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SECTION 3 TRANSMISSION SYSTEM ENGINEERING

3.1 INTRODUCTION

This Application for Certification (AFC) for the Rio Mesa Solar Electric Generating Facility (Rio Mesa SEGF or Project) has been prepared in accordance with the California Energy Commission's (CEC) Power Plant Site Certification Regulations (CEC-140-2008-001-REV1, current as of July 2008). In addition, this AFC includes elements necessary for the United States (U.S.) Bureau of Land Management (BLM) to permit the Project through the National Environmental Policy Act (NEPA). The "Applicant" for purposes of this AFC comprises Rio Mesa Solar I, LLC, Rio Mesa Solar II, LLC, and Rio Mesa Solar III, LLC, owners of the three separate solar plants and certain shared facilities being proposed. These three Delaware limited liability companies will hold equal one-third shares in the ownership of shared facilities and will separately own their respective plants. They are wholly owned by Rio Mesa Solar Holdings, LLC (a Delaware limited liability company) which is in turn wholly owned by BrightSource Energy, Inc. (BrightSource) a Delaware corporation and the ultimate parent company. The Applicant will use BrightSource's solar thermal technology for the Rio Mesa SEGF.

The proposed project site is situated on the Palo Verde Mesa in Riverside County, California, 13 miles southwest of the City of Blythe, and is located partially on private land and partially on public land administered by BLM. The project will include three solar concentrating thermal power plants and a shared common area to include shared systems. The first plant, a 250 megawatt (MW) (nominal) facility known as Rio Mesa I, will be constructed at the south end of the project and owned by Rio Mesa Solar I, LLC. The second plant, another 250 MW (nominal) facility known as Rio Mesa II, will be located in the central portion of the project site and owned by Rio Mesa Solar II, LLC. Rio Mesa III, a third 250 MW (nominal) facility, will be constructed in the northern portion of the project site and owned by Rio Mesa Solar III, LLC. These three plants will be connected via a common overhead 220 kilovolt (kV) generator tie-line (gen-tie line) to the Southern California Edison (SCE) Colorado River Substation (CRS) approximately 9.7 miles to the north.

Each plant will utilize a solar power boiler (referred to as a solar receiver steam generator or SRSG), located on top of a dedicated concrete tower, and solar field based on proprietary heliostat mirror technology developed by BrightSource. The reflecting area of an individual heliostat (which includes two mirrors) is about 19 square meters (205 square feet [sq. ft.]). The heliostat (mirror) fields will focus solar energy onto the SRSG which converts the solar energy to superheated steam. In each plant, a Rankine cycle non-reheat steam turbine receiving this superheated will be directly connected to a rotating generator that generates and pushes the electricity onto the transmission system steam. Each plant will generate electricity using solar energy as its primary fuel source. However, auxiliary boilers will be used to operate in parallel with the solar field during partial load conditions and occasionally in the afternoon when power is needed after the solar energy has diminished to a level that no longer will support solar generation of electricity. These auxiliary boilers will also assist with daily start-up of the power generation equipment and night time preservation.

This section addresses the scope of the direct connection facilities between the Rio Mesa SEGF and the existing electrical transmission grid, and the anticipated impacts that operation of the facility will have on the flow of electrical power in the project region. This analysis contains the following discussions:

- Proposed electrical interconnection between the Project and the electrical grid
- Impacts of the Project on the existing transmission grid
- Potential nuisances (electrical/magnetic field (EMF) effects, aviation safety, and fire hazards)
- Safety of the interconnection
- Applicable laws, ordinances, regulations, and standards (LORS)

3.2 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

This section describes the applicable LORS related to the design and construction of the proposed electrical interconnection facilities, including the gen-tie line, switchyard, and substation facilities. EMF, hazardous shocks, aviation safety, and fire hazards LORS are also presented.

3.2.1 Design and Construction LORS

Table 3.2-1 lists the application design and construction LORS for the electrical interconnection facilities.

Table 3.2-1
Design and Construction LORS

LORS	Applicability
GO-95, CPUC, "Rules for Overhead Electric Line Construction"	California Public Utilities Commission (CPUC) rule covers required clearances, grounding techniques, maintenance, and inspection requirements.
Title 8 California Code of Regulations (CCR), §§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 underground installation of alternating current (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.
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.
IEEE 980 "Containment of Oil Spills for Substations"	Provides recommendations to prevent release of fluids into the environment.
Suggestive Practices for Raptor Protection on Power lines, April 1996	Provides guidelines to avoid or reduce raptor collision and electrocution

AC = Alternating Current
CCR = California Code of Regulations
CPUC = California Public Utilities Commission
GO = General Order

3.2.2 Electrical and Magnetic Fields LORS

The applicable LORS pertaining to electric and magnetic field interference are listed in Table 3.2-2.

Table 3.2-2
Electric and Magnetic Field LORS

LORS	Requirements/Applicability
Decision 93-11-013 of the California Public Utilities Commission (CPUC)	CPUC position on electromagnetic field (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.
EMF Design Guidelines for Electrical Facilities, Southern California Edison Company, EMF Research and Education, 6090 Irwindale Avenue, Irwindale, California 91702, (626) 812-7545, September 2004	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)

CPUC = California Public Utilities Commission
EMF = Electromagnetic Field
GO = General Order
LORS = Laws, Ordinances, Regulations and Standards

3.2.3 Hazardous Shock LORS

Table 3.2-3 lists the LORS regarding hazardous shock protection for the project.

Table 3.2-3
Hazardous Shock LORS

LORS	Requirements/Applicability
Title 8 California Code of Regulations (CCR) §§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 Alternating Current (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.

AC = Alternating Current
CCR = California Code of Regulations
LORS = Laws, Ordinances, Regulations and Standards
NESC = National Electrical Safety Code

3.2.4 Communication Interference LORS

The applicable LORS pertaining to communication interference are listed in Table 3.2-4.

Table 3.2-4
Communications Interference LORS

LORS	Requirements/Applicability
Title 47 Code of Federal Regulations (CFR) § 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), California Public Utilities Commission (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 California Energy Commission (CEC)'s RI-TVI mitigation requirements, developed and adopted by the CEC in past siting cases.
ANSI/IEEE 1260 "IEEE Guide on the Prediction, Measurement, and Analysis of AM Broadcast Reradiation by Power Lines"	Presents guidelines and procedures for dealing with reradiation of AM broadcast signals from power lines and other large metallic structures.

CEC = California Energy Commission
CFR = Code of Federal Regulations
CPUC = California Public Utilities Commission
GO = General Order
LORS = Laws, Ordinances, Regulations and Standards
RI = Radio Interference
TVI = Television Interference

3.2.5 Aviation Safety LORS

Table 3.2-5 lists the aviation safety LORS that may apply to the proposed construction and operation of the Rio Mesa SEGF.

Table 3.2-5
Aviation Safety LORS

LORS	Requirements/Applicability
Title 14 Code of Federal Regulations (CFR) Part 77 "Objects Affecting Navigable Airspace"	Describes the criteria used to determine whether a "Notice of Proposed Construction or Alteration" (NPCA, Federal Aviation Administration [FAA] Form 7460-1) is required for potential obstruction hazards in navigable airspace.
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), §§ 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.

CFR = Code of Federal Regulations
FAA = Federal Aviation Administration
LORS = Laws, Ordinances, Regulations and Standards
NPCA = Notice of Proposed Construction or Alteration
PUC = Public Utilities Code

3.2.6 Fire Hazard LORS

Table 3.2-6 lists the LORS governing fire hazard protection for the Rio Mesa SEGF project.

Table 3.2-6
Fire Hazard LORS

LORS	Requirements/Applicability
Title 14 California Code of Regulations (CCR) §§ 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 Alternating Current (AC) Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.
General Order 95 (GO-95), California Public Utilities Commission (CPUC), "Rules for Overhead Electric Line Construction" § 35	CPUC rule covers all aspects of design, construction, operation, and maintenance of electrical transmission line and fire safety (hazards).

AC = Alternating Current
CCR = California Code of Regulations
CPUC = California Public Utilities Commission
GO = General Order
LORS = Laws, Ordinances, Regulations and Standards

3.3 TRANSMISSION LINE DESCRIPTION, DESIGN AND OPERATION

3.3.1 Transmission Interconnection System Impact Studies

On December 6, 2010, Rio Mesa Solar Holdings, LLC (formerly known as Palo Verde Mesa, LLC) submitted an Interconnection Request (IR) to the California Independent System Operator Corporation (CAISO) for interconnection of the Rio Mesa SEGF Project to the CAISO Controlled Grid at SCE's CRS in Blythe, California. The IR is for a full-delivery, steam turbine plant with a total rated output of 750 MW.

In accordance with Federal Energy Regulatory Commission (FERC) approved Generator Interconnection Procedures (GIP) for Interconnection Requests in a Queue Cluster Window (CAISO Appendix Y), the Project was grouped with Queue Cluster 3 Phase I Study (QC3) projects to determine the impacts of the group as well as impacts of the Project on the CAISO Controlled Grid. The QC3 Phase 1 Interconnection Study Report (Appendix A – Q#643AC) dated May 27, 2011 provides information on:

- transmission system impacts caused by the projects in the cluster;
- system reinforcements necessary to mitigate the adverse impacts caused by the projects in the cluster under various system conditions; and
- a list of required facilities and a non-binding, good faith estimate of the clusters and the RMS Project's individual cost responsibility and time to construct these facilities.

