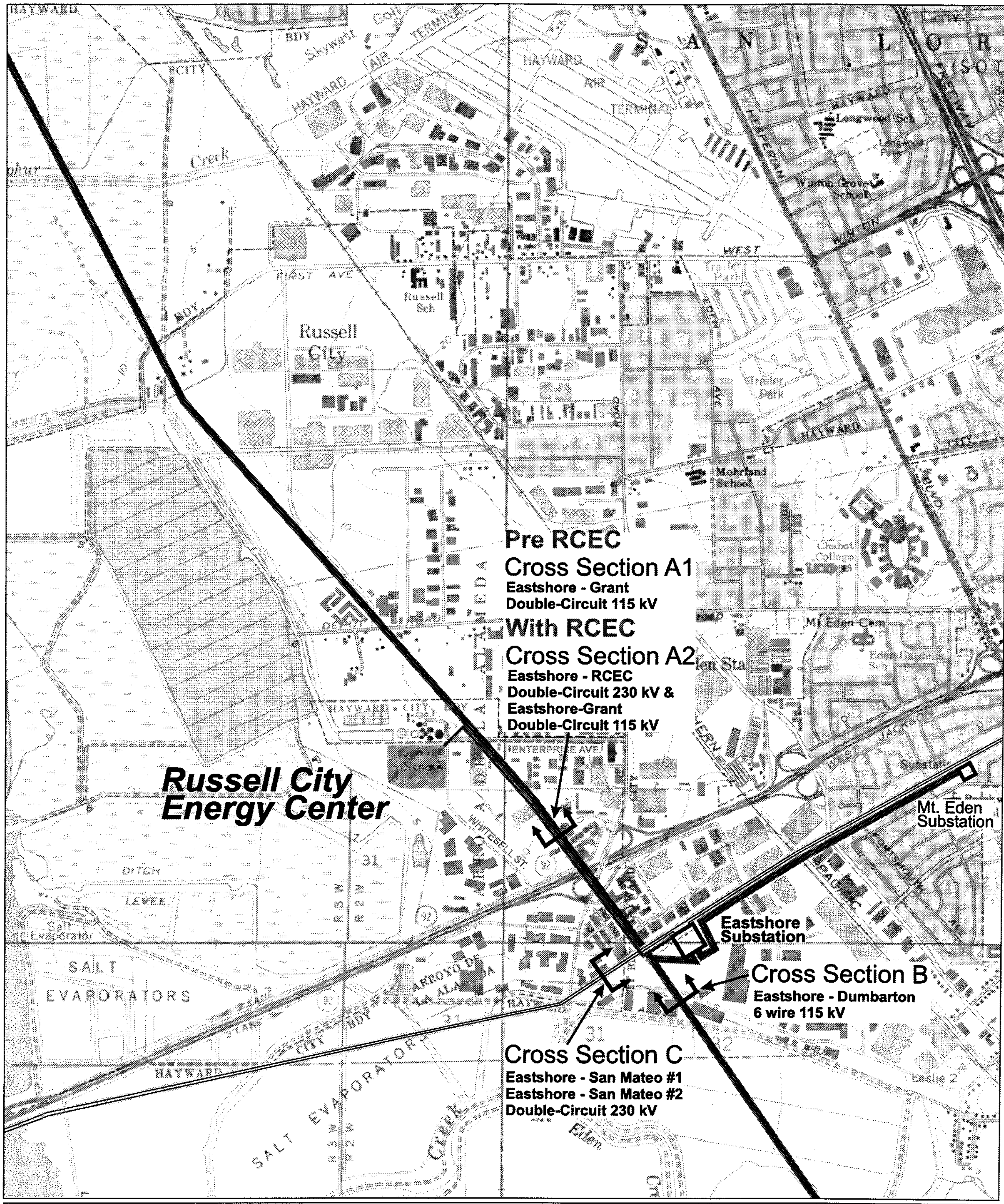
*** These lines are part of the RCEC project and will be designed to have a sufficient rating.

**** Six-wire circuit

cross sections represent the same corridor, the structure used after the addition of the RCEC will support all four circuits and the existing 115-kV towers will be removed. The two proposed 230-kV circuits would be constructed over the existing 115-kV circuits for approximately 4,500 feet to the Eastshore Substation. Cross-sections B and C are representative of the indicated transmission lines for the EMF values calculated without the RCEC and also for the EMF levels expected after the RCEC. In addition, for purposes of calculating magnetic field, it is assumed in this study that the lowest clearance for all cross sections described above is 30 feet at mid-span.

Figure 6.4-2 is Cross-section A1 and represents the existing PG&E Eastshore-Grant double-circuit 115-kV line. The cross-phasing configuration, conductor and shield wire used, and dimensions assumed for the EMF studies are pictured. After the RCEC interconnection, Cross-section A2, illustrated in Figure 6.4-3, will be representative of the proposed RCEC to Eastshore corridor. The proposed four-circuit structure, the horizontal cross-phasing configurations, conductor and shield wire used, and dimensions assumed for the EMF studies are pictured.

Cross-section B, as seen in Figure 6.4-4, is the PG&E Eastshore-Dumbarton 115-kV corridor. The lattice towers carry a 6-wire circuit. Cross-section B is just south of the Eastshore Substation site. The phasing configuration, conductor and shield wire, and dimensions assumed for the EMF studies are pictured.



Proposed Radial Connection
Existing 115 kV Transmission Line
Existing 230 kV Transmission Line
Proposed Russell City Energy Center

N S W E

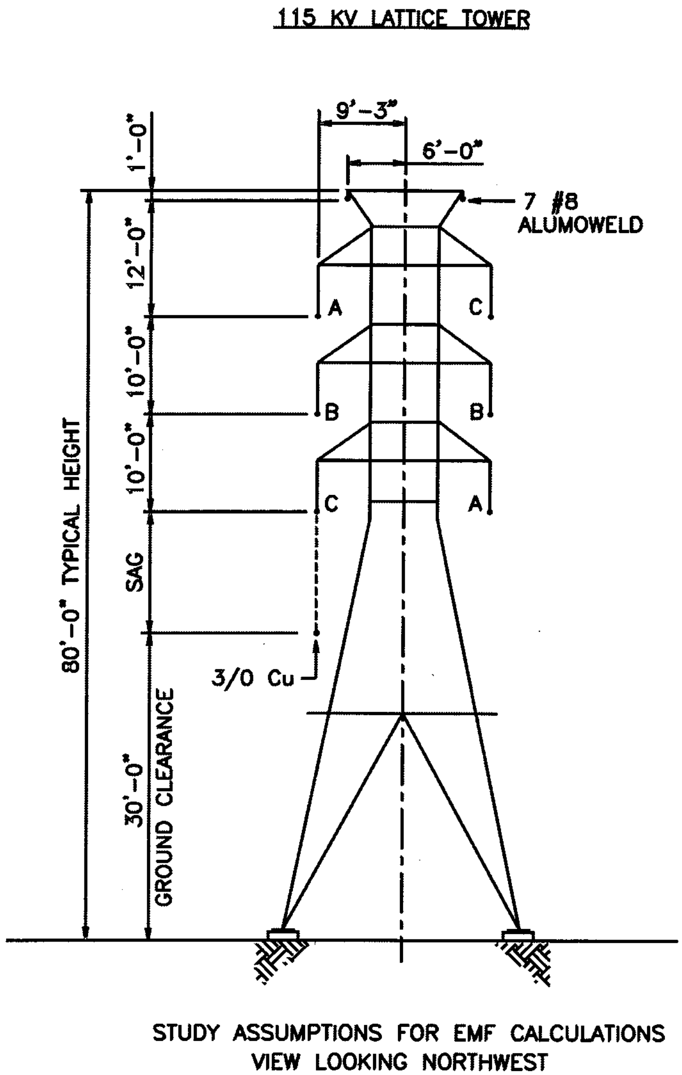
Scale: 1" = 2,000'
0 1000 2000
FEET

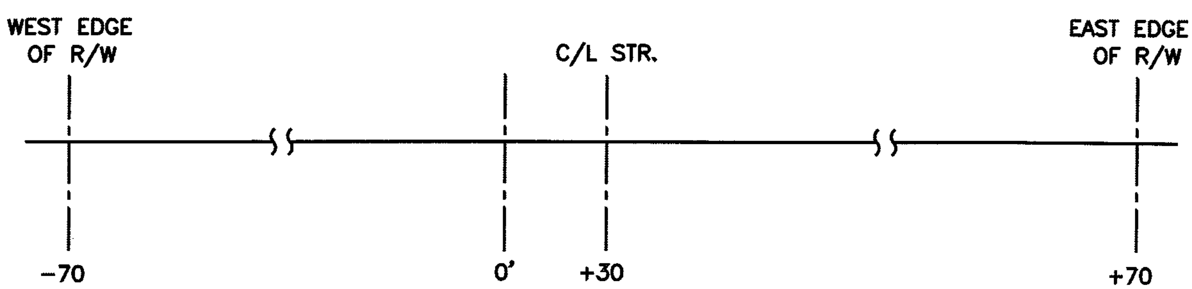
California
Map Area

Figure 6.4-1
EMF Study Cross Sections
Proposed Russell City Energy Center
Hayward, California
Calpine

Prepared By: May 7, 2001
CAI Commonwealth Associates Inc.
Jackson, Michigan
Engineers • Consultants • Construction Managers

Basemap: SureMaps Raster - USGS 7.5 Minute Topographic Quadrangle Maps.





