EXHIBIT AA

ELECTRIC TRANSMISSION LINE

OAR 345-021-0010(1)(aa)
OAR 345-024-0090(1)
OAR 345-024-0090(2)

TABLE OF CONTENTS

Page

TABLES

FIGURES *(located after text)*

ATTACHMENT

AA.1 INTRODUCTION

OAR 345-021-0010(1)(aa) *If the proposed facility includes an electric transmission line:*

See sections AA.2 and AA.7.

AA.2 ELECTRIC AND MAGNETIC FIELDS

(A) Information about the expected electric and magnetic fields, including:

AA.2.1 Distance from Transmission Line Center Line to Edge of Right-of-Way

(i) The distance in feet from the proposed center line of each proposed transmission line to the edge of the right-of-way;

Response: The Project will include two separate overhead transmission lines, along routes spanning 4 miles and 11 miles in length. The overhead transmission lines will consist of a 230-kilovolt (kV) line, both with and without a 12.47-kV underbuild, and a 500-kV line. In addition, there will be underground 34.5-kV collector circuits between the wind turbines and a new collector substation.

The overhead transmission line for the 230-kV portion would be constructed within a 150-foot-wide corridor, approximately. Therefore, the centerline of the transmission line would be typically 75 feet from the edge of the right-of-way.

The overhead transmission line for the 500-kV portion would be constructed within a 200-foot–wide corridor, approximately. Therefore, the centerline of the transmission line would be typically 100 feet from the edge of the right-of-way.

For the underground 34.5-kV collector circuits, the distance between the centerline of the 34.5-kV circuits and the edge of the right-of-way is undefined, because the entire wind farm is considered right-of-way for the collection circuits.

AA.2.2 Types of Occupied Structures within 200 Feet of Center Line of Proposed Transmission Lines

(ii) The type of each occupied structure, including but not limited to residences, commercial establishments, industrial facilities, schools, daycare centers, and hospitals, within 200 feet on each side of the proposed center line of each proposed transmission line.

Response: There is one residence located within 200 feet of center line on the proposed 230-kV transmission line route where the 12.47-kV underbuild circuit is located on the structure. There are no occupied buildings, including residences, within 200 feet of center line on either side of the proposed 500-kV transmission line route or the proposed 230-kV line route without the 12.47-kV underbuild distribution circuit.

AA.2.3 Distance from Proposed Center Lines to Structures

(iii) The approximate distance in feet from the proposed center line to each structure identified in (A);

Response: One residence is located approximately 150 feet from the center line of the proposed 230-kV transmission line route where the 12.47-kV underbuild circuit is located on the structure. No other buildings are located within 200 feet of the proposed 500-kV transmission line route or the proposed 230-kV transmission line route without the 12.47-kV underbuild distribution circuit.

AA.2.4 Graphs of Electric and Magnetic Field Levels

(iv) At representative locations along each proposed transmission line, a graph of the predicated electric and magnetic fields levels from the proposed center line to 200 feet on each side of the proposed center line;

Response: Refer to Figures 4M, 4E, 5M, 5E, 6M, 6E, 7 & 8.

AA.2.4.1 Generation of Electric and Magnetic Fields (EMF)

All electric utility wires and devices generate alternating electric and magnetic fields (EMF). The earth itself generates steady-state magnetic and electric fields. The EMF produced by the alternating current (AC) electrical power system in the United States has a frequency of 60 hertz (Hz), meaning that the fields change from positive to negative and back to positive, 60 times per second.

This section addresses the estimates of the maximum possible 60-Hz AC electric and magnetic field strengths that will be produced by the proposed 230-kV and 500-kV overhead transmission lines and the proposed 34.5-kV underground collector circuits. These estimates are computed for a height of 1 meter (3.3 feet) above the ground on the proposed line routes.

In AC power systems, voltage swings positive to negative and back to positive, a 360 degree cycle, 60 times every second. Current follows the voltage, flowing forward, reversing direction, and returning to the forward direction, again a 360 degree cycle, 60 times every second. Each AC 3-phase circuit carries power over three conductors. One phase of the circuit is carried by each of the three conductors. The AC voltage and current in each phase conductor is out of sync with the other two phases by 120 degrees, or one-third of the 360 degree cycle. The fields from these conductors tend to cancel out because of the phase difference. However, when a person stands under a transmission line, or over a buried circuit of underground cables, one conductor is always significantly closer, which will result in a net field at the person's location.

Electric fields around transmission lines are produced by electrical charges, measured as voltage, 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 a sensor is from the conductors, so that the electric field strength declines as the distance from the conductor increases. For this transmission line, the voltage and electric field alternate at a frequency of 60 Hz. The strength of the electric field is measured in units of kilovolts per meter (kV/m). The voltage, and therefore 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 electrical load or the level of current flow, measured in terms of amperage, through the conductors. Like the electric field, the magnetic field alternates at a frequency of 60 Hz. The magnetic field strength is directly proportional to the amperage; that is, increased amperage produces a stronger magnetic field. The magnetic field is inversely proportional to the sensor's distance from the conductors. Also, 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). However, unlike voltage, the amperage and therefore the magnetic field around a transmission line fluctuate daily and seasonally as the usage of electricity varies and the amount of current flow varies.

Considerable research has been conducted over the last 30 years on the possible biological 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, many states, including Washington and Oregon, have chosen not to specify maximum levels of EMF. Instead, these states mandate a program of prudent avoidance, whereby EMF exposure to the public is to be minimized by encouraging electric utilities to use low-cost techniques to reduce the levels of EMF. The states reason that because there is no established scientific evidence linking EMF with health risks, it is difficult to justify expensive mitigations. The prudent-avoidance approach encourages new facilities to incorporate design features or configurations that will significantly reduce EMF exposure and risk levels, if the costs of those features or alternative configurations do not add significantly to the cost of the facility. A 5 percent construction cost premium is usually considered to be a significant increase in cost if done solely for the purpose of EMF risk mitigation.

AA.2.4.2 EMF Calculations for the 230-KV Overhead Transmission Line

For this Project, EMF exposure risk is very low because the line will pass over and through undeveloped land. Construction with single steel poles, with the conductors configured in a triangle instead of horizontally, reduces EMF levels on the right-of-way and under the conductors.

The conductor arrangement proposed for the 230-kV transmission line consists of two similar design segments. The first segment is composed of one, 3-phase, single conductor, 230-kV circuit, with one OPGW shield wire for the entire length of the transmission line. A typical structural configuration for this design is illustrated in Figure AA-1, and consists of 3 – 795 ACSR "Drake" conductors, and 1 – OPGW shield wire.

The second segment begins 0.75 miles from the proposed Collection Substation where a Wasco Electric PUD 12.47-kV underbuild circuit will be added to the 230-kV transmission line described above. This additional circuit will consist of a 12.47-kV, 3 phase with neutral, single conductor (4 – conductors total) underbuild. In this configuration, the addition of the Wasco Electric PUD underbuild creates a total of 8 wires (3 – 230-kV 795 ASCR "Drake" conductors, 3 – 12.47-kV 4/0 ASCR "Penguin" conductors, 1 – 4/0 ASCR "Penguin" neutral, and 1 – OPGW shield wire). This configuration is illustrated in Figure AA-2.