Preliminary engineering of the proposed transmission interconnection was based on the results of the QC3 Phase 1 Interconnection Study Report, input from SCE and the CAISO, physical survey data, and preliminary engineering for the Rio Mesa Solar Project Switchyard. The following subsection discusses the existing transmission facilities in the vicinity of the proposed Rio Mesa SEGF and other potentially impacted transmission resources.

The CAISO Final Queue Cluster 3 Phase I Interconnection Study Report – Group Report in SCE's Eastern Bulk System Final Report dated May 27, 2011 (Report) was completed in coordination with SCE per CAISO Tariff Appendix Y Generator Interconnection Procedures for Interconnection Requests in a Queue Cluster Window. There were 21 generation projects in the SCE service territory modeled in QC3. Six QC3 projects were modeled in the Eastern Bulk System and the Report provides the study results for this Eastern Bulk System.

Appendix A – Q#643AC of the Report addresses the Palo Verde Mesa Project (Queue Cluster 3 Phase 1 Final Report) is included in this AFC as Appendix 3A. In April of 2011, BrightSource changed the name of the project from Palo Verde Mesa to Rio Mesa to prevent confusion with a nearby nuclear facility. References to Palo Verde Mesa, LLC shall be considered as a reference to Rio Mesa Solar Holdings, LLC. Palo Verde Mesa, LLC submitted a completed IR to the CAISO for their proposed Palo Verde Mesa Project. The Project is a full delivery, steam turbine plant with a total rated output of 750 MW to the proposed Point of Interconnection (POI) at SCE's Colorado River 220kV Substation located in Blythe, California.

The QC3 study has determined that the Project, together with the five other projects in the Eastern Bulk System of QC3, contributes to various reliability and/or deliverability problems for which mitigation plans have been proposed. Further studies (Phase II Study) will determine the final mitigation required for these projects including the share of the RMS Project.

3.3.2 Existing Transmission Facilities

The proposed project site is located on the Palo Verde Mesa in Riverside County, California, 13 miles southwest of Blythe, California on both lands owned by the Metropolitan Water District of Southern California (MWD) and federal land managed by the BLM.

The proposed plant site is located within approximately 8 miles of four existing electrical transmission lines. As shown in Section 2, Figure 2-2, Project Features Map, the Buck-Julian Hinds 220 kV transmission line, Imperial Irrigation District (IID) 161 kV transmission line and Western Area Power Administration (WAPA) 161 kV transmission line run parallel with each other until the lines are crossed by SCE's Devers - Palo Verde (DPV)-1 500 kV line, which is located approximately 1.7 miles north of the project site's northern boundary. At this point the Buck–Julian Hinds 220 kV line turns northwest to parallel SCE 500 kV line on the north side of the 500 kV corridor. The WAPA and IID lines continue in a southerly direction to a point approximately a half mile north of the of the project northern boundary where the IID line turns southwest and no longer parallels the WAPA line. The WAPA 161kV line traverses through the eastern portion of the site. In addition, the TransCanada Gas Transmission Company (TCGT) Northern Baja Gas Pipeline runs parallel and east of the WAPA transmission line which also traverses the project site.

3.3.3 Proposed Transmission Interconnection Facilities

SCE recently received approval to construct the Colorado River Substation (CRS) which will be located just south of the SCE 500 kV route. Rio Mesa I, II and III will be interconnected to the SCE grid through the new CRS which will be interconnected to SCE's Devers-Palo Verde (DPV1) 500-kV line passing approximately 2 to5 miles north of the CRS site on an east-west ROW. SCE has developed a service plan for the CRS to interconnect additional projects and allow for future growth. SCE's service plan will include the following: the new CRS and other system upgrades to interconnect and deliver electrical power from Rio Mesa SEGF and other interconnecting customers in the region, as well as to support future growth. The CRS construction is projected to be completed in 2013 or 2014, well before the Rio Mesa SEGF is expected to come online. The design of the CRS and associated upgrades will be performed by SCE.

Power from each plant will be interconnected to the CAISO grid via a common 220 kV gen-tie line to the CRS. The Project will include a common area switchyard (Rio Mesa Switchyard) on site where all three project generator underground tie lines will terminate. These shared facilities will be jointly owned by all three project companies in an equal percentage. The Rio Mesa SEGF single line diagram is included in Section 2 as Figure 2.7. This diagram shows the high voltage electrical interconnection between the three generators and the Rio Mesa switchyard, and from the switchyard to the CRS.

3.3.3.1 Generator Step-up Substation and Tie-Line Characteristics

Each of the three plants will include a 220 kV Generator Step-up Substation (GSUS) which consists of one 220 kV motor operated disconnect switch adjacent to the 220 kV terminals of the Generator Step-up Unit (GSU) transformer. The Rio Mesa Switchyard and all associated equipment will be designed for the maximum short-circuit and load-flow design conditions of the installation. Surge arresters will be used at the underground cable terminators, and at the high voltage terminal of the GSU transformers, to minimize lightening and switching surges. Each of the generators will be connected to the low voltage side of the GSU transformer via a generator breaker. A tap between the generator breaker and low voltage terminals of the GSU transformer will serve the plant auxiliary loads via a 21 kV to 13.8 kV/6.9 kV Unit Auxiliary Transformer (UAT). Each plant UAT will be adequately sized to provide power to all auxiliary loads within each facility. Startup and standby power will be supplied through the GSU and unit auxiliary transformers. Auxiliary controls for the 220 kV motor operated disconnect switch of the GSUS will be located in the common area administration/control building located separate from the power plants.

The proposed tie lines from the three GSUS's to the Rio Mesa Switchyard will be engineered for operation at 220 kV, nominal. The lines will be designed for underground installation using cross linked polyethylene (XLPE) insulation. The lines will be installed underground the entire route from each plant's substation to the Rio Mesa Switchyard. The lines will exit each plant substation and will follow the outside of the power block and continue along the access roads to the Rio Mesa Switchyard. Each line will be designed to carry the maximum output of each plant.

3.3.3.2 Rio Mesa Switchyard

The design of the Rio Mesa Switchyard will be performed by the EPC based on the plant generation and interconnection requirements. Figure 3.3-1 shows an illustration of the proposed configuration for the Rio Mesa Switchyard (all figures are included at the end of this section). The switchyard will be configured in a ring bus arrangement with five 220 kV breakers and five line positions. The five line positions include the three 220 kV lines coming from the three Project GSUSs to the switchyard and the two outgoing lines (double circuit overhead line) going from the switchyard to the CRS. A control enclosure will be provided to house the relay panels, communication equipment, batteries, chargers and low voltage AC station service equipment. The switchyard will be fenced and surfaced with crushed stone.

3.3.3.3 Gen-Tie Line Characteristics

The proposed overhead double circuit gen-tie line from the Rio Mesa Switchyard to SCE's CRS will be engineered for operation at 220 kV, nominal. The double circuit line will be supported by single-pole structures at appropriate intervals with final heights as determined during final design. The lines will be insulated from the poles using glass, porcelain or polymer insulators, engineered for safe and reliable operation. Figure 3.3-2 illustrates the conceptual design of a typical double-circuit structure. These pole designs were engineered to provide conceptual design limits for purposes of the EMF studies. Final design will be based on actual field conditions and site requirements.

3.3.3.4 Colorado River Substation

The design of the CRS will be performed by SCE and analyzed conceptually from input provided based on the requirements of Rio Mesa SEGF and other generation projects in the queue, as well as future load growth requirements. The Phase 1 Interconnection Study Report analyzed the project with the installation of two dedicated 220 kV double breaker positions to terminate the Project's two 220 kV lines. However, SCE is also considering a single breaker interconnection to the CRS from the Rio Mesa SEGF.

3.4 TRANSMISSION SYSTEM SAFETY AND NUISANCES

This section discusses safety and nuisance issues associated with the proposed electrical interconnection of the Rio Mesa SEGF with the CAISO electrical grid.

3.4.1 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 Electrical 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; and/or
- distance from the energized conductors to other parallel power lines.

The proposed Rio Mesa SEGF 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 Figures 3.3-2 and 3.4-1 through 3.4-5 should be regarded only as reference for the EMF calculations. The minimum ground clearance for a 220 kV transmission line per California Public Utilities Commission (CPUC) General Order 95 (GO- 95) is 30 feet, based on the road-crossing minimum. This is the design clearance 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 were based on 220 kV line clearances per SCE's "EMF Design Guidelines for Electrical Facilities" (EMF Research and Education, 2004). The final design value will be consistent with GO-95.

3.4.2 Electrical Effects

The electrical effects of high-voltage transmission lines fall into two broad categories: EMF effects and corona effects. EMF effects are the voltages and currents that may be induced in nearby conducting objects. The transmission line's 60 hertz (Hz) cycle for alternating current can cause these EMF 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 gradients at the surface of the hardware during certain conditions. Corona may result in radio and television reception interference, audible noise, light, and production of ozone. Corona is a function of the voltage of the line, the diameter of the conductor (or bundle of conductors), and the condition of the conductor and hardware.

3.4.2.1 EMF Effects

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 operate up to 1,600 kilohertz (kHz; television, 890 megahertz (MHz); cellular telephones, 900 MHz, 3 gigahertz (GHz) and 4 GHz; microwave ovens, 2.4 GHz; and X-rays, about 1 billion (1018) Hz. 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. High frequencies, such as X-rays, have enough energy to cause ionization (breaking of atomic or 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. The 60 Hz fields do not radiate, unlike radio-frequency fields. 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 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 is also 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 one moves away from the conductor. 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.