NOT TO SCALE

ALL DIMENSIONS AND PHASING ARE ESTIMATES
AND ARE PROVIDED FOR PURPOSES OF CALCULATING EMF ONLY

Cross Section A1
115 kV Typical Double-Circuit Structure

Russell City Energy Center - Calpine/Bechtel

Figure 6.4-2

May 7, 2001

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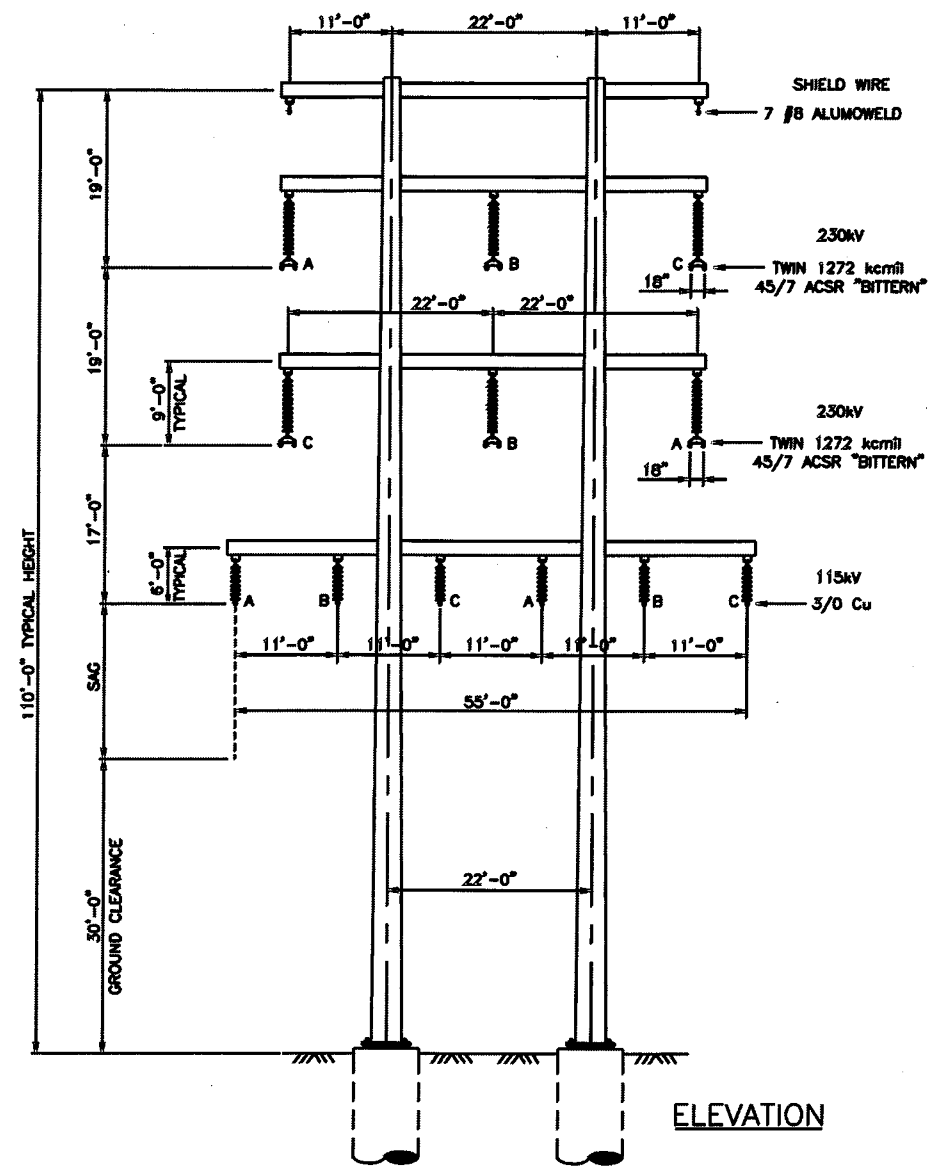
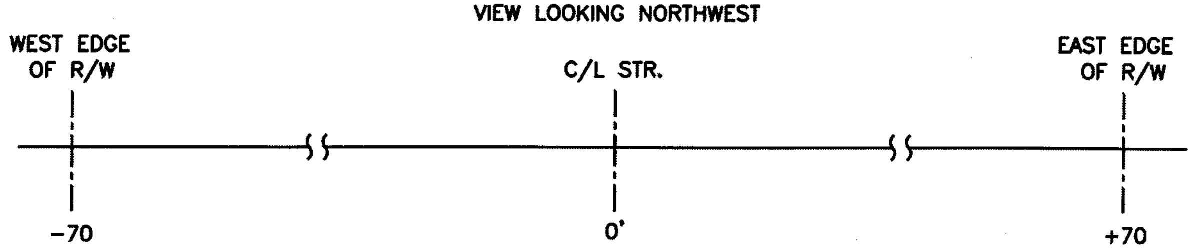
Russell City Energy Center AFC

May 2001

PROPOSED 115/230 KV LATTICE TOWER



STUDY ASSUMPTIONS FOR EMF CALCULATIONS
VIEW LOOKING NORTHWEST



NOT TO SCALE
ALL DIMENSIONS AND PHASING ARE ESTIMATES
AND ARE PROVIDED FOR PURPOSES OF CALCULATING EMF ONLY

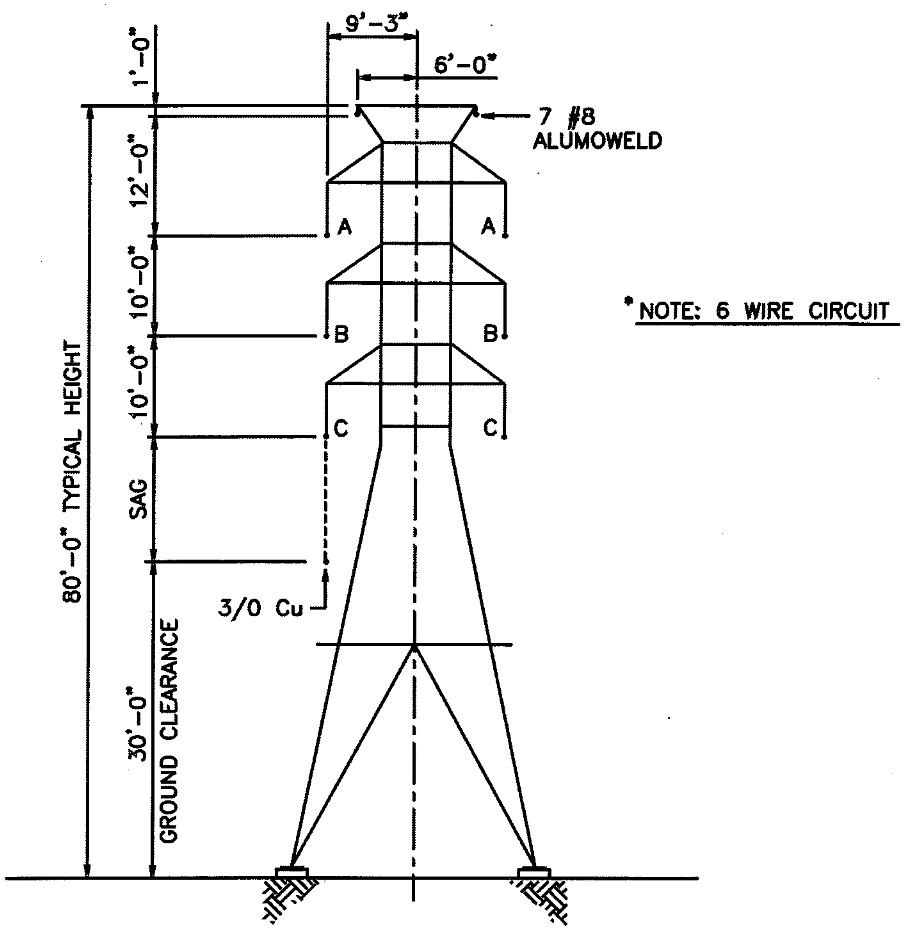
Cross Section A2
115/230 kV Transmission Line Tangent

Russell City Energy Center - Calpine/Bechtel

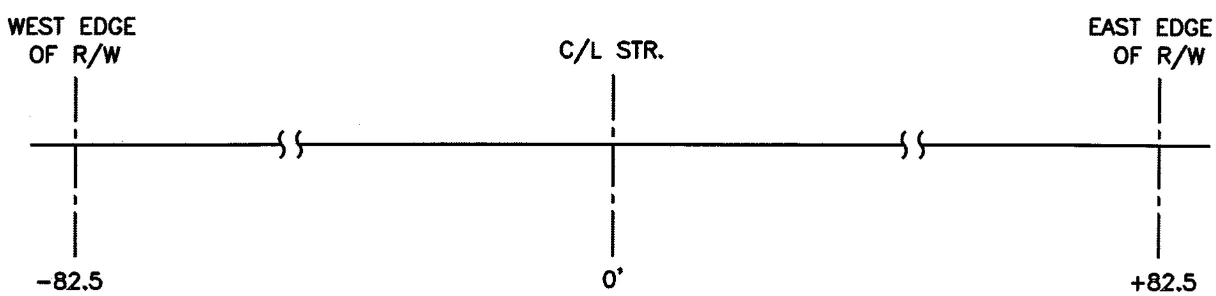
Figure 6.4-3

May 7, 2001

Prepared By: Commonwealth Associates Inc.
Jackson, Michigan
Engineers Consultants Construction Managers



STUDY ASSUMPTIONS FOR EMF CALCULATIONS
VIEW LOOKING NORTHWEST



NOT TO SCALE
ALL DIMENSIONS AND PHASING ARE ESTIMATES
AND ARE PROVIDED FOR PURPOSES OF CALCULATING EMF ONLY

Cross Section B
115 kV Typical Double-Circuit Structure

Russell City Energy Center -
Calpine/Bechtel

Figure 6.4-4

May 7, 2001

Prepared By:
Commonwealth Associates Inc.
Jackson, Michigan
Engineers Consultants Construction Managers

Russell City Energy Center AFC

May 2001

Cross-section C is illustrated in Figure 6.4-5. This section consists of existing PG&E 230-kV double-circuit lattice towers. The assumed phasing, conductor and shield wire, and dimensions used for the EMF studies are pictured.

EMF Calculations

EMF levels were calculated at one meter above flat terrain using ENVIRO, a TLWorkstation (TLW) program developed by the Electric Power Research Institute. Measurements for electric and magnetic fields at one meter above the ground surface are in accordance with the Institute of Electrical and Electronic Engineers (IEEE) standards. ENVIRO calculates the electric field levels expressed as kilovolts per meter (kV/m) and the magnetic field levels expressed in milliGauss (mG). The various inputs for the calculations include voltage, current load (amps), current angle (i.e., phasing), conductor type and spacing, number of subconductors, subconductor bundle symmetry, spatial coordinates of the conductors and shield wire, various labeling parameters, and other specifics. The field level is calculated perpendicular to the line and at mid-span where the overhead line sags closest to the ground (calculation point). The mid-span location, therefore, provides the maximum value for the field. Also using an ENVIRO mathematical model, audible noise is calculated at a 5-foot microphone height above flat terrain with information concerning rain, snow, and fog rates for daytime and nighttime hours as input. Audible noise is expressed in decibels (db(A)). Graphs and tables in support of Section 6 were produced by importing ENVIRO data into Microsoft Excel.

A power flow model was developed from a PG&E data set (PG&E's 2003 Summer Peak Full-Loop Base Case). Two scenarios were calculated for comparison:

- without the proposed RCEC operating (Base Case)
- with the proposed RCEC nominal net generation of 620 MW added (Study Plan)

The variations in the power flow for the studied cross sections are presented in the following table.

Results of EMF and Audible Noise Calculations

Electric Field and Audible Noise

Line voltage and arrangement of the phases determine the electric field. The PG&E lines represented by Cross-sections B and C have no changes in either the voltage or the phasing. Therefore, the electric field in these vicinities will remain the same. However, the corridor represented by Cross-sections A1 and A2 has both voltage and phasing changes. The analytical results of the electric field are shown in Appendix 6-K. Graphical views are shown in Figures 6.4-6 through 6.4-9.

The highest levels of corona and, hence, audible noise will occur during foul weather when the line conductors are wet. For these conditions, the conductor will produce a small amount of corona. However, no change in audible noise over the existing lines will occur because the conductor and voltages will remain the same as those of the existing system. For the proposed tap line, the hardware used to connect the conductors to the structures will be of low-corona design. Special care will be employed during stringing of the conductor to minimize nicks and scrapes to the conductor. These actions will ensure a low-corona design. The analytical results for the audible noise calculations are shown in Appendix 6-L. Graphical views are shown in Figures 6.4-10 through 13.