Except for special construction required for crossing under other transmission lines, the ground-level magnetic field intensity across the corridor is determined by the currents and geometry of these typical facilities.

AA.2.4.3 EMF Calculations for the 500-kV Overhead Transmission Line

For the 500-kV transmission line, EMF exposure risk is very low because the line will pass over and through undeveloped land. The conductor arrangement proposed for this facility, the 500-kV transmission line consists of one, 3-phase, 500-kV circuit (3 – conductor bundle per phase; 9 – 1033 kcmil ACSR "Ortolan" conductors total) with one OPGW shield wire. This circuit configuration is illustrated in Figure AA-3. The ground-level magnetic field intensity across the corridor is determined by the currents and geometry of these typical facilities.

AA.2.4.4 Line Loads for EMF Calculation

It is important that any discussion of EMF include the assumptions used to calculate these fields. It is also important to remember that EMF in the vicinity of the power lines varies with regard to line design, line loading, distance from the line, and other factors. The electric field depends on line voltage, which remains nearly constant for a transmission line in normal operation. The magnetic field is proportional to line loading (amperage), which varies as power plant generation is changed by the wind. Maximum magnetic fields are produced at the maximum (peak) conductor currents.

The first and second segments of the 230-kV overhead lines in this study are rated for a nominal voltage of 230 kV. Line loading value assumed for the 230-kV line is 200 MVA, or 502 amperes per phase, at peak system load. The line loading for the Wasco Electric PUD 12.47-kV underbuild circuit is assumed as 5 MVA, or 232 amperes per phase. These values were used in the EMF study.

The 500-kV overhead transmission line in this study is rated for a nominal voltage of 500kV. Line loading value assumed for the line is 200 MVA, or 231 amperes per phase (77 amperes per conductor, 3 conductors per phase) at peak system load. This value was used in the EMF study.

AA.2.4.5 Calculation Methods

To estimate the maximum fields, calculations are performed at mid-span where the conductor is positioned at its lowest point between structures (the estimated maximum sag point). The magnetic fields are computed at 1 meter above ground with a program called Corona and Field Effect Program (Version 3), developed by the Bonneville Power Administration. This program and others like it have been used to predict electric and magnetic field levels for many years, and results have been confirmed by field measurements performed by numerous utilities.

The distance between the centerline of the 230-kV circuit and the edge of the right-of-way is assumed to be 75 feet. The distance between the centerline of the 500-kV circuit and the edge of the right-of-way is assumed to be 100 feet.

AA.2.4.6 Results of EMF Calculations

Table AA-1 and AA-2 provide the calculated values of the magnetic and the electric field values at left and right edges of the right-of-ways, and at the centerline, for the projected maximum currents during peak load at minimum conductor ground clearances. The actual magnetic field values vary, as load varies daily, seasonally, and as conductor sag changes with ambient temperature. The levels shown represent the highest magnetic fields expected for the proposed transmission lines. Average fields along the ground between poles, and over a year’s time would be considerably reduced from the peak values shown.

230-kV Transmission Line

Table AA-1 illustrates that the magnetic field and electric field values are higher on the right-of-way, than at the edges of the right-of-way. These results are plotted on graphs as follows:

- Figure AA-4M 230-kV Magnetic field profile with only OPGW shield wire.
- Figure AA-4E 230-kV Electric field profile with only OPGW shield wire.
- Figure AA-5M 230-kV Magnetic field profile with 12.47-kV circuit and OPGW shield wire.
- Figure AA-5E 230-kV Electric field profile with 12.47-kV circuit and OPGW shield wire.

Table AA-1 Calculated Maximum Magnetic and Electric Field Values for the 230-kV Line

		Magnetic Field (mGauss)			Electric Field (KV/M)		
Figure	Voltage	Left R/W (75’)	Max. on R/W	Right R/W (75’)	Left R/W (75’)	Max. on R/W	Right R/W (75’)
AA-4M and AA-4E	230-kV	10.9	63.5	10.5	0.4	2.4	0.4
AA-5M and AA-5E	230-kV	9.2	46.1	9.6	0.4	1.8	0.4

500-kV Transmission Line

Table AA-2 illustrates that the magnetic field and electric field values are higher on the right-of-way than at the edges of the right-of-way. Figures AA-6M and AA-6E are the graphed results of the Magnetic field and Electric field profiles for the 500-kV transmission line with an OPGW shield wire.

Table AA-2 Calculated Maximum Magnetic and Electric Field Values for the 500-kV Line

		Magnetic Field (mGauss)			**Electric Field (KV/M)**		
Figure	**Voltage**	**Left R/W (100')**	**Max. on R/W**	**Right R/W (100')**	**Left R/W (100')**	**Max. on R/W**	**Right R/W (100')**
AA-6M and AA-6E	500-kV	6.5	24.0	5.2	1.2	7.2	1.4

AA.2.4.7 EMF Calculations for 34.5-KV Underground Collection System

For an underground 34.5-kV circuit, the electric field is totally contained within the insulation of the cable. Each cable has a semi-conducting insulation shield and a grounded concentric neutral, made up of multiple strands of copper wire that encircle the cable just under the outer jacket. This means that the cable jacket has no measurable voltage to ground, or between other cable jackets, and that the cables can be safely touched, although it is not recommended. Because the electric field is contained within the buried cables, no electric field is measurable at the surface of the ground.

However, the underground cables do not contain the magnetic field and the net magnetic field of buried cables is measurable on the surface of the ground above the cables.

For an overhead transmission line, the conductors are isolated above the ground and insulated by air. Therefore, for overhead lines, neither the electric field nor magnetic fields are contained, and both the net electric and magnetic field strength are measurable on the ground.

AA.2.4.8 Calculation Method

The calculation methods used for the analysis that follows are provided in Chapter 8 of the *Transmission Line Reference Book, 345-kV and Above* (EPRI, 1987). The software tool program used for these analyses is based on the methods and equations given in the referenced text. The calculation tool used is called "Corona and Field Effect Program (Version 3), and is provided by Bonneville Power Administration. This program and others like it have been used to predict electric and magnetic field levels for many years. The predicted values of field strength from these programs have been consistently confirmed by field measurements.

To estimate the maximum fields, calculations are performed for a height of 1 meter above the ground, and at mid-span where the conductor is positioned at its lowest point between structures (the estimated maximum sag point).

AA.2.4.9 34.5-kV Configuration and Line Loading

Maximum magnetic fields are produced at the maximum conductor currents. The Project's largest cables will carry the maximum currents. For this EMF analyses, the maximum line loading is assumed to be 600 amperes per phase, and the cable is assumed to be 1,000 kcmil Aluminum, with 345 mils of XLPE-TR insulation. The underground trench is assumed to be 48 inches deep and all cables are assumed to be direct buried in a trefoil arrangement.

AA.2.4.10 Calculation Results

Electric Fields: The underground cable construction contains the electric field within the cable insulation so that no electric field is present external to the cables.

Magnetic Fields: Maximum magnetic fields are computed at 1 meter above ground with a program called Corona and Field Effect Program (Version 3) developed by the Bonneville Power Administration.

To estimate maximum fields that might occur, one needs to consider locations where (Case 1) a circuit is remote from other circuits and (Case 2) a circuit parallels other circuits.

Case 1—34.5-kV Underground Cable Remote from Other Circuits

For this case, the distance between the centerline of 34.5-kV circuits and the edge of the right-of-way is undefined because the entire Project is considered right-of-way.