3.4.2.2 Corona Effects

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. 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.

Corona activity on the 220 kV transmission line can generate a small amount of sound energy. Corona also results in a small amount of power loss to the transmission line. The audible noise level can increase during foul weather conditions. Water drops may collect on the surface of the conductors and increase corona activity so that a crackling or humming sound may be heard near a transmission line. Audible noise decreases with distance away from a transmission line.

Audible noise is measured in decibels (dB) of sound pressure with respect to the threshold of human hearing (taken as 20 micropascals). The decibel is a dimensionless unit used to compare the level of some quantity to a reference level and it always needs a reference quantity to have meaning. The apparent loudness that attributed to sound varies not only with the pressure but also with the frequency (or pitch) of the sound. The human hearing system is non-linear and has a complex response. Corona-induced noise tends to be broadband and can sometimes have a pure tone (primarily at 120 Hz).

Corona-generated radio interference (RI) is most likely to affect the amplitude modulation (AM) radio broadcast band (530 to 1,700 kHz); frequency modulation (FM) radio is rarely affected. Only AM receivers located near transmission lines that are tuned to a weak station are typically affected by RI. An example is the humming noise on an AM radio that happens when the radio is near a power line but diminishes as the radio moves away from the line.

Television interference (TVI) is the degradation of a television signal by television frequency electromagnetic disturbances and is reported as the field strength of the interference. TVI is now less of a concern since the recent national switch to digital television. Digital television does not experience the typical TVI noise effects that analog television did, such as shadowing or snow. With digital television, there is either signal or no signal, and the signals are less susceptible to the noise due to their higher operating frequencies. However, the values are reported since there may be a few local low-strength analog stations broadcasting in the area, or for any remaining VHF digital channels on the fringe of their operating range.

Both RI and TVI are measured in dB of one microvolt per meter (μV/m) which is a logarithmic scale.

3.4.2.3 EMF and Corona Effects Assumptions

It is important that any discussion of EMF and corona effects include the assumptions used to calculate these values and to remember that EMF and corona effects 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 corona effects depend on line voltage, which remains nearly constant for a transmission line during normal operation. A worst-case voltage of 241.5 kV was used in the calculations for the 220 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 electrical demand. Line loading values assumed for the EMF and corona effects studies are presented in Table 3.4-1.

Table 3.4-1
Estimated Line Capacities for EMF and Corona Studies

Line	Voltage/Circuits	Capacity
Rio Mesa	220 kV double-circuit (241.5 kV)	375 MW per circuit (897 Amps)

The following additional data was used for the analysis.

- Only the Rio Mesa 220 kV double circuit line was considered for the EMF and audible noise analysis.
- A single 1590 kcmil ACSR 45/7 “Lapwing” conductor was used for the 220 kV lines in the analysis.
- The shield wires are Optical Ground Wire (OPGW) and were assumed to have a core of 48 optical fiber count (resulting in an outer diameter of 0.72 inches). These wires provide lightning protection as well as provide a communication link between interconnected points.
- The conductor spacing was assumed to be as labeled on the structure drawing (L0-2 Rev. A) provided for reference. Should a different configuration be used, the results may vary significantly.
- The phasing of the circuits (top-to-bottom) are BCA on the left and ACB on the right side of the structure.
- The ROW width is 100 feet with the structures located in the center of ROW resulting in 50 feet to the edge of right-of-way from the center of the structures.
- The minimum conductor height was 30 feet for the lowest conductor.
- A sag value of 34.5 feet was assumed for the 220 kV lines.
- The elevation of the corridor is less than 1,000 feet.

The data and assumptions used for the EMF and corona effects studies are discussed in the following paragraphs and illustrated in Figures 3.4-1 through 3.4-5. The cross section of the pole used to calculate the EMF and corona effects is illustrated in Figure 3.3-2. The study calculations are based on the preliminary conceptual design of the interconnection facilities.

3.4.2.4 EMF and Corona Effects Calculations

EMFs were calculated using the Bonneville Power Administration’s (BPA) Corona and Field Effects Program (CAFEP) software to model the tangent double circuit transmission line configurations. 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. CAFEP calculates the electric fields expressed as kV/m and the magnetic fields expressed in 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 wires, various labeling parameters, and other specifics. The field level is calculated directly under and perpendicular to the line, at mid-span where the overhead line sags closest to the ground (calculation point). The mid-span location provides the maximum value for the field. Also using the CAFEP mathematical model, audible noise is calculated at 5-foot microphone height above flat terrain with information concerning rain, and fog rates for daytime and nighttime hours as input. Audible noise is expressed in a-weighted decibels (dBA). The values for RI are reported for fair weather conditions as rainy weather disturbs the signal more than the corona effects. RI is reported at either edge of the ROW and measured at a height of six (6.0) feet (1.83 m) above ground. The values for TVI are reported for wet conductor conditions, as TVI is negligible during fair weather. Values are calculated at a height of 32.8

feet (10 m) above the ground per IEEE Standard 430-1986 and FCC measurement guidelines. Both RI and TVI use the average conductor height to approximate the average values along the entire line. Figures 3.3-2 to 3.3-6 were produced by importing CAFEP data into Microsoft Excel.

3.4.2.5 Results of EMF and Corona Effects Calculations

Electric Field and Corona Effects

Line voltage, arrangement of the phases, and elevation of the cables determine the electric field. The results of the electric field for the 220 kV lines are shown in Table 3.2-2. The maximum electric field for the Project is 2.212 kV/m at 18 feet from the center line as shown in Figure 3.4-1.

Table 3.4-2
Calculated Electric Field Levels from the Rio Mesa Gen-Tie Line

Electric Field Strength (kV/m)	
Distance From Centerline (feet)	**Rio Mesa**
-90	0.028
-72	0.075
-54	0.384
-36	1.236
-18	2.212
Centerline	1.107
18	2.212
36	1.236
54	0.384
72	0.075
90	0.028

The corona-produced RI may affect AM radio reception but not FM radio reception. Calculations were performed at a reference frequency of 1 MHz (near the middle of the AM band). While RI is greater in rainy weather, the AM signals are more distorted by the atmospheric conditions than any corona sources. Therefore, results are presented in fair weather conditions (consistent with typical industry practice). The RI produced by the 220 kV line during fair weather conditions is shown in Table 3.4-3 and Figure 3.4-2.

Table 3.4-3
Calculated Radio Interference Levels Produced During Fair Weather Conditions from the Rio Mesa Gen-Tie Line

Radio Interference (L50 Rain dBuV/m)	
Distance From Centerline (feet)	Rio Mesa
-90	31.5
-72	33.8
-54	36.6
-36	40.7
-18	43.4
Centerline	42.2
18	43.4
36	40.7
54	36.6
72	33.8
90	31.5

The corona-produced TVI is calculated using the average conductor height with the results reported at a height of ten meters (32.8 feet) above the ground and at the edge of the ROW per FCC guidelines. During fair weather conditions TVI effects are generally negligible so effects during rainy weather are calculated and reported. Television interference is not expected to be a concern due to digital television signals being less susceptible to interference than analog signals. The TVI produced by the 220 kV line during rainy weather conditions is shown in Table 3.4-4 and in Figure 3.4-3.

The calculated RI and TVI Interference levels from the 230 kV gen-tie line are expected to cause less than significant effects on existing radio and television broadcast signals in their respective primary coverage areas.

Table 3.4-4
Calculated Television Interference Levels Produced During Rainy Weather Conditions from the Rio Mesa Gen-Tie Line

Television Interference (Rain dBuV/m)	
Distance From Centerline (feet)	Rio Mesa
-90	10.5
-72	12.9
-54	16.0
-36	20.7
-18	28.6
Centerline	23.9
18	28.6
36	20.7
54	16.0
72	12.9
90	10.5

In fair weather, the audible noise will not be observable by a person standing at ground level. During rain, the noise level will be higher but will be masked by the sound of the falling raindrops as well as ambient noise. The audible noise produced for the 220 kV lines during rainy weather as measured 5 feet above ground is shown in Table 3.4-5 and in Figure 3.4-4.

Table 3.4-5
Calculated Audible Noise Levels Produced During Rainy Weather Conditions from the Rio Mesa Gen-Tie Line

Audible Noise (L50 Rain dBA)	
Distance From Centerline (feet)	Rio Mesa
-90	41.1
-72	41.9
-54	42.8
-36	43.6
-18	44.3
Centerline	44.5
18	44.3
36	43.6
54	42.8
72	41.9
90	41.1

Magnetic Field Line current and arrangement of the phases determine the magnetic field. The magnetic fields of the 220 kV lines are shown in Figure 3.4-5. Table 3.4-6 summarizes calculated values for the magnetic field at various distances from the center line. The maximum magnetic field for Rio Mesa is 120.1 mG at the center line as shown in Figure 3.4-5.

Table 3.4-6
Calculated Magnetic Field Levels from the Rio Mesa Gen-Tie Line

Calculated Magnetic Field Level (mG)	
Distance From Centerline (feet)	**Rio Mesa**
-90	9.6
-72	16.1
-54	29.0
-36	55.5
-18	98.1
Centerline	120.1
18	98.1
36	55.5
54	29.0
72	16.1
90	9.6

3.4.2.6 Transmission Line EMF Reduction

While the State of California does not set a statutory limit for electric and magnetic field levels, the 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 have developed their own design guidelines to reduce EMF at each new facility. The CEC, which regulates transmission lines to the first point of connection, requires generators to follow the existing guidelines that are in use by local electric utilities or transmission-system owners.