Magnetic Field

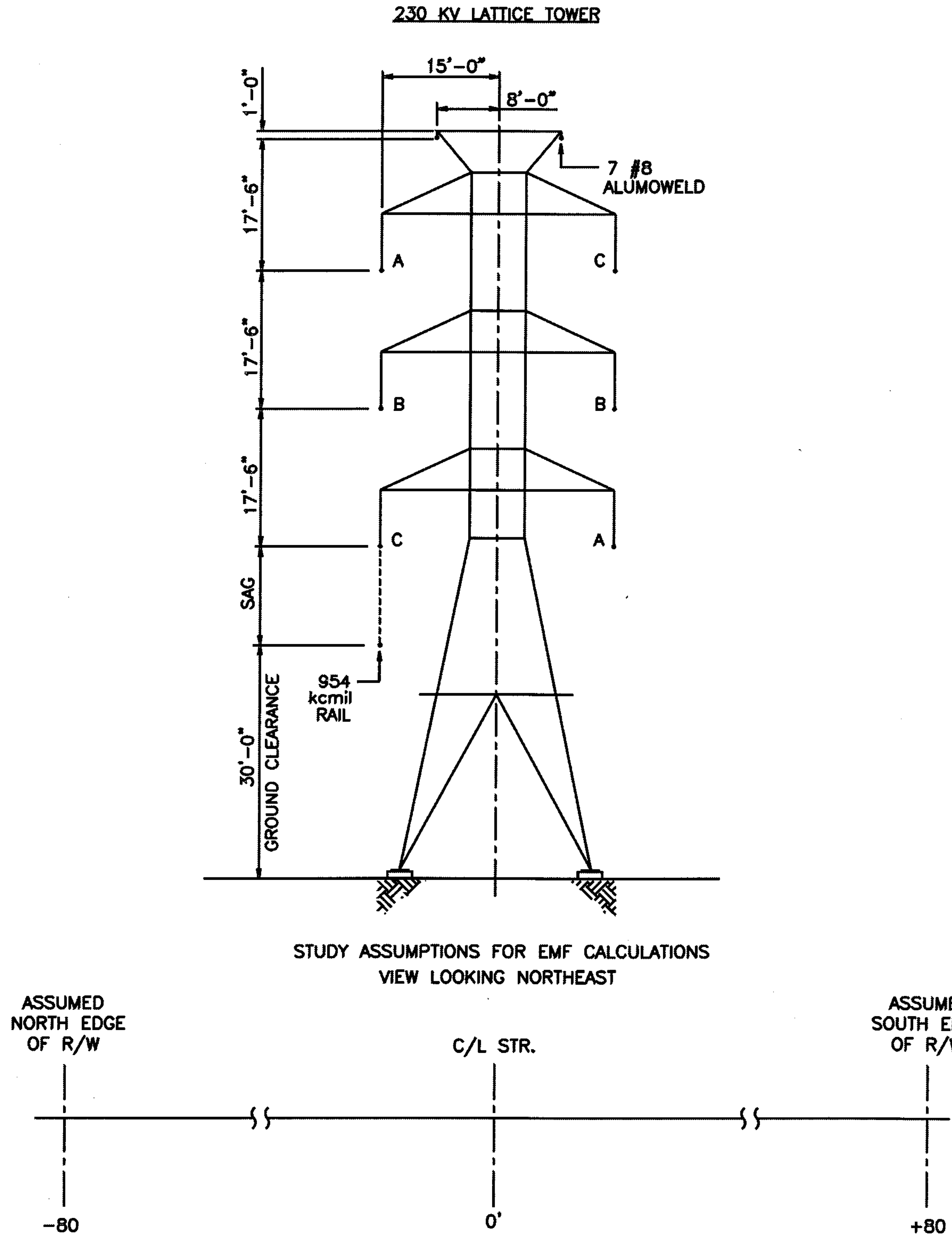
The complete analytical results of the magnetic field calculations are provided in Appendix 6-M, and a graphical view is given in Figures 6.4-14 through 16. Table 6.4-2 summarizes calculated values for the magnetic field. The ±70 feet from centerline coincides with the edge of right-of-way for Cross-sections A1 and A2 and the ±80 feet from the centerline represents the edge of right-of-way for Cross-sections B and C. For each cross-section, the distance is given where the maximum field value was located.

Table 6.4-2. Magnetic field (mG), calculated field at mid-span perpendicular to transmission centerline.

	Distance from Transmission Centerline (feet)				
System at Peak Load	**-80**	**-70**	**Location of Maximum Value**	**+70**	**+80**
Cross-section A1	**West of Centerline**		**+30**	**East of Centerline**	
Without RCEC Plant		0.54	12.18	3.84	
Cross-section A2			**At Centerline**		
With RCEC Plant		19.09	61.98	18.30	
Cross-section B	**West of Centerline**		**At Centerline**	**East of Centerline**	
Without RCEC Plant	1.31		6.53		1.32
With RCEC Plant	7.32		36.46		7.36
Cross-section C	**North of Centerline**		**+15**	**South of Centerline**	
Without RCEC Plant	13.82		55.54		16.22
			At Centerline		
With RCEC Plant	10.28		83.81		9.58

Transmission Line EMF Reduction

While the State of California does not set a statute limit for electric and magnetic field levels, the California Public Utilities Commission (CPUC), which regulates electric transmission lines, mandates EMF reduction as a practicable design criterion for new and upgraded electrical facilities. As a result of this mandate, the regulated electric utilities, including PG&E, have developed their own design guidelines to reduce EMF at each new facility. The CEC, which regulates new transmission lines from new generators to the point of connection to the utility grid, requires generators to follow the existing guidelines that are in use by local electric utilities or transmission-system owners.



NOT TO SCALE
ALL DIMENSIONS AND PHASING ARE ESTIMATES
AND ARE PROVIDED FOR PURPOSES OF CALCULATING EMF ONLY

Cross Section C
230 kV Typical Double-Circuit Structure

Russell City Energy Center - Calpine/Bechtel

Figure 6.4-5

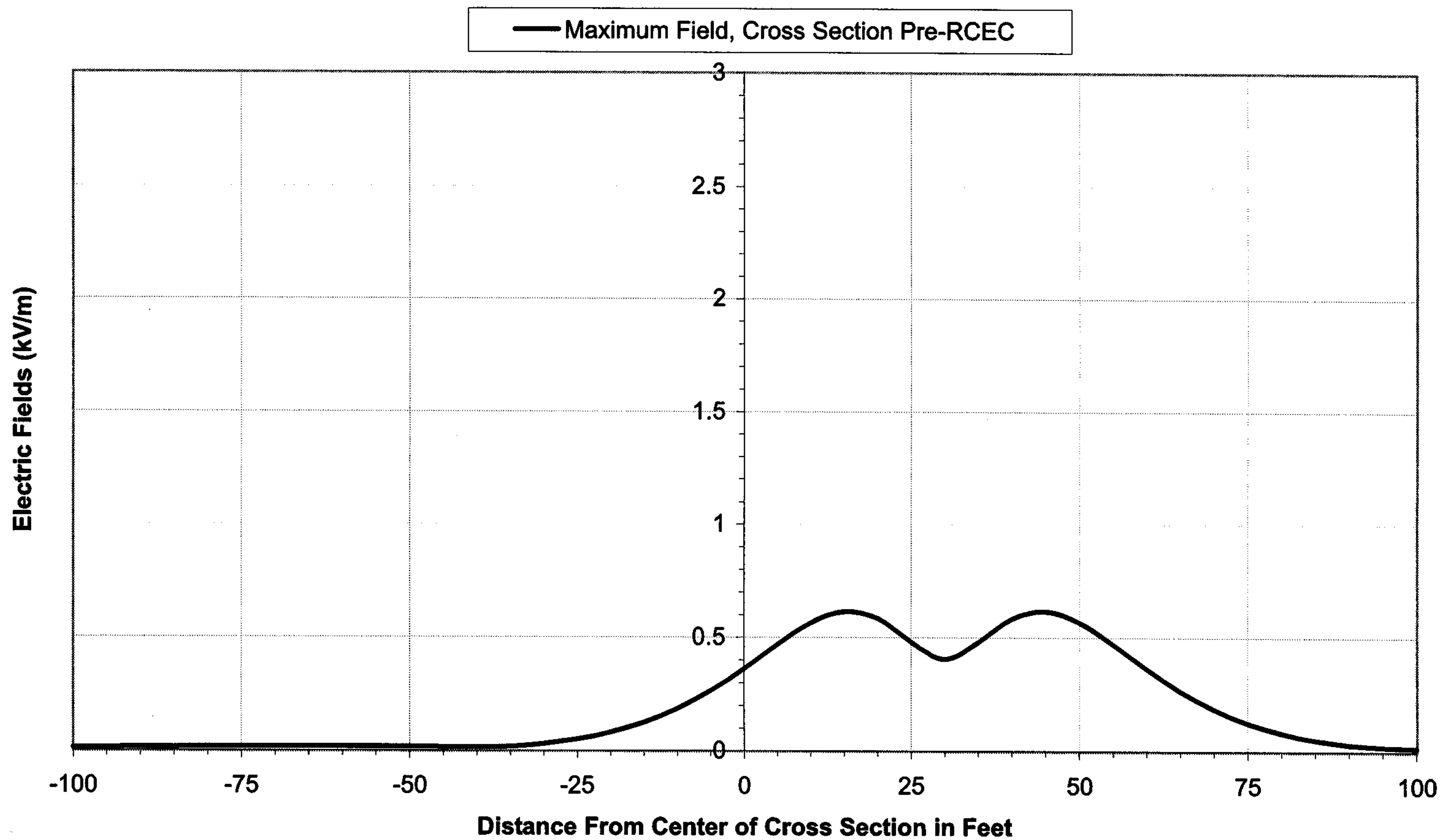
May 7, 2001

Prepared By: Commonwealth Associates Inc. Jackson, Michigan
Engineers Consultants Construction Managers

Russell City Energy Center AFC

May 2001

Cross Section A1
Electric Field (kV/m)
115 kV Line
121 kV (115 + 5%) Conditions

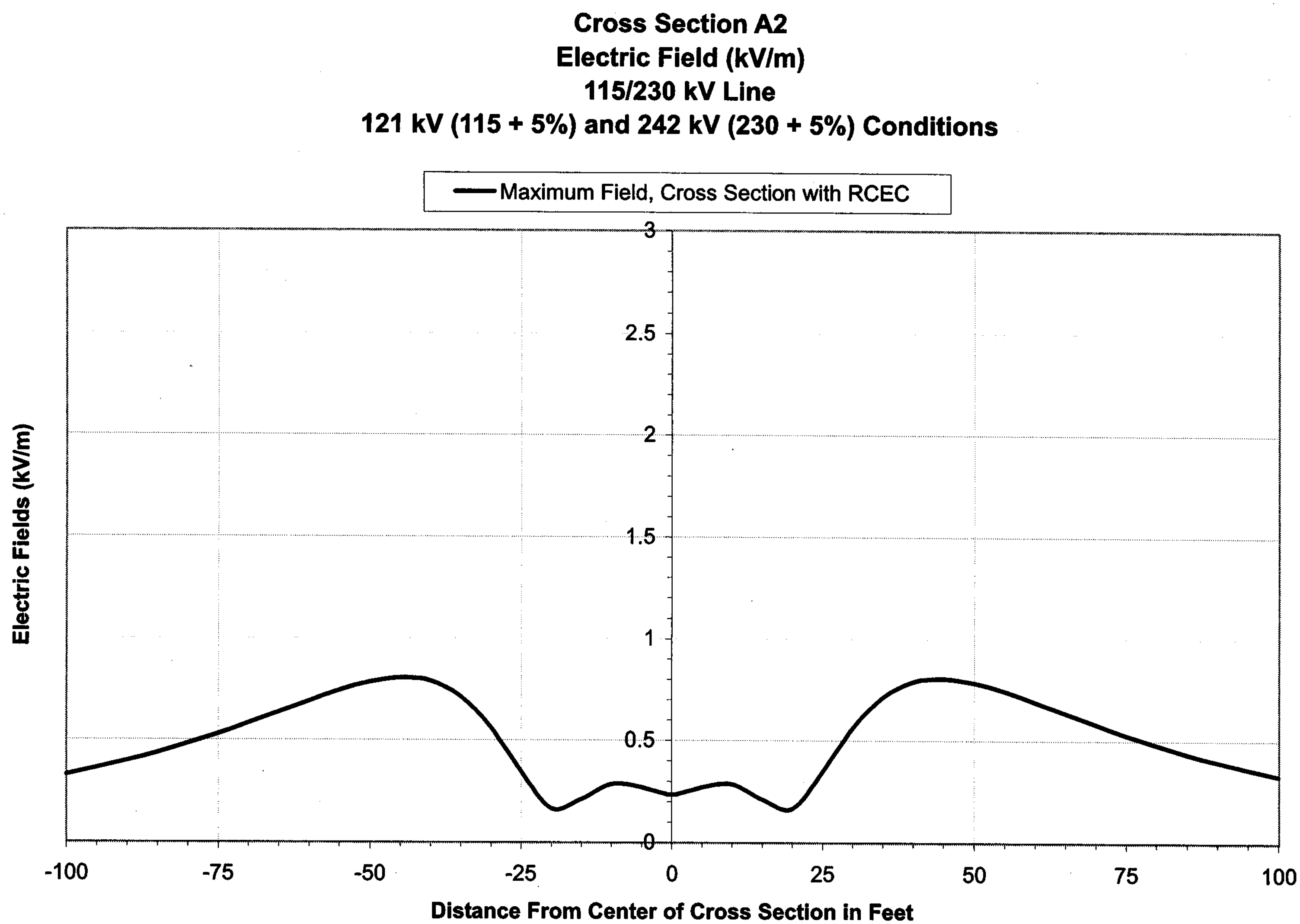


Cross Section A1
Electric Field

M:Proj/Calpine/172028/Cross Section A/Section A1 Graph, E Field

Figure 6.4-6

Commonwealth Associates, Inc.