Figure AA-7 illustrates the profile of the resulting magnetic field strength perpendicular to the underground circuit.

Case 2—34.5-kV Underground Circuit Parallel to Other Circuits

For this case, three parallel 34.5-kV circuits are considered. The distance between the centerlines of the 34.5-kV circuits is assumed to be 10 feet to achieve thermal isolation.

Figure AA-8 illustrates the profile of magnetic fields resulting from this construction.

AA.2.4.11 Conclusion

The maximum magnetic field values for the underground 34.5-kV collection system occur for the main feeder circuits (1,000 kcmil cables) where multiple circuits are in proximity to one another. The maximum magnetic field value for the underground circuits occurs approximately 5 feet off of centerline of a multiple circuit run, and will be 33.8 mG.

No electric field is present external to the cable.

AA.2.5 Measures Proposed to Reduce Electric or Magnetic Field Levels

(v) Any measures the applicant proposes to reduce electric or magnetic field levels;

Response: For the 230-kV transmission lines, no measures are proposed to reduce electric or magnetic fields for the following reasons:

- There are no nearby residences closer than 150 feet to the line. At this distance, EMF levels are below industry recognized levels.
- Mitigating construction would increase cost by more than 5 percent.
- EMF levels are not excessive.

For the 500-kV transmission line, reasonable and prudent efforts have been made to reduce electric and magnetic fields of the proposed line. Both triangular and horizontal construction configurations were analyzed. The triangular construction configuration produces the lowest EMF fields.

Further field ground-level reductions are possible only by increasing conductor ground clearances. However, this is impractical for several reasons:

- There are no nearby residences closer than 430 feet to the line. At this distance, EMF levels are extremely low.
- Significantly taller poles will increase construction costs by more than 5 percent.
- EMF levels, as designed, are less than industry recognized levels.

AA.2.6 Assumptions and Methods Used in Electric and Magnetic Field Analyses

(vi) The assumptions and methods used in the electric and magnetic field analysis, including the current in amperes on each proposed transmission line; and

Response: See response *(iv)*. In addition, Attachment AA-1 shows data inputs and assumptions used in the electric and magnetic field analysis. The BPA Corona and Field Effects (Version 3) program was used.

AA.2.7 Monitoring Program

(vii) The applicant's proposed monitoring program, if any, for actual electric and magnetic field levels;

Response: No program for monitoring actual electric and magnetic field levels is proposed at this time.

AA.3 ALTERNATE METHODS

(*B*) *An evaluation of alternate methods and costs of reducing radio interference likely to be caused by the transmission line in the primary reception area near interstate, U.S., and state highways;*

AA.3.1 Radio and TV Interference Generation

Electric transmission lines are designed to be efficient by economically minimizing both resistive-related and corona-related losses. Resistive losses occur in the aluminum conductor (wire) and result in heating losses that are carried away by the air in convective cooling. The resistive losses also radiate away in the infrared electromagnetic frequency spectrum; therefore, resistive losses do not contribute in any way to radio and television reception interference. Radio interference (RI) and television interference (TVI) are caused by transmission line corona.

Transmission line corona is the physical phenomenon of air ionization at the surface of the conductor. When corona is produced, it is heard as snaps, crackles, and pops. Under the line on a dark night, corona might be visible as a glow around the conductor. Corona losses are principally a function of the conductor diameter and the voltage of the transmission line. Transmission line designers have two options to reduce the surface voltage gradient at the conductor surface and thus minimize corona losses: (1) increase the diameter of the conductor or (2) increase the effective diameter by using multiple conductors held apart by spacers.

Because designers take special steps to control corona losses, corona effects and corona losses are primarily a foul weather phenomenon. The small diameters of rain droplets increase voltage gradients and lead to ionization of air in the vicinity of the conductors. Corona causes audible noise, and also generates electromagnetic noise throughout the electromagnetic spectrum. Fortunately, electromagnetic corona noise amplitude and power is inversely proportional to frequency, and is also inversely proportional to the square of distance from the source. This being the case, RI and TVI are confined to the area within a few hundred feet of a high-voltage transmission lines. RI is more likely to be a problem because the power in corona-caused electromagnetic radiation at AM radio frequencies (0.535-1.605 MHz) is much greater than at TV and FM radio frequencies (54-108 MHz). RI or TVI corona noise of all frequencies attenuates with the square of the distance from the conductor; therefore, corona noise dims quickly to insignificance with distance from the centerline of the facility.

AA.3.2 RI and TVI Calculations

The electric utility industry has developed methods for calculating the RI and TVI performance of transmission lines. The most recent, and most comprehensive, summary of corona phenomena, and corona-caused electromagnetic noise analysis methods, are presented in the EPRI (1987). The analysis that follows for the three previously defined circuit configurations uses the Bonneville Power Administration Corona and Field Effects Program, based on the calculation methods set forth in Chapters 4 and 5 of EPRI (1987).

This analysis produces values of RI and TVI that are measured in decibel microvolts/meter. These units are designed to be used in signal-to-noise calculations because RI and TVI pose problems only when the strength is significant compared to the received signal.

AA.3.2.1 Analysis for the 230-kV Overhead Transmission Line

For this radio and TV interference analysis, the nominal line voltage is assumed to be 230 kV, with one conductor per phase of 795-kcmil ACSR “Drake” having a diameter of

1.108 inches. The 12.47-kV underbuild circuit uses one conductor per phase of 4/0 ACSR "Penguin" with a diameter of 0.563 inches.

Figures AA-1 and AA-2 illustrate typical configurations of the proposed 230-kV transmission line structures.

Figure AA-9 (in db microvolts/meter) presents the RI levels to a distance of 200 feet on either side of the centerline of the 230-kV transmission line with 12.47-kV underbuild circuit.

Figure AA-10 (in db microvolts/meter) presents the TVI levels to a distance of 200 feet on either side of the centerline the 230-kV transmission line with 12.47-kV underbuild circuit.

Conclusions for the 230-kV Overhead Transmission Line

The proposed transmission line will generate random corona radiation incidentally, during wet weather, because of raindrops on the wire. The power levels are most detectable on the 230-kV transmission line with the 12.47-kV underbuild circuit, but even with amplified receivers, the thus generated power levels are difficult to detect at any significant distance from the power line.

The 230-kV transmission line proposed for this Project is of conventional design and will have RI and TVI performance typical for the industry. As such, RI and TVI produced by the line will not be a problem or nuisance any more than the typical 230-kV line. For example, southbound travelers on Oregon's I-5 are within 100-200 feet of a BPA 230-kV line for much of the distance between Wilsonville and Salem. This BPA line has a similar voltage and conductor, and apparently has acceptable RI performance. The project transmission lines will be located in central Oregon, which has a much drier climate and thus will have fewer corona-causing conditions than the Willamette Valley example.

Cars traveling near or under the proposed line in foul weather might experience some RI when tuning weak stations. Residential AM radio receivers within 300 feet of the centerline also might detect RI when tuning weak and distant AM stations, especially in bad weather.

This Project will be designed and constructed with conventional transmission line methods, configurations, and materials. These types of 230-kV facilities have traditionally performed well in fair weather, and without unacceptable electromagnetic corona noise generation, even in foul weather. The levels of radio and TV noise calculated here indicate typical values. Therefore, corona is not expected to cause any interference, except in wet weather, and then, only for AM receiver equipment located within a few hundred feet of the centerline.