In keeping with the goal of EMF reduction, the interconnections of the Project will be designed and constructed using the principles outlined in the SCE publication, "EMF Design Guidelines for Electrical Facilities" (EMF Research and Education, 2004). 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 transmission line structures, conductors, and ROWs are designed and routed according to the SCE guidelines, the transmission line is consistent with the CPUC mandate.

The primary techniques for reducing EMF anywhere along a transmission line are to:

1. Increase the pole height for overhead design

2. Use compact pole-head configuration
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 Rio Mesa interconnections as designed. If required, the pre- and post-interconnections verification measurements will be made consistent with IEEE guidelines and will provide sample readings of EMF at the edge of ROW. Additional measurements will be made upon request for locations of particular concern.

3.4.2.7 EMF and Corona Effects Conclusions

The public exposure to EMF and corona effects levels due to the proposed interconnection of Rio Mesa SEGF are within typical industry accepted levels, notwithstanding the fact that there will be very little public exposure at the site. The effect of the added EMF and corona effects would be well below the levels produced by the existing SCE 500 kV line.

3.4.3 Induced Current and Voltages

A conducting object such as a vehicle or person in an electric field will have induced voltages and currents. The strength of the induced current will depend on 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 milliampere (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 ROW 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 aboveground 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 oriented parallel to the transmission line.

The proposed 220 kV transmission interconnection will be constructed in conformance with GO-95 and Title 8 California Code of Regulations § 2700 (8 CCR § 2700) requirements. Therefore, hazardous shocks are unlikely to occur as a result of project construction or operation.

3.4.4 Aviation Safety

Federal Aviation Administration (FAA) Regulations, Title 14 of the Code of Federal Regulations (CFR), Part 77 establishes standards for determining obstructions in navigable airspace in the vicinity of airports that are available for public use and are listed in the Airport Directory of the current Airman's Information Manual. These regulations set forth requirements for notification of proposed obstruction that extend above the earth's surface. FAA notification is required for any potential obstruction structure erected over 200 feet in height above ground level. Also, notification is required if the obstruction is greater 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 with no obstruction greater than a 100:1 ratio of the distance from the runway. For airports with runways measuring 3,200 feet or less, the restricted space extends 10,000 feet (1.7 nautical miles) with a 50:1 ratio of the distance from the runway. For heliports, the restricted space extends 5,000 feet (0.8 nautical miles) with a 25:1 ratio.

The project is located approximately 4.7 miles from Blythe Municipal Airport, which has two runways 5,800 and 6,543 feet in length. The proposed gen-tie line structures will be located approximately 25,000 feet from the end of the nearest runway. According to the FAA horizontal distance equation for a runway greater than 3,200 feet, a 100 to 1 imaginary slope extending from the nearest point of a runway nearest to the site of the proposed structure is restricted to 20,000 feet. Accordingly, a distance of approximately 25,000 feet will allow a structure of up to 125 feet. A typical 220 kV transmission structure for this project will range from 85 to 120 feet in height.

As specified by FAA Regulations, Title 14 of the CFR, Part 77, there are no airports (public or private) within 20,000 feet and no heliports within 5,000 feet of the proposed project site. For additional information on FAA Regulations see Section 5.6, Land Use.

3.4.5 Fire Hazards

The proposed 220 kV gen-tie line built along the alignments to the CRS will be designed, constructed, and maintained in accordance with CPUC's GO-95. GO-95 establishes clearances from other man-made and natural structures as well as tree-trimming requirements to mitigate fire hazards. The proposed construction site, on the Palo Verde Mesa in Riverside County, has been surveyed to ensure neither man-made nor natural structures are located in the vicinity of the proposed facilities that would contribute to a fire hazard.

The fire protection system will be designed to protect personnel and limit property loss and plant downtime in the event of a fire. The primary source of fire protection water will be the service/firewater storage tank(s).

An electric jockey pump and electric-motor-driven main fire pump will be provided to increase the water pressure in the plant fire main to the level required to serve all firefighting systems. In addition, a back-up diesel engine-driven fire pump will be provided to pressurize the fire loop if the power supply to the electric-motor-driven main fire pump fails. A fire pump controller will be provided for each fire pump.

The fire pump will discharge to a dedicated underground firewater loop piping system. Normally, the jockey pump will maintain pressure in the firewater loop. Both the fire hydrants and the fixed suppression systems will be supplied from the firewater loop. Fixed fire suppression systems will be installed at determined fire risk areas such as the transformers and turbine lube oil equipment. Sprinkler systems will also be installed in the combined administration, control, warehouse and maintenance building and fire pump enclosure as required by NFPA and local code requirements. Handheld fire extinguishers of the appropriate size and rating will be located in accordance with NFPA 10 throughout the facility.

Section 5.5, Hazardous Materials Handling, includes additional information for fire and explosion risk, and Section 5.10, Socioeconomics, provides information on local fire protection capability.

3.5 INVOLVED AGENCIES AND AGENCY CONTACTS

Table 3.5-1 lists the agencies involved in transmission system engineering for the Project and a contact person at each agency.

Table 3.5-1
Agency Contacts

Agency	Issue	Contact
California Independent System Operator P.O. Box 639014 Folsom, CA 95763-9014	Transmission Interconnection	Linda Wright, Project Specialist (916) 351-4470
Southern California Edison 2244 Walnut Grove Avenue Rosemead, CA 91770	Transmission Interconnection	Gordon Brown, Contracts Manager (626) 302-7343

3.6 PERMITS REQUIRED AND PERMIT SCHEDULE

Table 3.6-1 identifies Federal, State, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, and/or enforce the above referenced LORS. Table 3.6-1 also identifies the associated responsibilities of these agencies as they relate to the construction and operation of Rio Mesa SEGF. Any required permits will be obtained during the course of the CEQA and NEPA licensing processes.

Table 3.6-1
Jurisdictional Agencies for Transmission System Engineering-Related LORS

Agency or Jurisdiction	Responsibility
California Energy Commission (CEC)	Jurisdiction over new transmission lines associated with thermal power plants that are 50 MW or more. (Public Resources Code [PRC] 25500)
CEC	Jurisdiction of lines out of a thermal power plant to the first point of interconnection 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)

Table 3.6-1
Jurisdictional Agencies for Transmission System Engineering-Related LORS

Agency or Jurisdiction	Responsibility
California Public Utilities Commission (CPUC)	Regulates construction and operation of overhead transmission lines. (General Order [GO] No. 95 and 131-D)
CPUC	Regulates construction and operation of power and communications lines for the prevention of inductive interference. (GO No. 52)
Federal Aviation Administration (FAA)	(AC No. 70/7460-1G) Establishes regulations for marking and lighting of obstructions in navigable airspace. (AC No. 70/7460-1G)
California Independent System Operator (CAISO)	Provides Final Interconnection Approval
Bureau of Land Management (BLM)	Establishes and enforces zoning regulations for specific land uses. Issues variances in accordance with zoning ordinances.
CEC	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity. (NFPA 70) Issues and enforces certain ordinances and regulations concerning fire prevention and electrical inspection

BLM = Bureau of Land Management
CAISO = California Independent System Operator
CEC = California Energy Commission
CPUC = California Public Utilities Commission
FAA = Federal Aviation Administration
GO = General Order
PRC = Public Resources Code

3.7 REFERENCES

Appendix A – Q#643AC.Palo Verde Mesa, LLC. Queue Cluster 3 Phase 1 Final Report.

California Independent System Operator Final Queue Cluster 3 Phase 1 Interconnection Study Report – Group Report in SCE's Eastern Bulk System Final Report.

California Public Service Commission, Decision 93-11-013.

California Public Service Commission, General Order 128, Rules for Construction of Underground Electric Supply and Communications Systems.

California Public Service Commission, General Order 131D, Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities.

California Public Service Commission, General Order 52, Construction and Operation of Power and Communication Lines.

California Public Service Commission, General Order 95, Rules for Overhead Electric Line Construction.

Electric Power Research Institute. 1975. Transmission Line Reference Book, 345-kV and Above. Palo Alto, California.

Electric Power Research Institute. 1978. Transmission Line Reference Book, 115-138-kV Compact Line Design. Palo Alto, California.

EMF Research and Education. 2004. EMF Design Guidelines for Electrical Facilities, Southern California Edison Company. Irwindale, California.

IEEE Power Engineering Society. 1985. Corona and Field Effects of AC Overhead Transmission Lines, Information for Decision Makers. July.

National Electrical Safety Code, ANSI C2.

Power flow cases used for the LGIP "Interconnection Feasibility Study" provided by CAISO

SCE Federal Energy Regulatory Commission (FERC) Form 715

U.S. Department of Energy. 1989. Electrical and Biological Effects of Transmission Lines, A Review. Bonneville Power Administration, Portland, Oregon. June.

United States of America, 14CFR1250-1258-Fire Prevention Standards for Electric Utilities.

United States of America, 15CFR77-Objects Affecting Navigable Airspace.

United States of America, 47CFR15.25-Operating Requirements, Incidental Radiation.