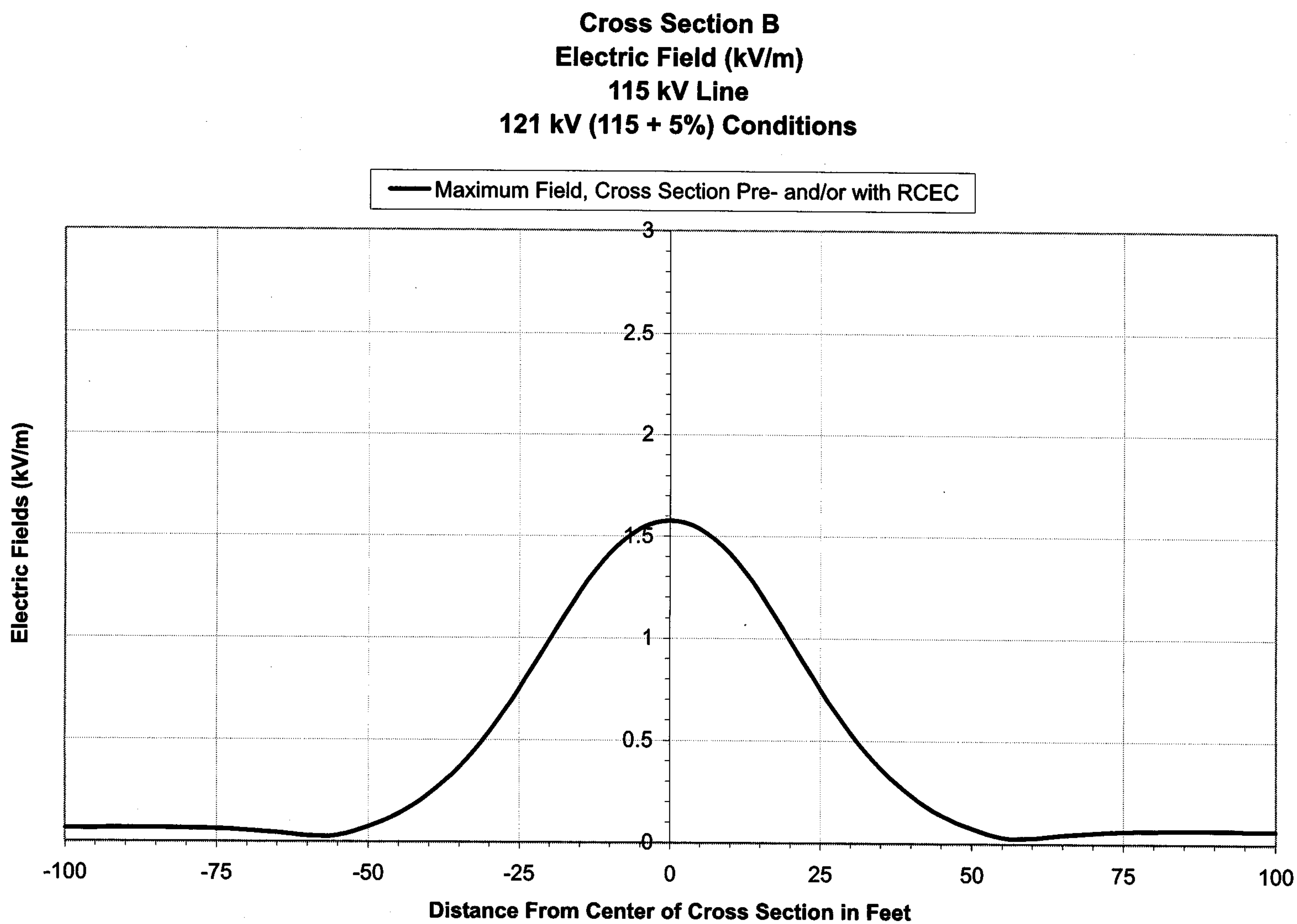


Cross Section A2
Electric Field

M:Proj/Calpine/172028/Cross Section A/Section A2 Graph, E Field

Figure 6.4-7

Commonwealth Associates, Inc.



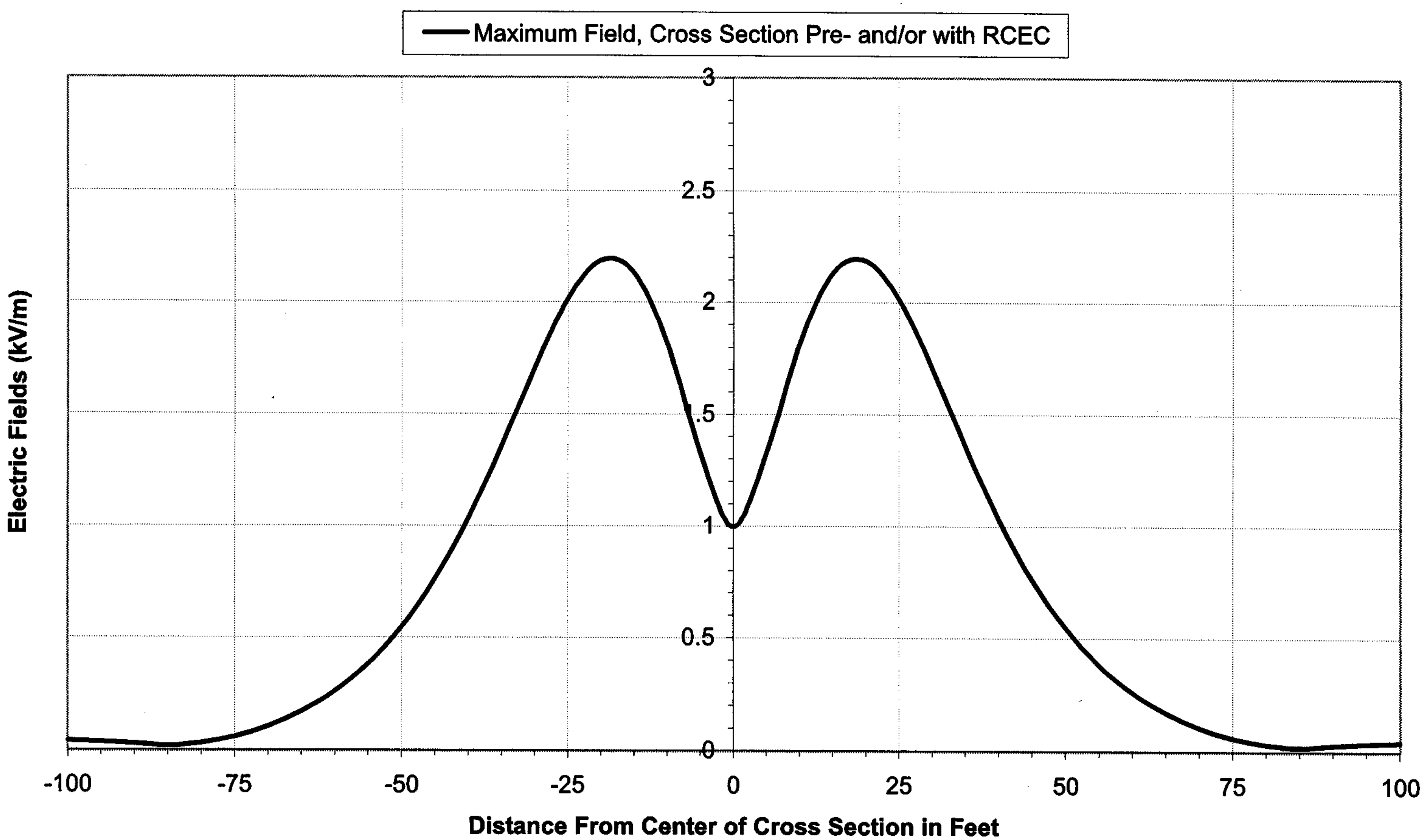
Cross Section B
Electric Field

M:Proj/Calpine/172028/EMF/TLW/Cross Section B/Section B Graph, E Field

Figure 6.4-8

Commonwealth Associates, Inc.