AA.3.2.2 Analysis for the 500-kV Overhead Transmission Line

For this radio and TV interference analyses, the nominal line voltage is assumed to be 500-kV. The conductor is assumed to be a triple-bundle per phase of 1033-kcmil ACSR "Ortolan" with a diameter of 1.212 inches.

Figure AA-3 illustrates a typical configuration of the proposed 500-kV transmission line structure.

Figure AA-11 (in db microvolts/meter) presents the RI levels to a distance of 200 feet on either side of the centerline.

Figure AA-12 (in db microvolts/meter) presents the TVI levels to a distance of 200 feet on either side of the centerline.

Figure AA-13 (in dba) presents the audible noise levels to a distance of 200 feet on either side of the centerline.

Conclusions for the 500-kV Overhead Transmission Line

The proposed power line will generate random corona radiation incidentally, during wet weather, because of raindrops on the wire. The power levels thus generated will be so low as to be difficult to detect, even with amplified receivers, at any significant distance from the power line.

Ground clearance was increased beyond the NESC minimum so that audible noise from foul-weather corona comply with the Oregon night limit of 50 dba for noise-sensitive receptors at the right-of-way edge (OAR Chapter 340, Division 35, Noise Control Regulations for Industry and Commerce, Table 8).

The 500-kV transmission line proposed for this Project is of conventional design and will have RI and TVI performance typical for the industry. As such, RI and TVI produced by the line will not be a problem or nuisance any more than the typical 500-kV line.

This Project will be designed and constructed with conventional transmission line methods, configurations, and materials. These types of facilities have traditionally performed well in fair weather, and without unacceptable electromagnetic corona noise generation, even in foul weather. The levels of radio and TV noise calculated here indicate typical values. Therefore, corona is not expected to cause any interference, except in wet weather, and then only for AM receiver equipment located within a few hundred feet of the centerline.

AA.4 ALTERNATING CURRENT FIELDS

OAR 345-024-0090(1) *Can design, construct, and operate the proposed transmission line so that alternating current electric fields do not exceed 9 kV per meter at one meter above the ground surface in areas accessible to the public;*

Response: See Figures AA-4E and AA-5E. The electric field on the right-of-way of the proposed 230-kV line does not exceed 2.5 kV per meter. See Figure AA-6E. The electric field on the right-of-way of the proposed 500-kV line does not exceed 7.3 kV per meter.

AA.5 INDUCED CURRENTS

OAR 345-024-0090(2) *Can design, construct, and operate the proposed transmission line so that induced currents resulting from the transmission line and related or supporting facilities will be as low as reasonably achievable;*

AA.5.1 Induced Voltage Phenomena

Voltage is the electrical pressure that pushes current through a conducting wire or object. An animal or object, such as a bird, person, vehicle, or barbed-wire fence that is insulated from ground and in an electric field will possess an induced voltage. A bird flying through the field is safe because the induced voltage cannot make current flow through the bird, unless there is a conducting path for the current. Induced voltage on a metallic object, such as a fence or a large metal roof, can be a hazard only when the object is shorted to ground through a person or animal, allowing a path for significant current to flow. The conductivity of the air around the overhead conductor will determine the upper limit of the current that can flow when the object is shorted to ground.

A common induced voltage hazard occurs on fences that parallel overhead transmission lines. If the fence is ungrounded, it possesses the voltage of the net electric field of the overhead conductors. A person touching such a fence becomes a conducting path for the current and can feel a momentary shock if the available current is sufficient. The AC static voltage on the fence bleeds off quickly but can be annoying or hazardous. This hazard is easily removed by periodically bonding the fence wires to grounding rods driven into the soil, which guarantees that the fence and the pedestrian are at equal potential.

AA.5.2 Induced Current Phenomena

A current-carrying conductor will induce a current to flow in another conductor that is parallel to it. Induced currents result from the net AC magnetic field. In the common case cited in AA.5.1, grounded fences create electrical loops in which induced currents can flow. The value of the induced current depends upon the magnetic field strength, the size, and shape of the conducting object, and the object-to-ground resistance.

AA.5.2.1 Induced Current from the Proposed 230-kV Overhead Transmission Line

As stated in AA.5.1, induced voltage can present a hazard by creating the potential for hazardous current to flow through a person or animal that might contact a metallic object in the electric field. Figures AA-4M, AA-4E, AA-5M, and AA-5E show the electric and magnetic field values computed at right angles to the proposed centerline.
Table AA-1 indicates that the average electric field is at a maximum of 2.4 kV per meter, and using Figure AA-4E the peak is located approximately 15 feet to the left of centerline. This value is significantly lower than the recommended maximum value of 9 kV per meter. Therefore, the potential hazard is much less than it would be at 9 kV per meter.

The 230-kV transmission lines will be designed in accordance with current NESC codes and will thereby provide appropriate grounding of fences that parallel the transmission line. Also, any metal-roofed buildings in proximity to the line will be similarly grounded. This grounding practice is commonly done for transmission lines and will mitigate the shock hazard associated with the induced voltage.

AA.5.2.2 Induced Current from the Proposed 500-kV Overhead Transmission Line

As stated in AA5.1, induced voltages can present a hazard by creating the potential for hazardous currents to flow through a person or animal that might contact a metallic object in the electric field. Figures AA-6M and AA-6E show the electric and magnetic field values computed at right angles to the proposed centerline. Table AA-2 indicates that the average electric field is at its maximum of 7.2 kV per meter at a location approximately 15 feet to the left of centerline. This value is lower than the recommended maximum value of 9 kV per meter. Therefore, the potential hazard is less than it would be at 9 kV per meter.

The 500-kV transmission lines will be designed in accordance with current NESC codes and will thereby provide appropriate grounding of fences that parallel the transmission line. Also, any metal-roofed buildings in proximity to the line will be similarly grounded. This grounding practice is commonly done for transmission lines and will mitigate the shock hazard associated with the induced voltage.

AA.5.2.3 Induced Current from the Proposed 34.5-kV Underground Line

As stated earlier in this response (AA.2.4.10), the underground 34.5-kV cables do not generate electric fields and will not cause a voltage to appear on fences that parallel the underground circuits. Therefore, the grounding of fences in proximity to the underground lines is unnecessary.

As also stated in AA.2.4.10, underground circuits generate only magnetic fields, and these fields pose no shock hazards to people. The 34.5-kV underground lines will be designed in accordance with current NESC codes and will thereby provide mitigation of magnetic fields where required.

AA.6 CONCLUSION

Based on the above information, the Applicant has satisfied the required OAR 345-021-0010(1)(aa), and the Council may find that the standard contained in OAR 345-024-0090 has been satisfied.

AA.7 REFERENCES

EPRI. 1987. Transmission Line Reference Book, 345-kV and Above. Second Edition revised. Publication No. EL-2500, Electric Power Research Institute, Palo Alto, California.