DATA ADEQUACY WORKSHEET

Adequacy Issue: Adequate _____ Inadequate _____ Revision No. 0 Date ____________

Technical Area: **Trans Line Safety & Nuisance** Project: ____________ Technical Staff: ____________

Project Manager: ____________ Docket: ____________ Technical Senior: ____________

Siting Regulations	**Information**	**AFC Page Number And Section Number**	**Adequate Yes Or No**	**Information Required To Make AFC Conform With Regulations**
Appendix B (g) (1)	...provide a discussion of the existing site conditions, the expected direct, indirect and cumulative impacts due to the construction, operation and maintenance of the project, the measures proposed to mitigate adverse environmental impacts of the project, the effectiveness of the proposed measures, and any monitoring plans proposed to verify the effectiveness of the mitigation.	See all subsections of Section 5 of this AFC.		
Appendix B (g) (18) (A)	The locations and a description of the existing switchyards and overhead and underground transmission lines that would be affected by the proposed project.	Page 3-6, Section 3.3.2		
Appendix B (g) (18) (B)	An estimate of the existing electric and magnetic fields from the facilities listed in (A) above and the future electric and magnetic fields that would be created by the proposed project, calculated at the property boundary of the site and at the edge of the rights of way for any transmission line. Also provide an estimate of the radio and television interference that could result from the project.	Pages 3-9 through 3-17, Section 3.4.2.		
Appendix B (g) (18) (C)	Specific measures proposed to mitigate identified impacts, including a description of measures proposed to eliminate or reduce radio and television interference, and all measures taken to reduce electric and magnetic field levels.	Pages 3-16 and 3-17, Sections 3.4.2.6 and 3.4.2.7		
Appendix B (i) (1) (A)	Tables which identify laws, regulations, ordinances, standards, adopted local, regional, state, and federal land use plans, leases, and permits applicable to the proposed project, and a discussion of the applicability of, and conformance with each. The table or matrix shall explicitly reference pages in the application wherein conformance, with each law or standard during both construction and operation of the facility is discussed; and	Pages 3-2 through 3-5, Section 3.2		

Adequacy Issue: Adequate ____ Inadequate ____

DATA ADEQUACY WORKSHEET

Revision No. 0 Date ____

Technical Area: **Trans Line Safety & Nuisance** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

Siting Regulations	Information	AFC Page Number and Section Number	Adequate Yes or No	Information Required to Make AFC Conform with Regulations
Appendix B (i) (1) (B)	Tables which identify each agency with jurisdiction to issue applicable permits, leases, and approvals or to enforce identified laws, regulations, standards, and adopted local, regional, state and federal land use plans, and agencies which would have permit approval or enforcement authority, but for the exclusive authority of the commission to certify sites and related facilities.	Pages 3-19 and 3-20, Section 3.6		
Appendix B (i) (2)	The name, title, phone number, address (required), and email address (if known), of an official who was contacted within each agency, and also provide the name of the official who will serve as a contact person for Commission staff.	Page 3-19, Section 3.5		
Appendix B (i) (3)	A schedule indicating when permits outside the authority of the commission will be obtained and the steps the applicant has taken or plans to take to obtain such permits.	Page 3-19, Section 3.6		

DATA ADEQUACY WORKSHEET

Adequacy Issue: Adequate ____ Inadequate ____ Revision No. 0 Date ____

Technical Area: **Transmission System Design** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

Siting Regulations	Information	AFC Page Number and Section Number	Adequate Yes or No	Information Required to Make AFC Conform with Regulations
Appendix B (h) (2) (A)	A discussion of the need for the additional electric transmission lines, substations, or other equipment, the basis for selecting principal points of junction with the existing electric transmission system, and the capacity and voltage levels of the proposed lines, along with the basis for selection of the capacity and voltage levels.	Pages 3-5 through 3-8, Section 3.3		
Appendix B (h) (2) (B)	A discussion of the extent to which the proposed electric transmission facilities have been designed, planned, and routed to meet the transmission requirements created by additional generating facilities planned by the applicant or any other entity.	Page 3-7, Section 3.3.3 and Figures 3.3-1 and 3.3-2		
Appendix B (b) (2) (C)	A detailed description of the design, construction, and operation of any electric transmission facilities, such as power lines, substations, switchyards, or other transmission equipment, which will be constructed or modified to transmit electrical power from the proposed power plant to the load centers to be served by the facility. Such description shall include the width of rights of way and the physical and electrical characteristics of electrical transmission facilities such as towers, conductors, and insulators. This description shall include power load flow diagrams which demonstrate conformance or nonconformance with utility reliability and planning criteria at the time the facility is expected to be placed in operation and five years thereafter; and	Page 3-7 and 3.8, Section 3.3.3 and all Figures		
Appendix B (b) (2) (D)	A description of how the route and additional transmission facilities were selected, and the consideration given to engineering constraints, environmental impacts, resource conveyance constraints, and electric transmission constraints.	Page 3-7, Section 3.3.3, as well as Section 2, Project Description and Section 6.3, On-Site Alternatives.		

Adequacy Issue: Adequate ____ Inadequate ____ **DATA ADEQUACY WORKSHEET** Revision No. 0 Date ____

Technical Area: **Transmission System Design** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

Siting Regulations	Information	AFC Page Number and Section Number	Adequate Yes or No	Information Required to Make AFC Conform with Regulations
Appendix B (b) (2) (E)	A completed System Impact Study or signed System Impact Study Agreement with the California Independent System Operator and proof of payment. When not connecting to the California Independent System Operator controlled grid, provide the executed System Impact Study agreement and proof of payment to the interconnecting utility. If the interconnection and operation of the proposed project will likely impact an transmission system that is not controlled by the interconnecting utility (or California Independent System Operator), provide evidence of a System Impact Study or agreement and proof of payment (when applicable) with/to the impacted transmission owner or provide evidence that there are no system impacts requiring mitigation.	Appendix 3A, CAISO Queue Cluster 3 Phase 1 Final Report		
Appendix B (i) (1) (A)	Tables which identify laws, regulations, ordinances, standards, adopted local, regional, state, and federal land use plans, leases, and permits applicable to the proposed project, and a discussion of the applicability of, and conformance with each. The table or matrix shall explicitly reference pages in the application wherein conformance, with each law or standard during both construction and operation of the facility is discussed; and	Pages 3-2 through 3-5, Section 3.2		
Appendix B (i) (1) (B)	Tables which identify each agency with jurisdiction to issue applicable permits, leases, and approvals or to enforce identified laws, regulations, standards, and adopted local, regional, state and federal land use plans, and agencies which would have permit approval or enforcement authority, but for the exclusive authority of the commission to certify sites and related facilities.	Pages 3-19 through 3-20, Section 3.6		

Adequacy Issue: Adequate ____ Inadequate ____

DATA ADEQUACY WORKSHEET

Revision No. 0 Date ____

Technical Area: **Transmission System Design** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

Siting Regulations	Information	AFC Page Number and Section Number	Adequate Yes or No	Information Required to Make AFC Conform with Regulations
Appendix B (i) (2)	The name, title, phone number, address (required), and email address (if known), of an official who was contacted within each agency, and also provide the name of the official who will serve as a contact person for Commission staff.	Table 3.6-1, page 3-20		
Appendix B (i) (3)	A schedule indicating when permits outside the authority of the commission will be obtained and the steps the applicant has taken or plans to take to obtain such permits.	Page 3-19, Section 3.6		

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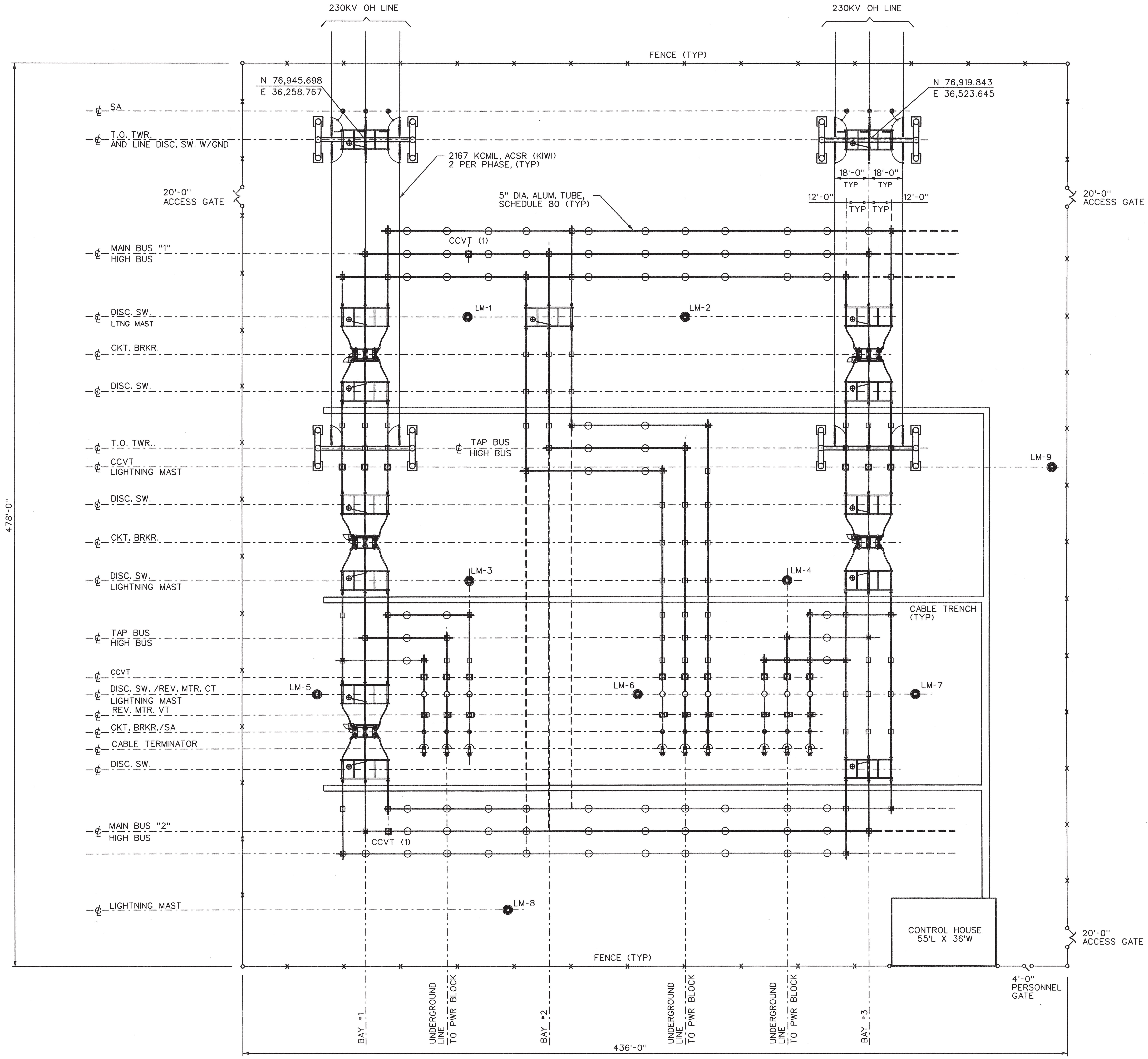