Cross Section C
Electric Field (kV/m)
230 kV Line
242 kV (230 + 5%) Conditions

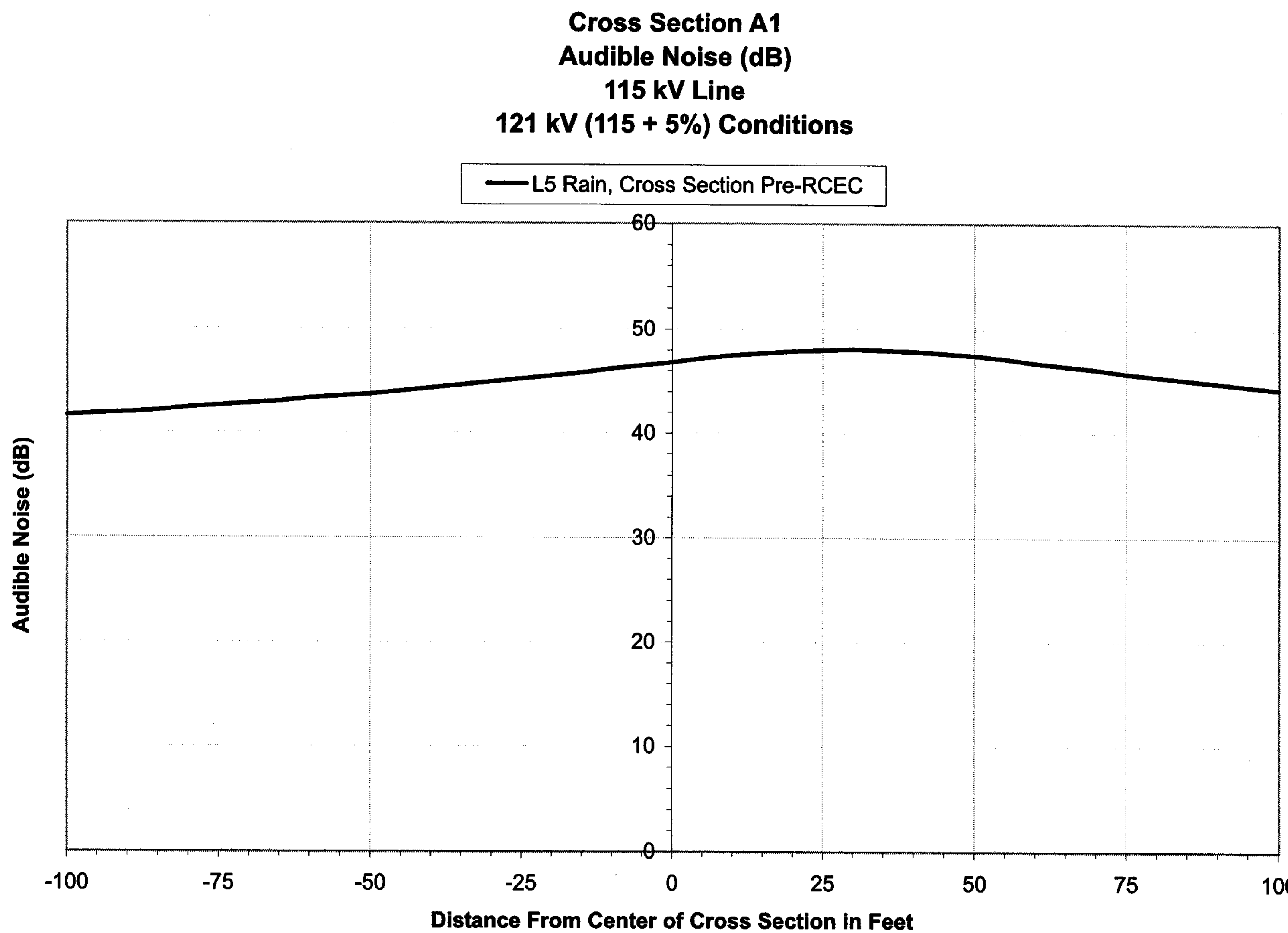


Cross Section C
Electric Field

M:Proj/Calpine/172028/EMF/TLW/Cross Section C/Section C Graph, E Field

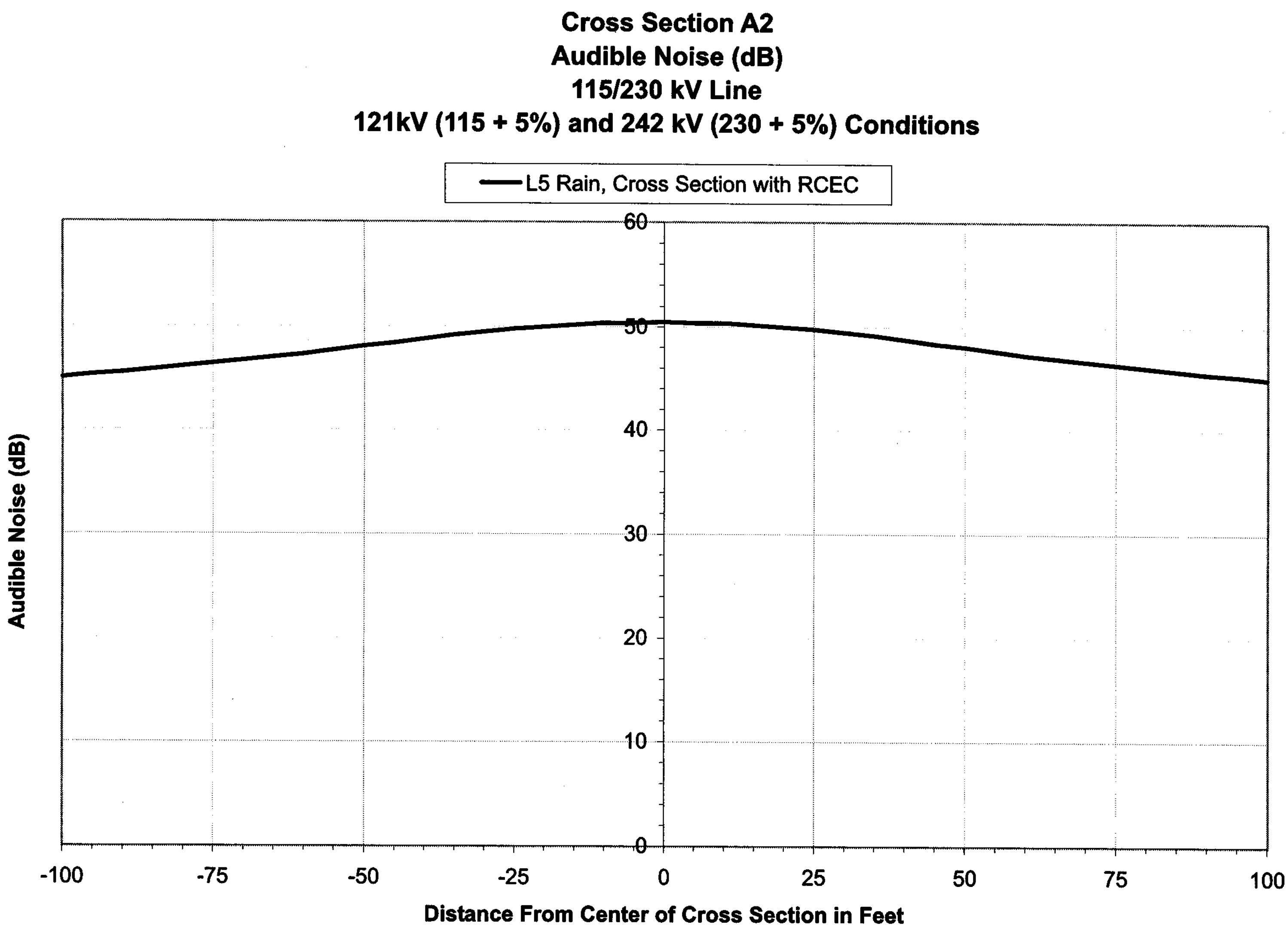
Figure 6.4-9

Commonwealth Associates, Inc.



Cross Section A1
Audible Noise

M:Proj/Calpine/172028/EMF/TLW/Cross Section A/Section A1 Graph, Audible Noise **Figure 6.4-10** *Commonwealth Associates, Inc.*

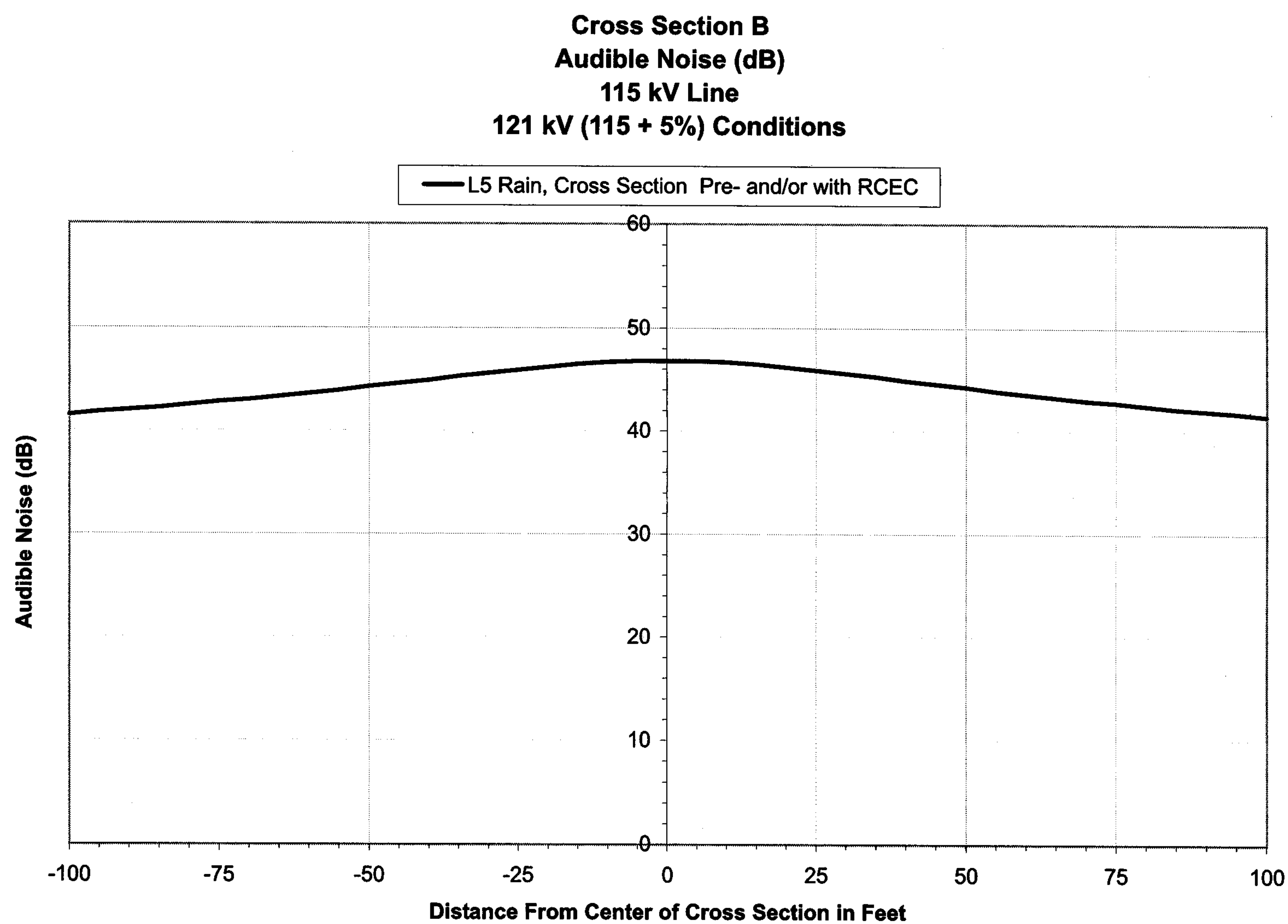


Cross Section A2
Audible Noise

M:Proj/Calpine/172028/EMF/TLW/Cross Section A/Section A2 Graph, Audible Noise

Figure 6.4-11

Commonwealth Associates, Inc.