Figures

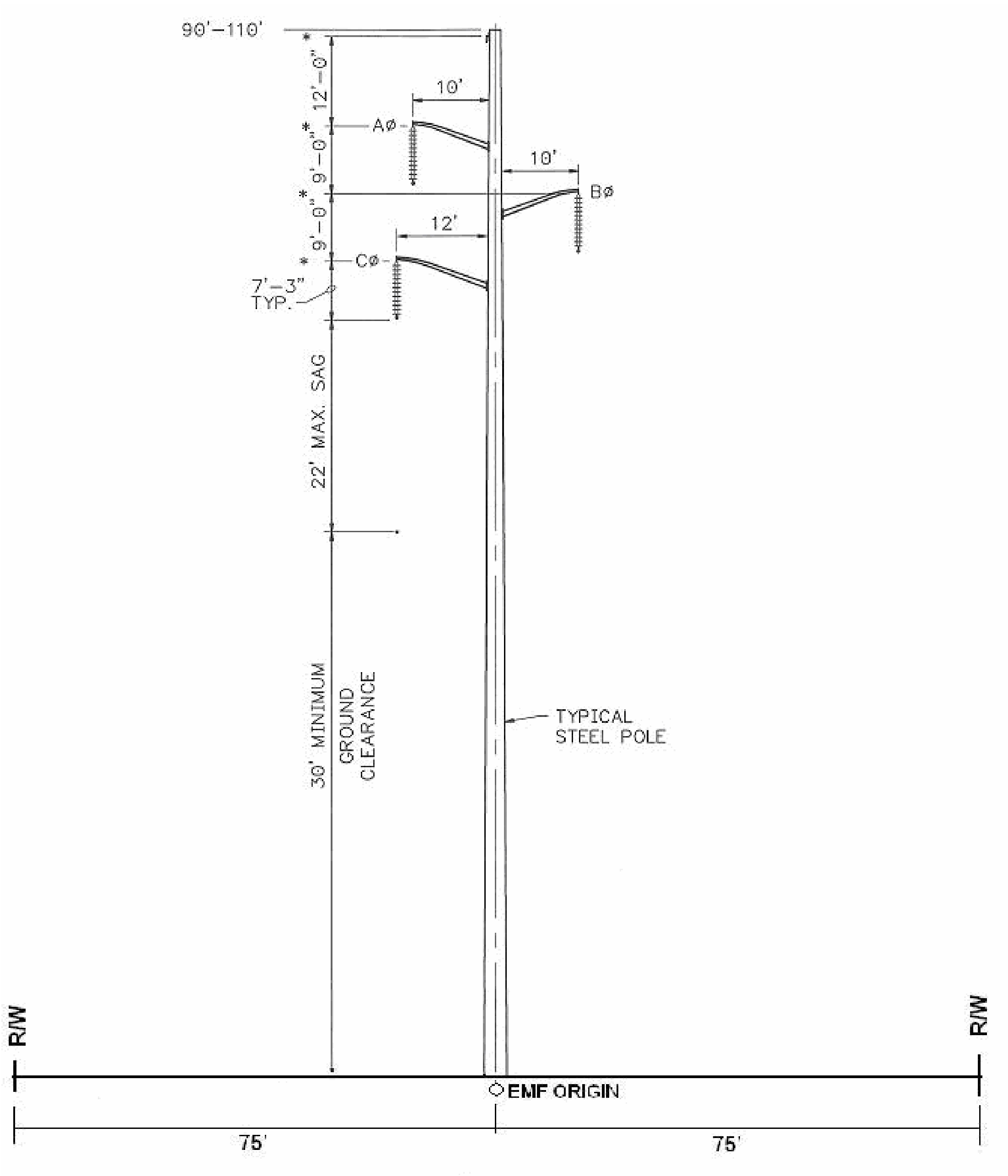

Figure AA-1 Proposed Typical 230-kV Configuration, without 12.47-kV Underbuild Circuit, with OPGW shield wire

600′ Ruling Span, 800′ Maximum

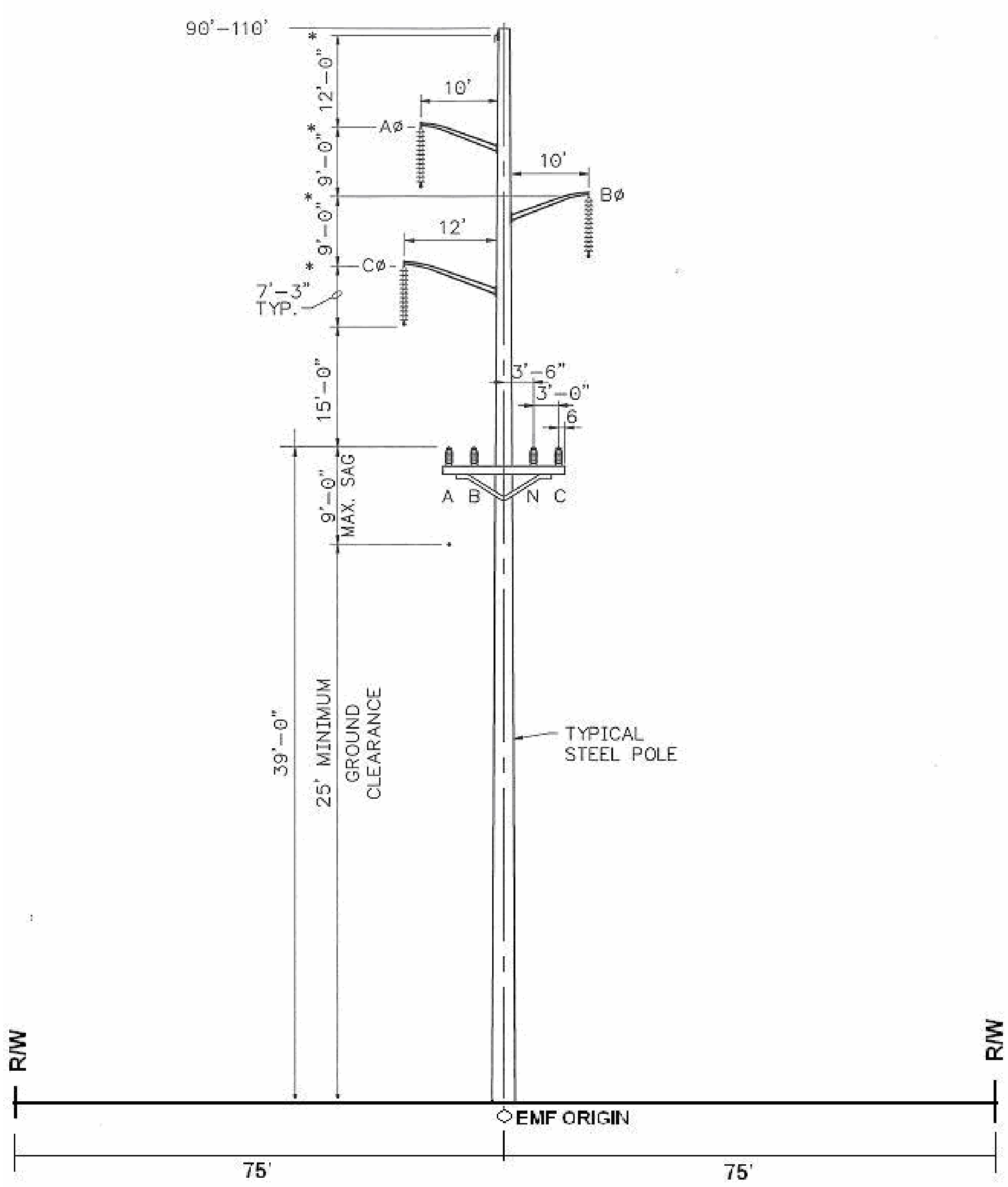

Figure AA-2 Proposed Typical 230-kV Configuration, with 12.47-kV Underbuild Circuit and OPGW Shield Wire