PLANT NORTH

LEGEND:

- ○ HIGH BUS SUPPORT
- □ LOW BUS SUPPORT
- ● LIGHTNING MAST (75 FT)

0 30 60 90 120FT

THIS IS A CONCEPTUAL GENERAL ARRANGEMENT.
EXACT LAYOUT AND DIMENSIONS WILL
BE DETERMINED DURING DETAILED DESIGN PHASE

NO.	DATE	REVISIONS	BY	CHK	DES SUPV.	ENGR.	PROJ ENGR	APPR
△	/ /							
△	/ /							
B	14/July/11	ISSUED FOR AFC AND REVISED TO A RING BUS CONFIGURATION	BLW	JCY	—	[illegible]	[illegible]	
A	26/APR/11	ISSUED FOR REVIEW	BLW	JCY	---	DPJ	TWA	

SCALE 1"=30' | DATE 06/15/2010 | DESIGNED JCY | DRAWN JCY | CHIEF ENGR.

BrightSource

BECHTEL POWER CORP.
DEDICATED TO SAFETY EXCELLENCE - ZERO ACCIDENTS
FREDERICK, MARYLAND

RIO MESA
SOLAR ELECTRIC GENERATING FACILITY

COMMON AREA 230KV SWITCHYARD
3 UNIT CONFIGURATION
GENERAL ARRANGEMENT

BSII (Ltd.)	FIG. NO: 3.3-1	OWNER DRAWING NO.: TBD	
BECHTEL	JOB NO. 25670	DRAWING NO. 009-EZ-3510-00001	REV. B

REF DFN=[ ] . DFN=[ ] . 22 x 34 "D" SIZE

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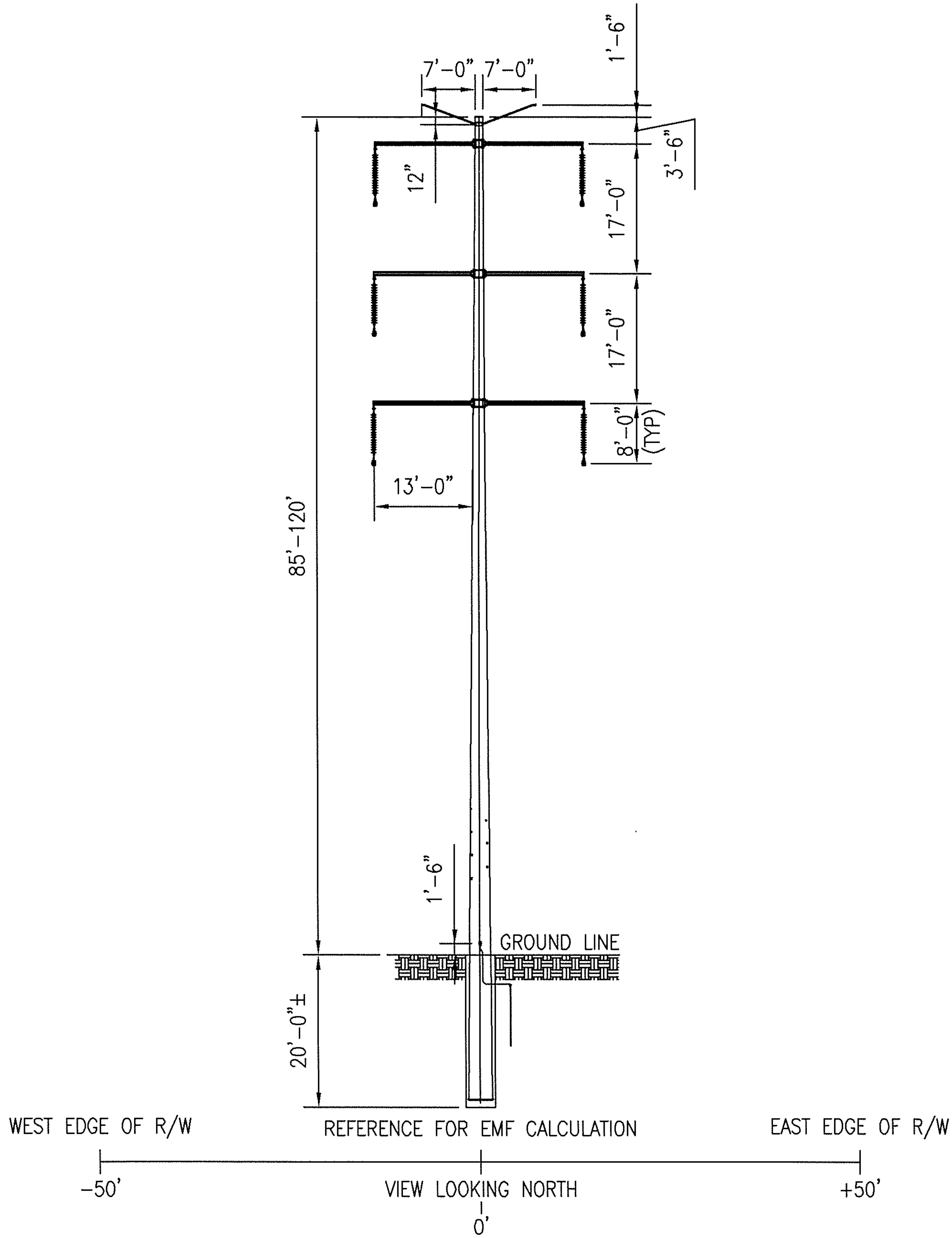
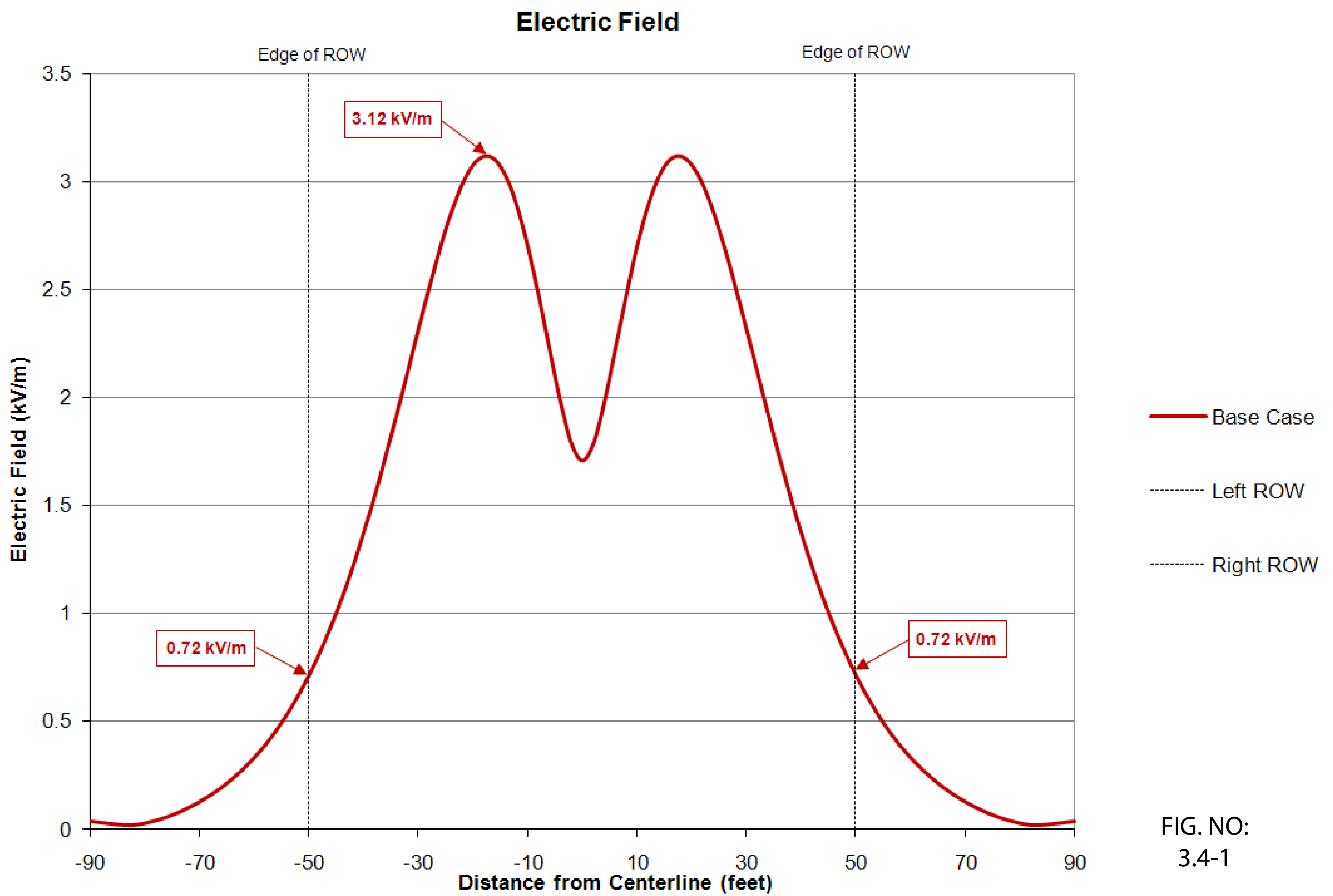
6 5 4 3 2