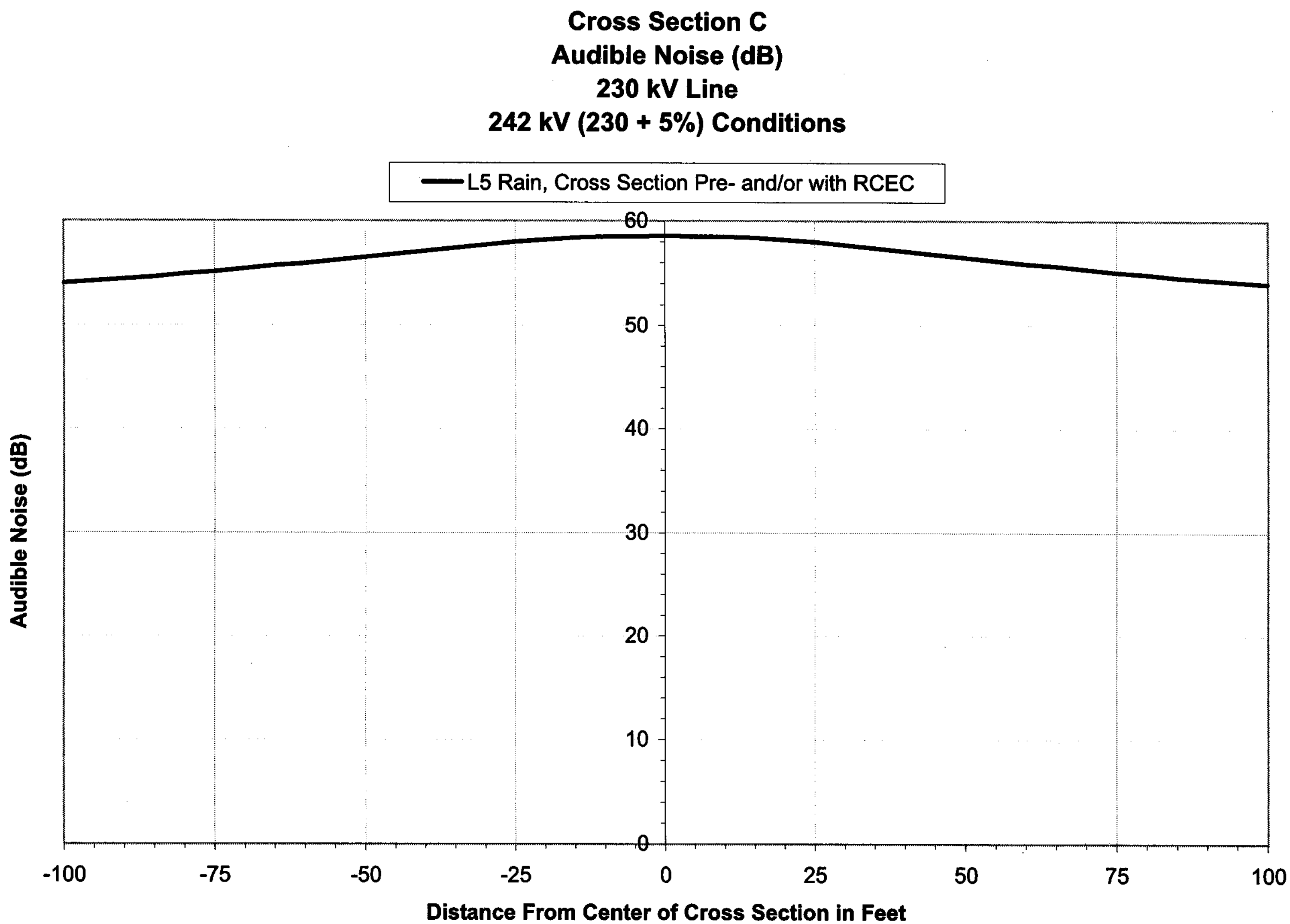


Cross Section B
Audible Noise

M:Proj/Calpine/172028/EMF/TLW/Cross Section B/Section B Graph, Audible Noise

Figure 6.4-12

Commonwealth Associates, Inc.

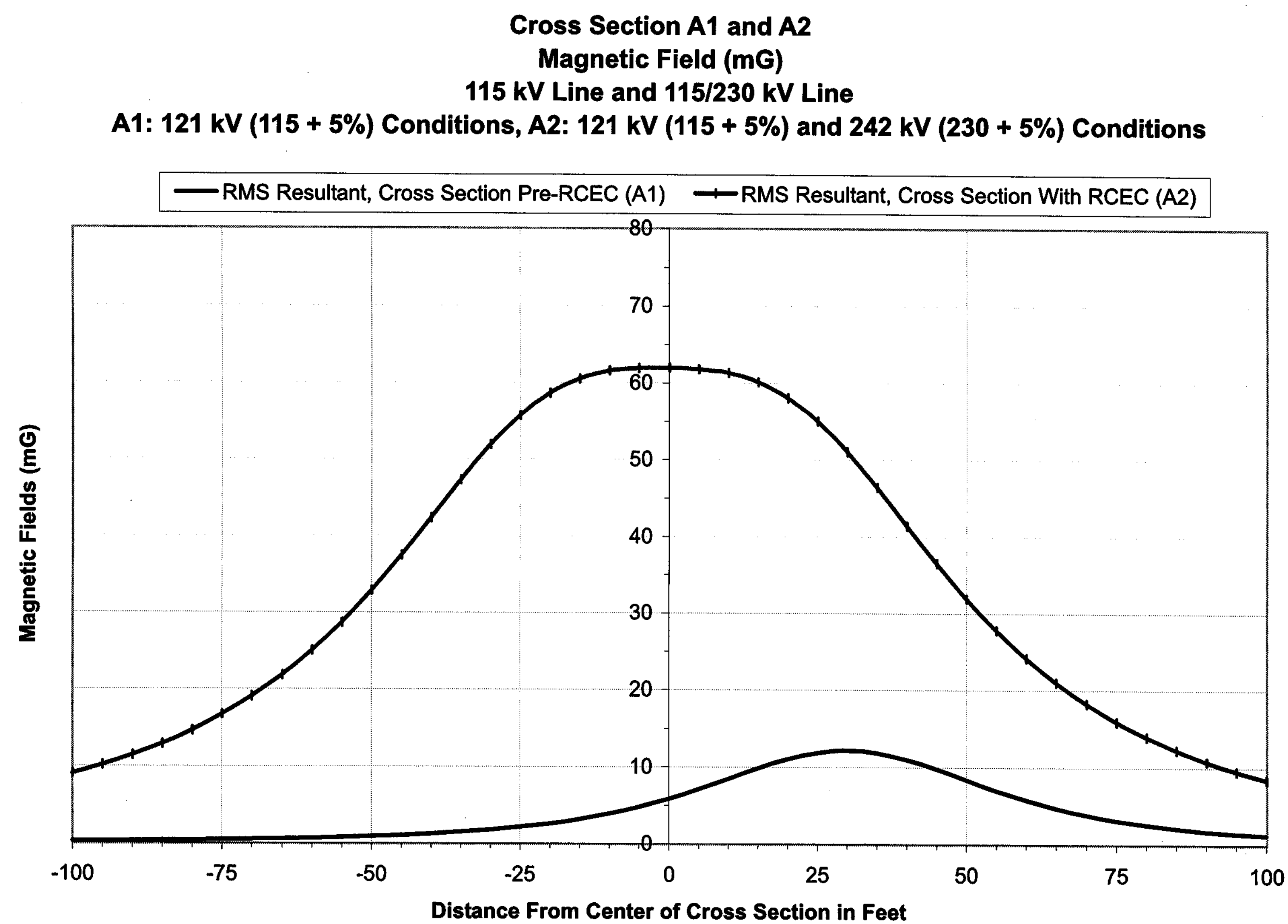


Cross Section C
Audible Noise

M:Proj/Calpine/172028/EMF/TLW/Cross Section C/Section C Graph, Audible Noise

Figure 6.4-13

Commonwealth Associates, Inc.

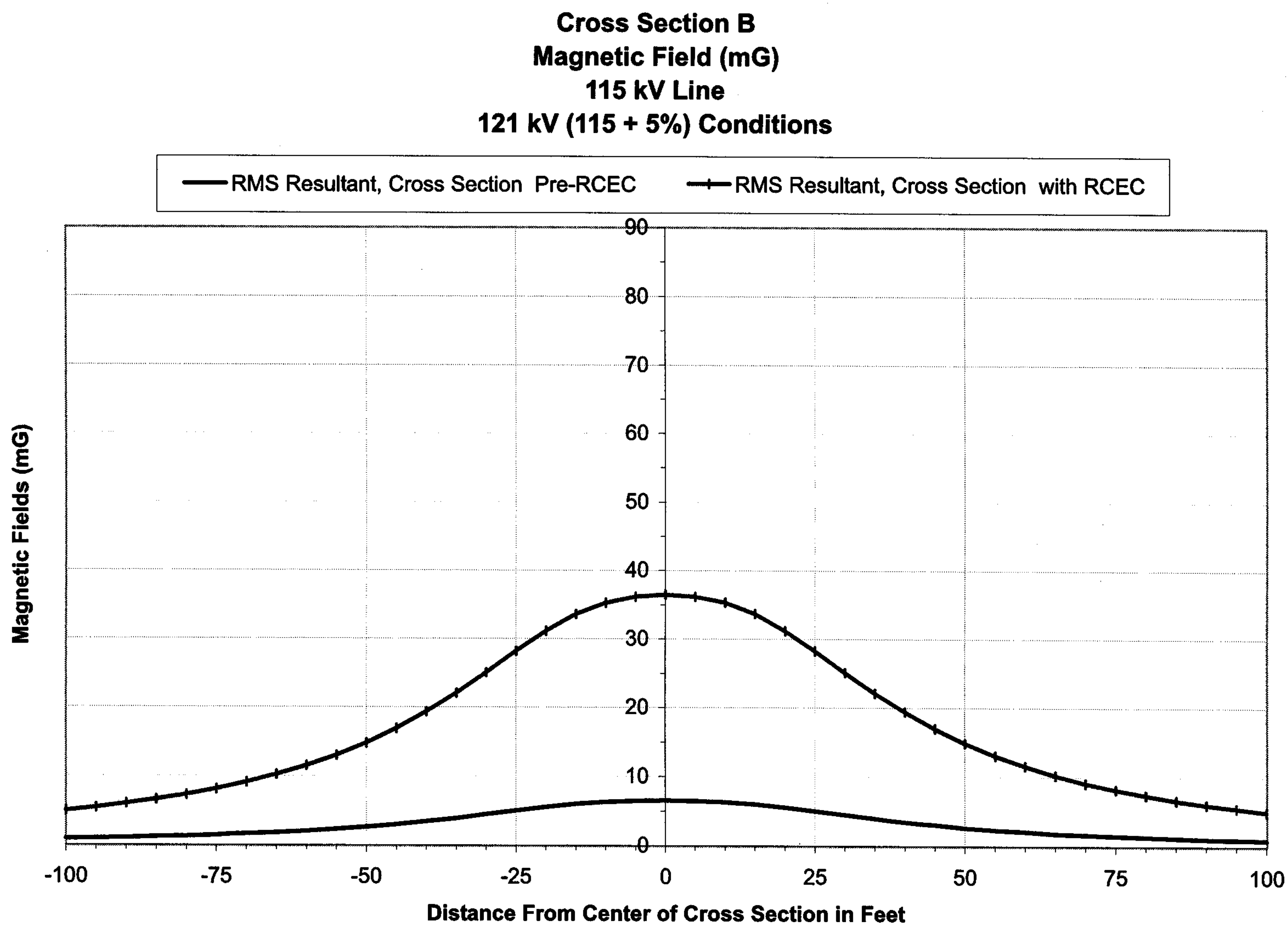


Cross Section A1 and A2
Magnetic Field

M:Proj/Calpine/172028/EMF/TLW/Cross Section A/Section A Graph, Mag Field

Figure 6.4-14

Commonwealth Associates, Inc.