350′ Ruling Span, 400′ Maximum

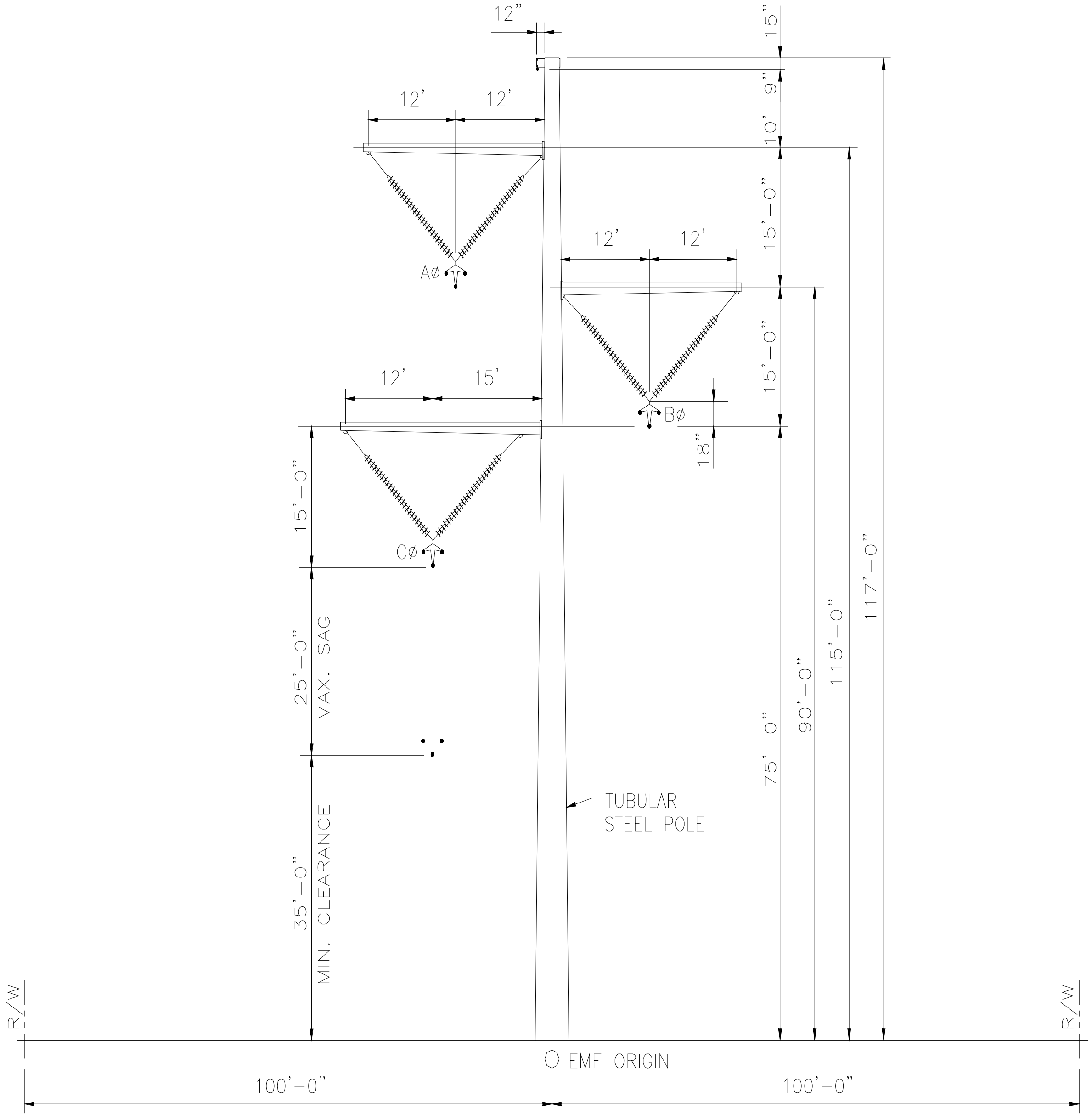

Figure AA-3 Proposed Typical 500-kV Configuration with OPGW Shield Wire

750′ Ruling Span, 800′ Maximum

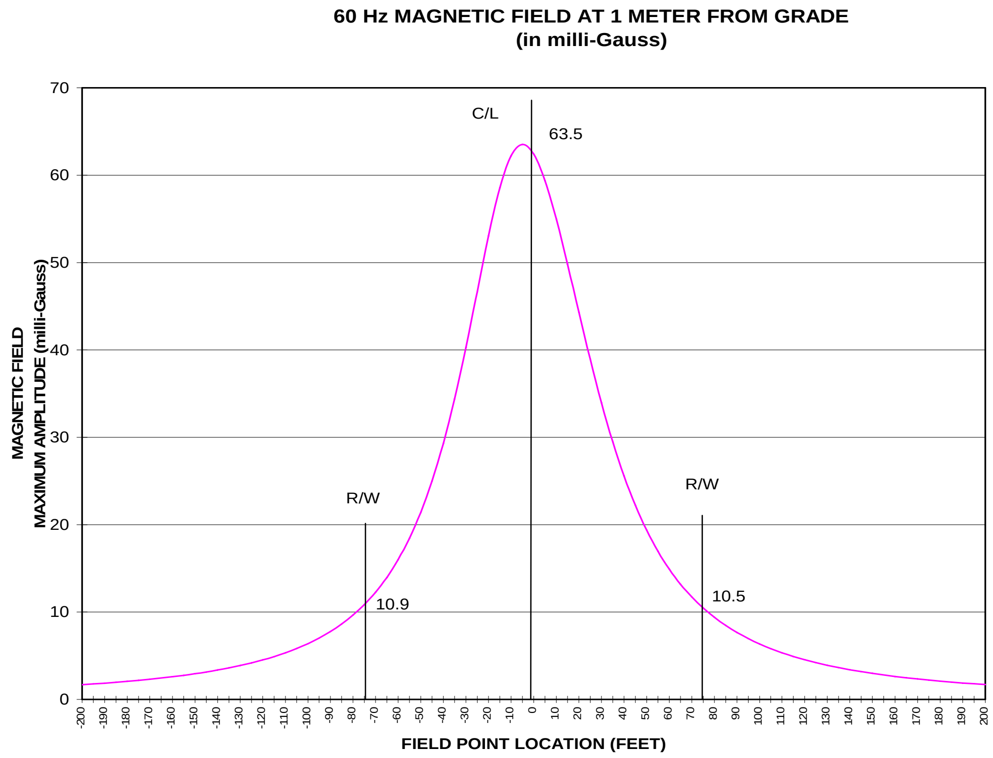

Figure AA-4M Magnetic Field Profile for 230-kV Line without 12.47-kV Underbuild Circuit