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

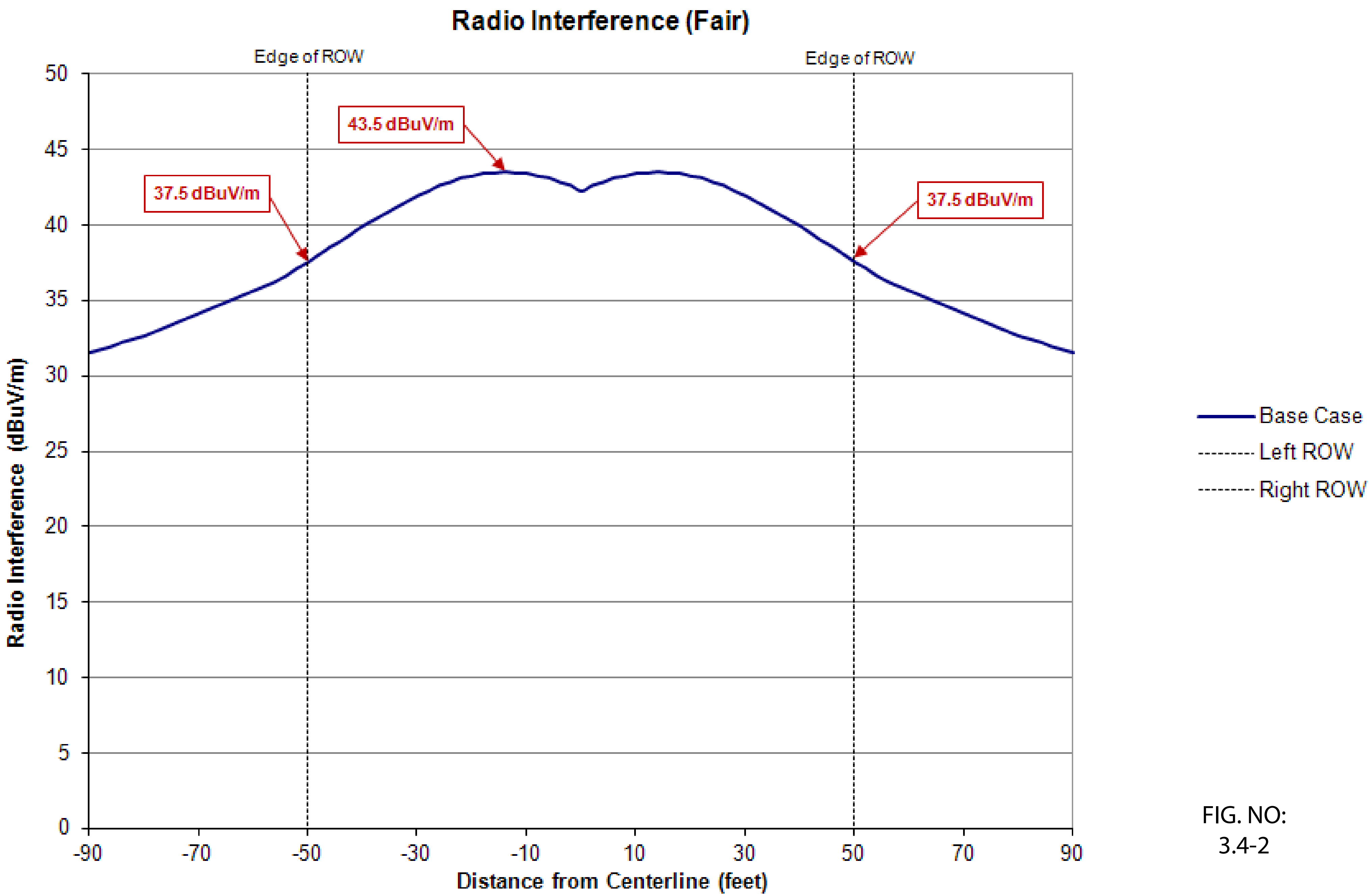
SOURCE:
POWER ENGINEERS, INC.

FIGURE 3.3-2
RIO MESA SOLAR
220 kV SINGLE CIRCUIT
STRUCTURE ELEVATION



Electric Field
Edge of ROW
Edge of ROW
3.12 kV/m
0.72 kV/m
0.72 kV/m
Electric Field (kV/m)
3.5
3
2.5
2
1.5
1
0.5
0
-90
-70
-50
-30
-10
10
30
50
70
90
Distance from Centerline (feet)
Base Case
Left ROW
Right ROW

FIG. NO: 3.4-1



Radio Interference (Fair)
Edge of ROW
Edge of ROW
43.5 dBuV/m
37.5 dBuV/m
37.5 dBuV/m
Radio Interference (dBuV/m)
50
45
40
35
30
25
20
15
10
5
0
-90
-70
-50
-30
-10
10
30
50
70
90
Distance from Centerline (feet)
Base Case
Left ROW
Right ROW