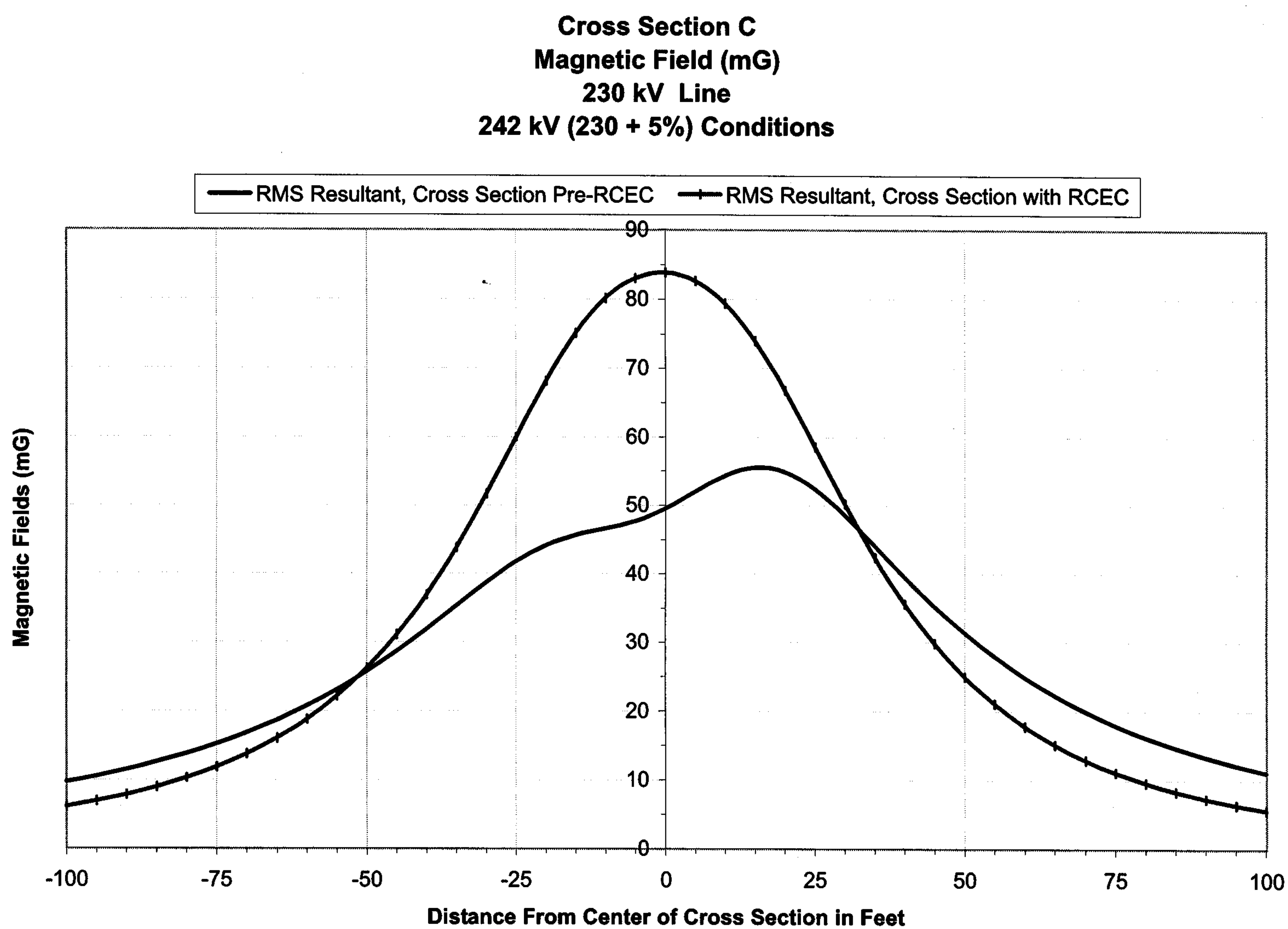


Cross Section B
Magnetic Field

M:Proj/Calpine/172028/EMF/TLW/Cross Section B/Section B Graph, Mag Field

Figure 6.4-15

Commonwealth Associates, Inc.



Cross Section C
Magnetic Field

M:Proj/Calpine/172028/EMF/TLW/Cross Section C/Section C Graph, Mag Field

Figure 6.4-16

Commonwealth Associates, Inc.

In keeping with the goal of EMF reduction, the interconnection of the RCEC will be designed and constructed using the principles outlined in the PG&E publication, "Transmission Line EMF Guidelines." These guidelines explicitly incorporate the directives of the CPUC by developing design procedures compliant with Decision 93-11-013 and General Orders 95, 128, and 131-D. That is, when the towers, conductors, and rights-of-way are designed and routed according to the PG&E guidelines, the transmission line is consistent with the CPUC mandate.

From page 12 of the PG&E guidelines, the primary techniques for reducing EMF anywhere along the line are as follows:

1. Increase the distance between conductors and EMF sensors
2. Reduce the spacing between the line conductors
3. Minimize the current on the line
4. Optimize the configuration of the phases (A, B, C)

Anticipated EMF levels have been calculated for the RCEC interconnection as designed. If required, the pre- and post-interconnection verification measurements will be made consistent with IEEE guidelines and will provide sample readings of EMF at the edge of right-of-way. Additional measurements will be made, as required, for locations of particular concern.

Conclusion on EMF and Audible Noise

In conclusion, for Cross-sections B and C, there will be no change to the existing lines' electric field or audible noise levels, as there will be no change to the voltage or line configurations. There will, however, be an increase of magnetic field levels because there is an increase of current load. No changes to these existing lines are anticipated.

Some changes do occur between Cross-sections A1 and A2. An entirely new structure involving changes in voltage, line configurations, and current load is shown in Cross-section A2. The new circuits result in an increase of calculated EMF strengths. The construction and operation of the RCEC will not result in any significant increases in EMF levels or audible noise.

6.4.2.4 Induced Current and Voltages

A conducting object such as a vehicle or person in an electric field will experience induced voltages and currents. The strength of the induced current will depend upon the electric field strength, the size and shape of the conducting object, and the object-to-ground resistance. Examples of measured induced currents in a 1 kV/m electric field are about 0.016 mA for a person, about 0.41 mA for a large school bus, and about 0.63 mA for a large trailer truck.

When a conducting object is isolated from the ground and a grounded person touches the object, a perceptible current or shock may occur as the current flows to ground. Shocks are classified as below perception, above perception, secondary, and primary. The mean perception level is 1.0 mA for a 180-pound man and 0.7 mA for a 120-pound woman. Secondary shocks cause no direct physiological harm, but may annoy a person and cause involuntary muscle contraction. The lower average secondary-shock level for an average-sized man is about 2 mA.

Primary shocks can be harmful. Their lower level is described as the current at which 99.5 percent of subjects can still voluntarily "let go" of the shocking electrode. For the 180-pound man this is 9 mA; for the 120-pound woman, 6 mA; and for children, 5 mA. The NESC specifies 5 mA as the maximum allowable short-circuit current to ground from vehicles, trucks, and equipment near transmission lines.

The mitigation for hazardous and nuisance shocks is to ensure that metallic objects on or near the right-of-way are grounded and that sufficient clearances are provided at roadways and parking lots to keep electric fields at these locations sufficiently low to prevent vehicle short-circuit currents from exceeding 5 mA.

Magnetic fields can also induce voltages and currents in conducting objects. Typically, this requires a long metallic object, such as a wire fence or above-ground pipeline that is grounded at only one location. A person who closes an electrical loop by grounding the object at a different location will experience a shock similar to that described above for an ungrounded object. Mitigation for this problem is to ensure multiple grounds on fences or pipelines, especially those that are orientated parallel to the transmission line.

Where railroads are crossed or are parallel to the transmission line, coordination is required with the railroad company to ensure that the magnetically induced voltages and currents in the rails do not interfere with railroad signal and communications circuits, which often are transmitted through the rails.

The proposed 230-kV transmission interconnection and the associated existing 115-kV line will be constructed in conformance with GO-95 and Title 8 CCR 2700 requirements. Therefore, hazardous shocks are unlikely to occur as a result of project construction or operation.

6.4.3 Aviation Safety

Federal Aviation Administration (FAA) Regulations, Part 77 establishes standards for determining obstructions in navigable airspace and sets forth requirements for notification of proposed construction. These regulations require FAA notification for any construction over 200 feet in height above ground level. In addition, notification is required if the obstruction is less than specified heights and falls within any restricted airspace in the approach to airports. For airports with runways longer than 3,200 feet, the restricted space extends 20,000 feet (3.3 nautical miles) from the runway. For airports with runways measuring 3,200 feet or less, the restricted space extends 10,000 feet (1.7 nautical miles). For heliports, the restricted space extends 5,000 feet (0.8 nautical mile).

The St. Rose Hospital Helistop Heliport is located approximately 2.4 nautical miles (14,400 feet) southeast of the proposed the RCEC site. The proposed interconnecting 230-kV transmission line would extend approximately 5,500 feet southeast toward the Eastshore Substation. However, the proposed alignment of the transmission line will place the closest structure no closer than 8,800 feet to the heliport. This places the structures of the interconnection outside the sector of restricted space around the heliport. Hayward Executive Airport is located approximately 3,600 feet (0.6 nautical miles) north-northeast of the proposed location of the RCEC. Its main runway is 3,107 feet long; however, the runway lies in a northwest-to-southeast orientation. This will place the RCEC, the interconnecting transmission line, and the Eastshore Substation outside the restrictive approach sectors to the airport.

Although it may be necessary to notify the FAA due to other tall elements of the project, the height of the new transmission towers (115 feet maximum) does not trigger a review. As a result of their location and height in relation to the Hayward Executive Airport, and the St. Rose Hospital Heliport, the structures of the preferred electrical transmission interconnection will pose no deterrent to aviation safety as defined in the FAA regulations.

6.4.4 Fire Hazards

The proposed double-circuit 230-kV transmission interconnection and the associated existing underbuilt, double-circuit 115-kV lines will be designed, constructed, and maintained in accordance with GO-95, which establishes clearances from other man-made and natural structures as well as tree-trimming requirements to mitigate fire hazards. It is not anticipated that the right-of-way for the proposed interconnecting transmission line will have any trees or brush due to its industrial/manufacturing location and its present use for an existing line (Figure 6.1-2). PG&E will maintain the interconnection corridor and immediate area in accordance with existing regulations and accepted industry practices that will include identification and abatement of any fire hazards.

6.5 APPLICABLE LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

This section provides a list of applicable laws, ordinances, regulations, and standards (LORS) that apply to the proposed transmission line, substations and engineering. The following compilation of LORS is in response to Section (h) of Appendix B attached to Article 6, of Chapter 6, of Title 20 of the California Code of Regulations. Inclusion of these data is further outlined in the CEC's publication entitled "Rules of Practice and Procedure & Power Plant Site Certification Regulations."

6.5.1 Design and Construction

Table 6.5-1 lists the applicable LORS for the design and construction of the proposed transmission line and substations.

Table 6.5-1. Design and construction LORS.

LORS	Applicability
General Order 95 (GO-95), CPUC, "Rules for Overhead Electric Line Construction"	California Public Utility Commission (CPUC) rule covers required clearances, grounding techniques, maintenance, and inspection requirements.
Title 8 California Code of Regulations (CCR), Section 2700 et seq. "High Voltage Electrical Safety Orders"	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical installation and equipment to provide practical safety and freedom from danger.
General Order 128 (GO-128), CPUC, "Rules for Construction of Underground Electric Supply and Communications Systems"	Establishes requirements and minimum standards to be used for the station AC power and communications circuits.
General Order 52 (GO-52), CPUC, "Construction and Operation of Power and Communication Lines"	Applies to the design of facilities to provide or mitigate inductive interference.
ANSI/IEEE 693 "IEEE Recommended Practices for Seismic Design of Substations"	Provides recommended design and construction practices.
IEEE 1119 "IEEE Guide for Fence Safety Clearances in Electric-Supply Stations"	Provides recommended clearance practices to protect persons outside the facility from electric shock.
IEEE 998 "Direct Lightning Stroke Shielding of Substations"	Provides recommendations to protect electrical system from direct lightning strokes.

Table 6.5-1. (continued)

LORS	Applicability
IEEE 980 "Containment of Oil Spills for Substations"	Provides recommendations to prevent release of fluids into the environment.
Suggestive Practices for Raptor Protection on Powerlines, April 1996	Provides guidelines to avoid or reduce raptor collision and electrocution.

6.5.2 Electric and Magnetic Fields (EMF)

The applicable LORS pertaining to electric and magnetic field interference are tabulated in Table 6.5-2.

Table 6.5-2. Electric and magnetic field LORS.

LORS	Applicability
Decision 93-11-013 of the CPUC	CPUC position on EMF reduction.
General Order 131-D (GO-131), CPUC, Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California	CPUC construction-application requirements, including requirements related to EMF reduction.
Pacific Gas & Electric Company, "Transmission Line EMF Design Guidelines"	Large local electric utility's guidelines for EMF reduction through structure design, conductor configuration, circuit phasing, and load balancing. (In keeping with CPUC D.93-11-013 and GO-131)
ANSI/IEEE 644-1994 "Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines"	Standard procedure for measuring EMF from an electric line that is in service.

6.5.3 Hazardous Shock

Table 6.5-3 lists the LORS regarding hazardous shock protection for the project.

Table 6.5-3. Hazardous shock LORS.