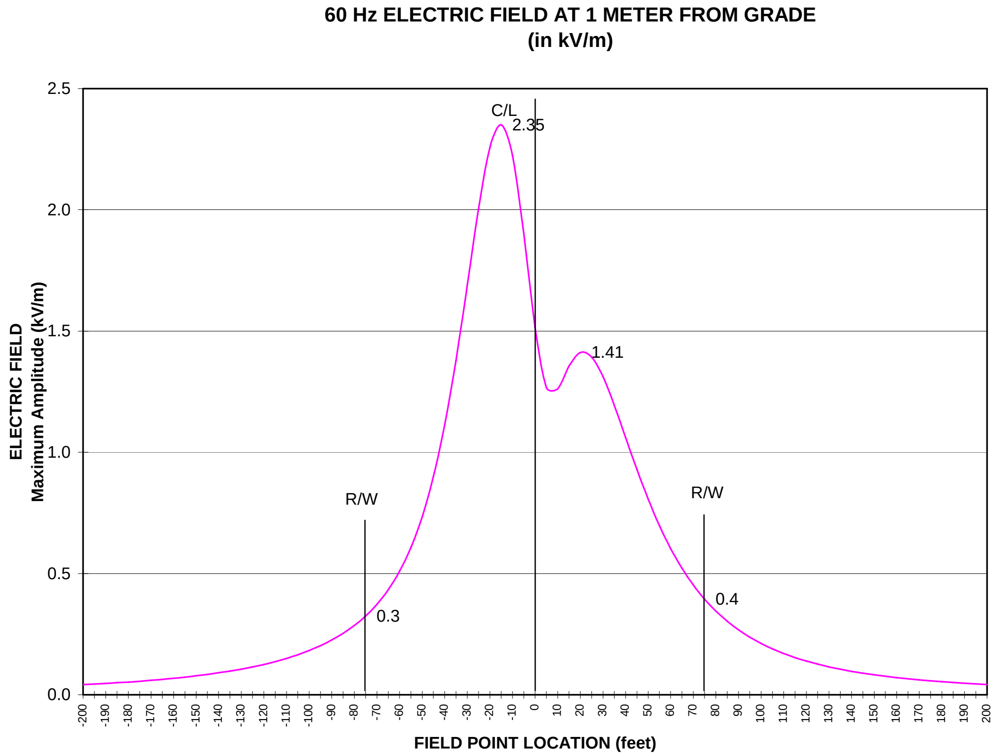

Figure AA-4E Electric Field Profile for 230-kV Line without 12.47-kV Underbuild Circuit