FIG. NO:
3.4-2

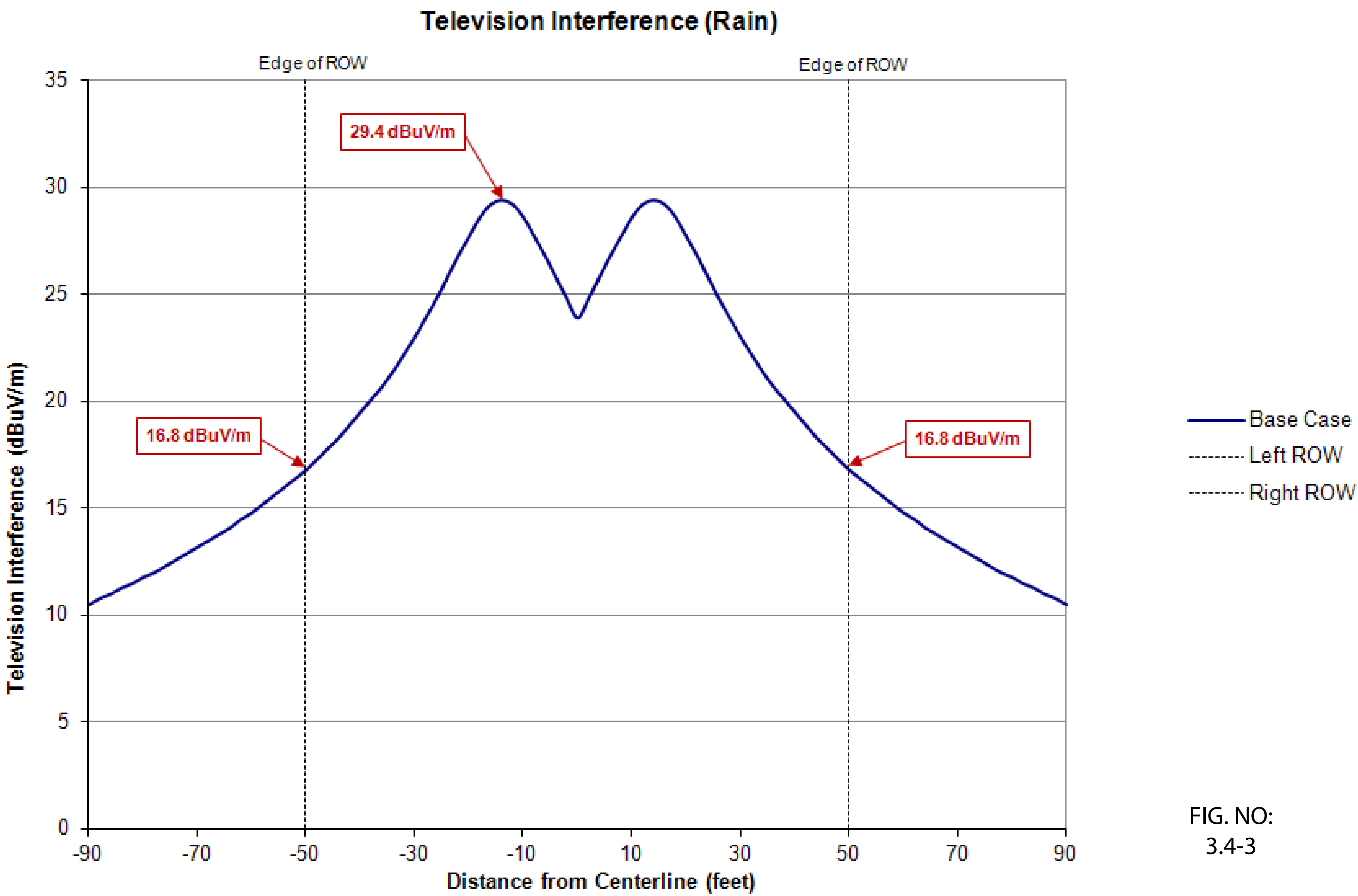
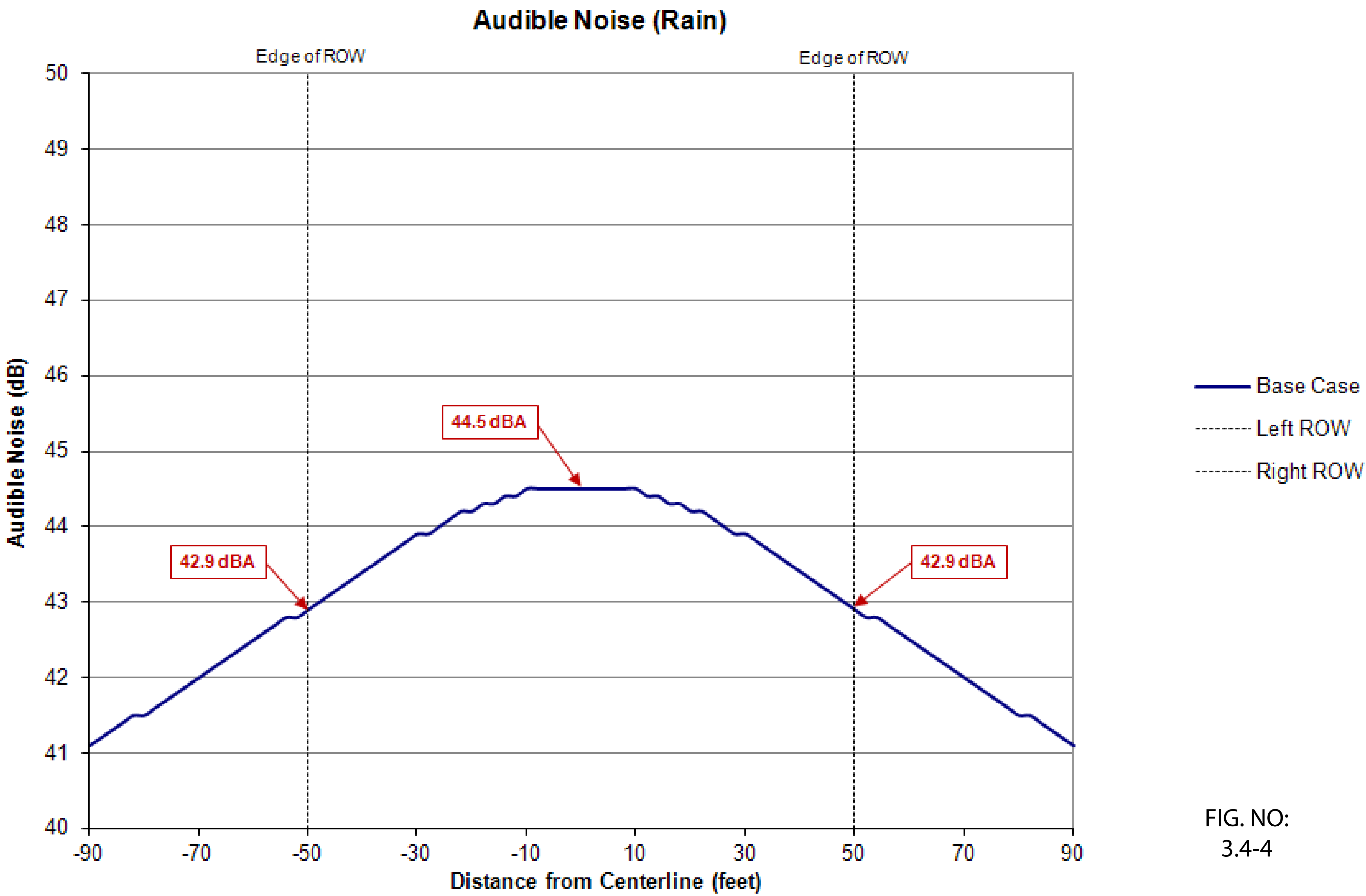

Television Interference (Rain)
Edge of ROW
Edge of ROW
29.4 dBuV/m
16.8 dBuV/m
16.8 dBuV/m
Television Interference (dBuV/m)
35
30
25
20
15
10
5
0
-90
-70
-50
-30
-10
10
30
50
70
90
Distance from Centerline (feet)
Base Case
Left ROW
Right ROW

FIG. NO:
3.4-3



Audible Noise (Rain)
Edge of ROW
Edge of ROW
Audible Noise (dB)
50
49
48
47
46
45
44
43
42
41
40
44.5 dBA
42.9 dBA
42.9 dBA
-90
-70
-50
-30
-10
10
30
50
70
90
Distance from Centerline (feet)
Base Case
Left ROW
Right ROW

FIG. NO: 3.4-4

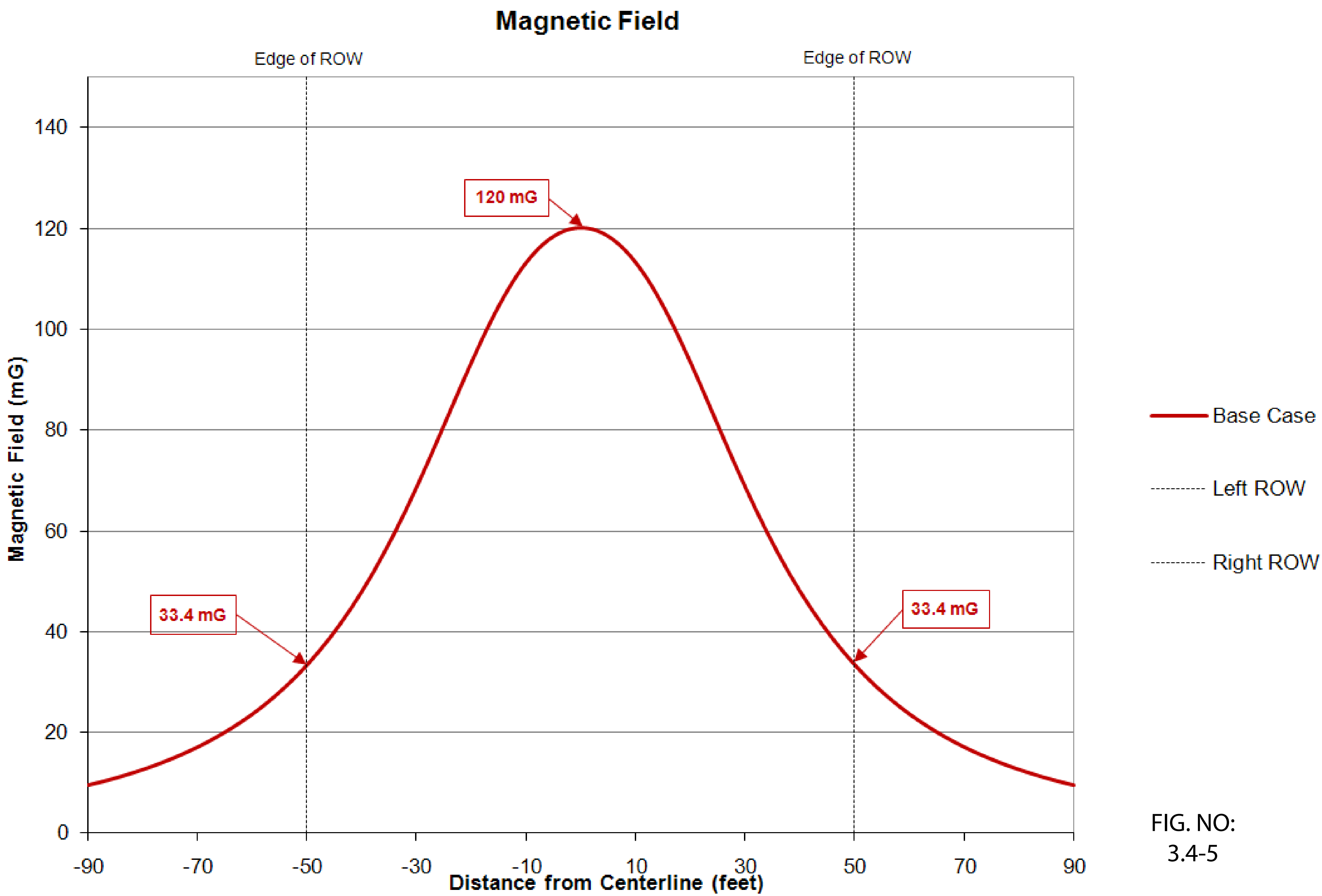

Magnetic Field
Edge of ROW
Edge of ROW
140
120
100
80
60
40
20
0
Magnetic Field (mG)
120 mG
33.4 mG
33.4 mG
-90
-70
-50
-30
-10
10
30
50
70
90
Distance from Centerline (feet)
Base Case
Left ROW
Right ROW

FIG. NO:
3.4-5