LORS	Applicability
Title 8 CCR Section 2700 et seq. "High Voltage Electrical Safety Orders"	Establishes essential requirements and minimum standards for installation, operation and maintenance of electrical equipment to provide practical safety and freedom from danger.
ANSI/IEEE 80 "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.
National Electrical Safety Code (NESC), ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C.	Covers grounding methods for electrical supply and communications facilities.

6.5.4 Communications Interference

The applicable LORS pertaining to communication interference are presented in Table 6.5-4.

Table 6.5-4. Communications interference LORS.

LORS	Applicability
Title 47 CFR Section 15.25, "Operating Requirements, Incidental Radiation"	Prohibits operations of any device emitting incidental radiation that causes interference to communications. The regulation also requires mitigation for any device that causes interference.
General Order 52 (GO-52), CPUC	Covers all aspects of the construction, operation, and maintenance of power and communication lines and specifically applies to the prevention or mitigation of inductive interference.
CEC staff, Radio Interference and Television Interference (RI-TVI) Criteria (Kern River Cogeneration) Project 82-AFC-2, Final Decision, Compliance Plan 13-7	Prescribes the CEC's RI-TVI mitigation requirements, developed and adopted by the CEC in past siting cases.

6.5.5 Aviation Safety

Table 6.5-5 lists the aviation safety LORS that may apply to the proposed construction and operation of the RCEC.

Table 6.5-5. Aviation safety LORS.

LORS	Applicability
Title 14 CFR Part 77 "Objects Affecting Navigable Airspace"	Describes the criteria used to determine whether a "Notice of Proposed Construction or Alteration" (NPCA, FAA Form 7460-1) is required for potential obstruction hazards.
FAA Advisory Circular No. 70/7460-1G, "Obstruction Marking and Lighting"	Describes the FAA standards for marking and lighting of obstructions as identified by Federal Aviation Regulations Part 77.
Public Utilities Code (PUC), Sections 21656-21660	Discusses the permit requirements for construction of possible obstructions in the vicinity of aircraft landing areas, in navigable airspace, and near the boundary of airports.

6.5.6 Fire Hazards

Table 6.5-6 tabulates the LORS governing fire hazard protection for the RCEC project.

Table 6.5-6. Fire hazard LORS.

LORS	Applicability
Title 14 CCR Sections 1250-1258, "Fire Prevention Standards for Electric Utilities"	Provides specific exemptions from electric pole and tower firebreak and electric conductor clearance standards, and specifies when and where standards apply.
ANSI/IEEE 80 "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.
General Order 95 (GO-95), CPUC, "Rules for Overhead Electric Line Construction" Section 35	CPUC rule covers all aspects of design, construction, operation, and maintenance of electrical transmission line and fire safety (hazards).

6.5.7 Involved Agencies and Agency Contacts

Table 6.5-7 identifies national, state, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, and/or enforce the above referenced LORS. Table 6.5-7 also identifies the associated responsibilities of these agencies as they relate to the construction and operation of the RCEC.

Table 6.5-7. Jurisdiction.

Agency or Jurisdiction	Responsibility
California Energy Commission (CEC)	Jurisdiction over new transmission lines associated with thermal power plants that are 50 megawatts (MW) or more (PRC 25500).
CEC	Jurisdiction of lines out of a thermal power plant to the interconnection point to the utility grid (PRC 25107).
CEC	Jurisdiction over modifications of existing facilities that increase peak operating voltage or peak kilowatt capacity 25 percent (PRC 25123).
CPUC	Regulates construction and operation of overhead transmission lines (General Order No. 95 and 131-D) (those not regulated by the CEC).
CPUC	Regulates construction and operation of power and communications lines for the prevention of inductive interference (General Order No. 52).
Federal Aviation Administration (FAA)	Establishes regulations for marking and lighting of obstructions in navigable airspace (AC No. 70/7460-1G).
Local Electrical Inspector	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity (NFPA 70).
Cal-ISO	Provides Final Interconnection Approval.
County of Alameda	Establishes and enforces zoning regulations for specific land uses. Issues variances in accordance with zoning ordinances. Issues and enforces certain ordinances and regulations concerning fire prevention and electrical inspection.

6.6 REFERENCES

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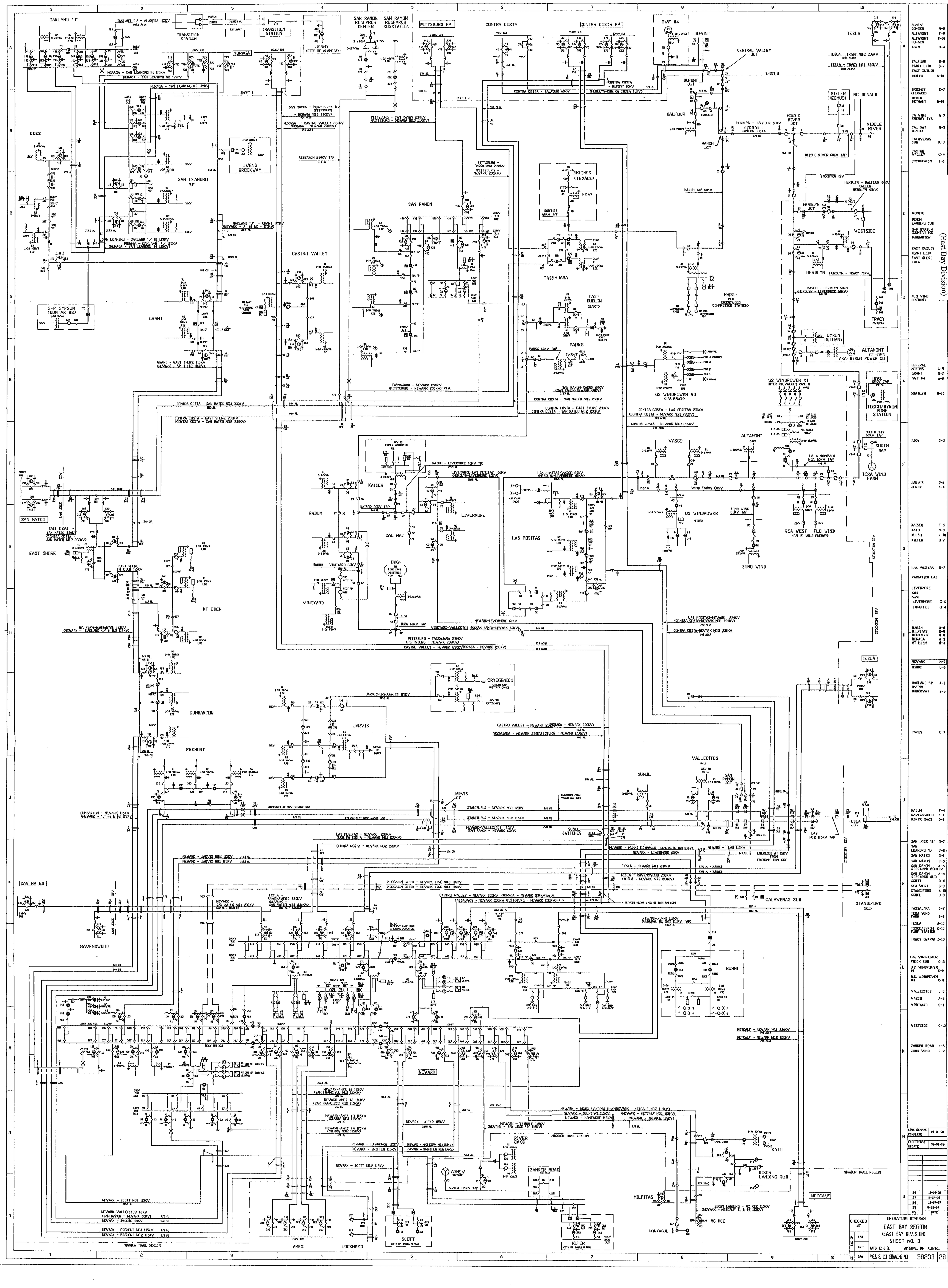
Figure 6.1-2
Proposed & Alternate Route Alignments
Proposed Russell City Energy Center
Hayward, California
Calpine
May 7, 2001
California
Map Area
Scale: 1" = 200'
0 100 200 300 400
FEET
Proposed Radial Connection Alignment
Alternative Route
Existing 115 kV Transmission Line
Existing 230 kV Transmission Line
37/158 Existing Tower & Tower Number
N
W
E
S
Prepared By:
CAI Commonwealth Associates Inc.
Jackson, Michigan
engineers • consultants • construction managers
Basemap: WAC Corporation, Inc., - color aerial photography, 4/13/99.
Proposed Russell City Energy Center
Pull Off Structure
East Bay-Grant 115 kV Circuits 1 & 2
RCEC-East Bay 230 kV Circuits 1 & 2 (proposed)
A
A
B
C
Enterprise Ave.
Falcon Ave
Clawiter Rd
Union Pacific Railroad
SR - 92
Industrial Blvd.
Whitesell St.
Breakwater Ave.
Eden Landing
Point Eden Way
Research Dr.
Trust Way
Investment Rd
Corporate Rd.
Arden Rd.
East Shore Substation
230 kV Bus
115 kV Bus
Switches Locked Open
East Shore-Contra Costa 230 kV Circuits 1 & 2
East Bay-Mt. Eden 115 kV Circuits 1 & 2
East Bay-Dumbarton 115 kV Circuits 1 & 2
13/86
12/85
12/84
12/83
12/82
12/81
12/80A
12/80
11/79
11/78
37/158
37/159
37/160
37/161
37/162
37/163
38/164



OAKLAND "J"
TRANSITION STATION
JENNY (CITY OF ALAMEDA)
SAN RAMON RESEARCH CENTER
SAN RAMON RESEARCH SUBSTATION
PITTSBURG PP
CONTRA COSTA
CONTRA COSTA PP
GWF #4
DUPONT
CENTRAL VALLEY JCT
TESLA
MORAGA
EDES
SAN LEANDRO "U"
OWENS BROCKWAY
BALFOUR
MARSH JCT
MIDDLE RIVER JCT
BIXLER (EBMUD)
MC DONALD
MIDDLE RIVER
BRIONES (TEXACO)
SAN RAMON
CASTRO VALLEY
TASSAJARA
EAST DUBLIN (BART)
MARSH
HERDLYN JCT
VESTSIDE
HERDLYN
TRACY
G-P GYPSUM (DOMTAR #2)
GRANT
PARKS
BYRON BETHANY
ALTAMONT CO-GEN AKA: BYRON POWER CO
US WINDPOWER #3 (J.W. RANCH)
US WINDPOWER #1
TOSCO/BYRON PUMP STATION
VASCO
ALTAMONT
SOUTH BAY
TERA WIND FARM
KAISER
RADUM
LIVERMORE
CAL MAT
SAN MATEO
EAST SHORE
LAS POSITAS
US WINDPOWER
SEA WEST
FLO WIND
ZOND WIND
EUKA
VINEYARD
MT EDEN
CRYOGENICS
DUMBARTON
JARVIS
FREMONT
VALLECITOS
SUNOL
SAN RAMON JCT
JARVIS JCT
TESLA JCT
SUNOL SWITCHES
LAB 115KV TAP
RAVENSWOOD
CALAVERAS SUB
STANDFORD
NUMMI
NEWARK
RIVER OAKS
ZANKER ROAD
AGNEW
KATO
DIXON LANDING SUB
METCALF
MILPITAS
MC KEE
MONTAGUE
AMES
LOCKHEED
SCOTT (CITY OF SANTA CLARA)
KIFER
MISSION TRAIL REGION
Operating Diagram
PG&E East Bay Region
(East Bay Division)
OPERATING DIAGRAM
EAST BAY REGION
(EAST BAY DIVISION)
SHEET NO. 3
PG&E CO. DRAWING NO. 58233 28