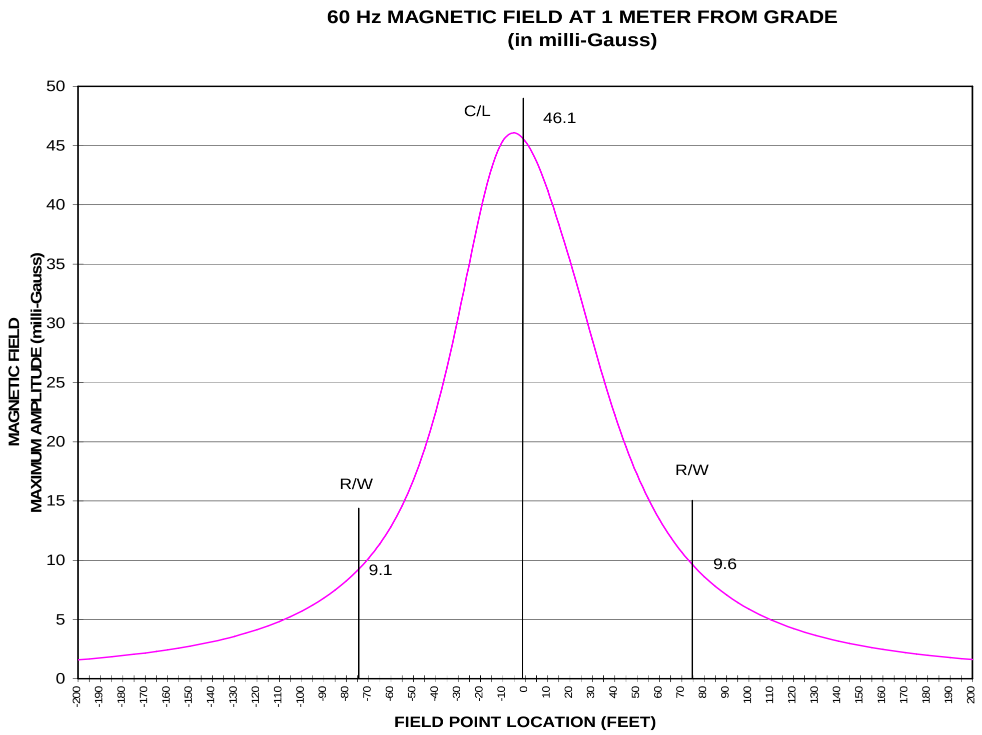

Figure AA-5M Magnetic Field Profile for 230-kV Line with 12.47-kV Circuit

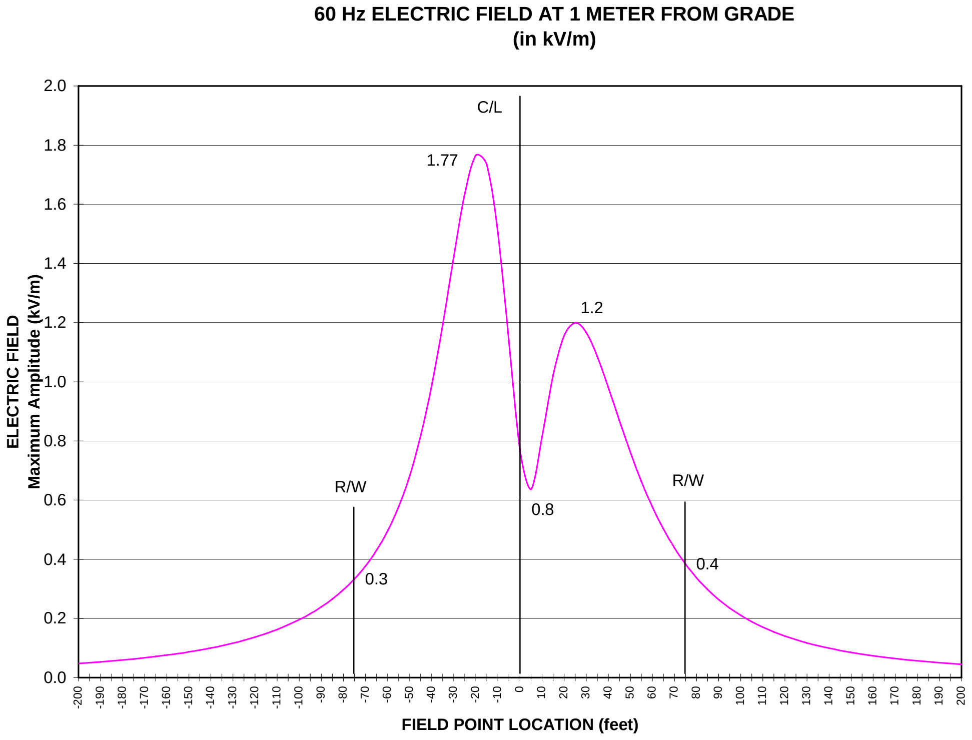

Figure AA-5E Electric Field Profile for 230-kV Line with 12.47-kV Circuit

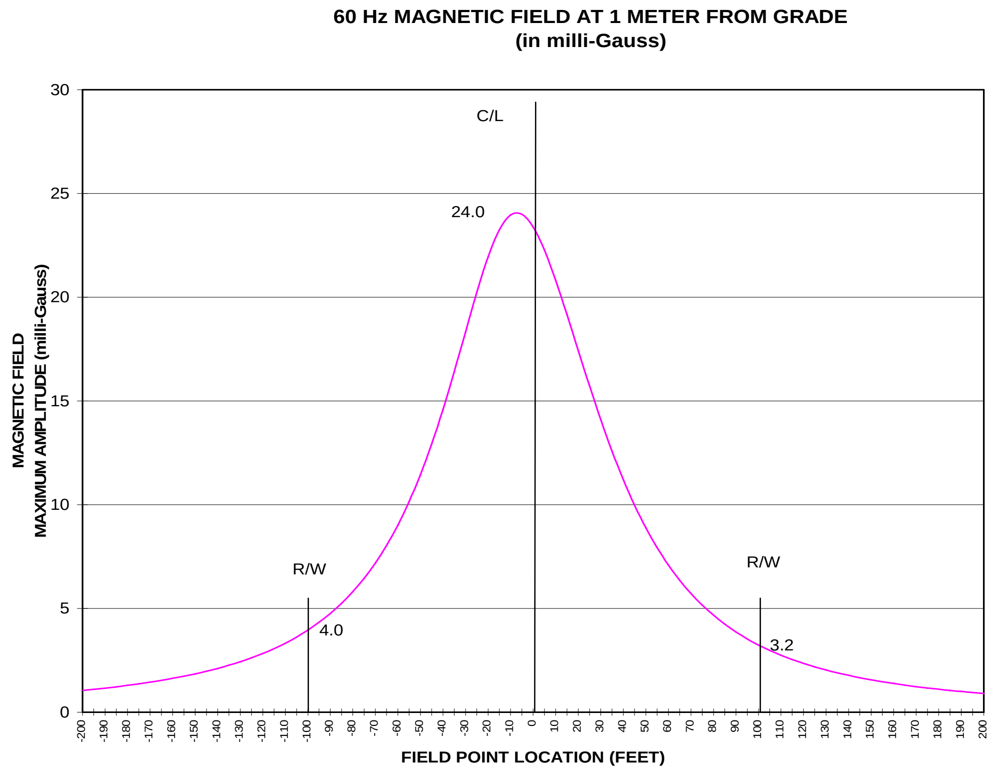

Figure AA-6M Magnetic Field Profile for 500-kV Line with Shield Wire

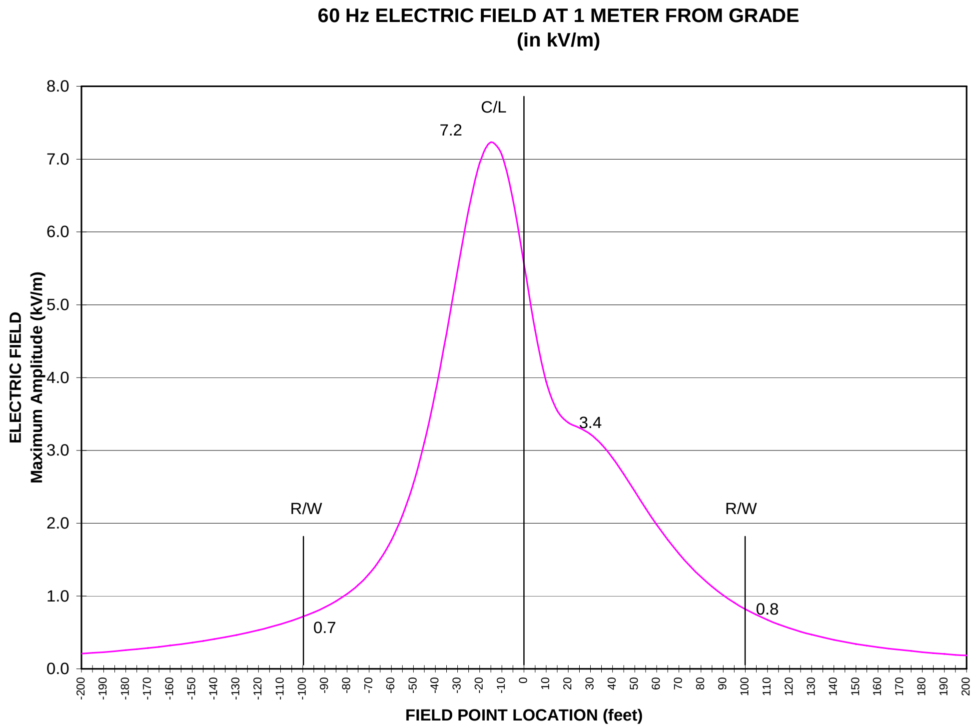

Figure AA-6E Electric Field Profile for 500-kV line with Shield Wire

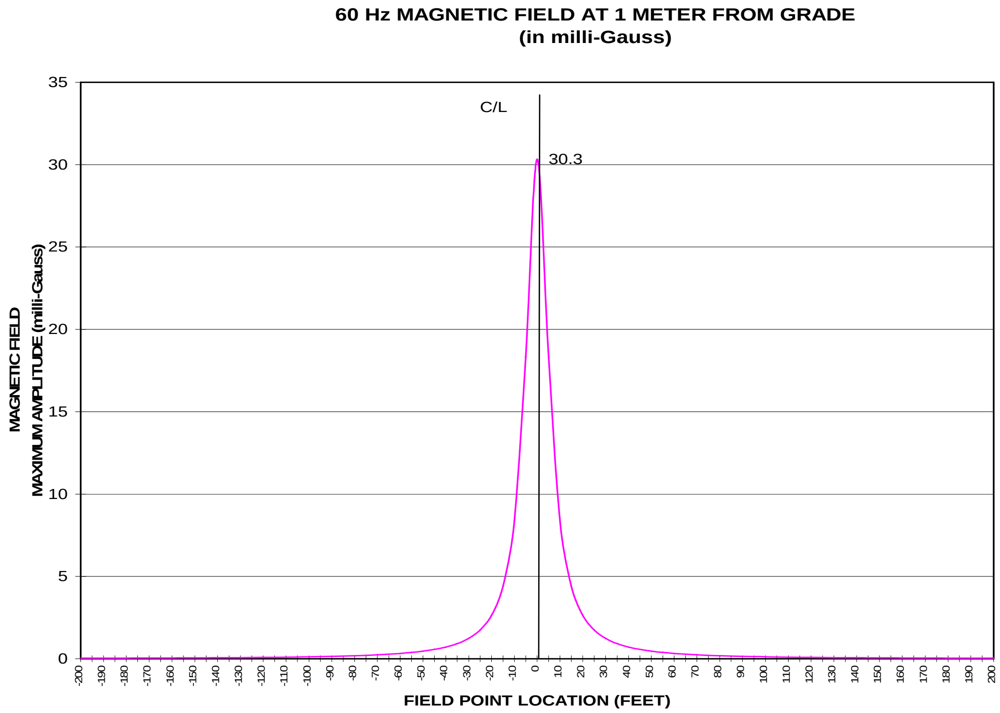

Figure AA-7 Magnetic Field Profile for One 34.5-kV Underground Circuit

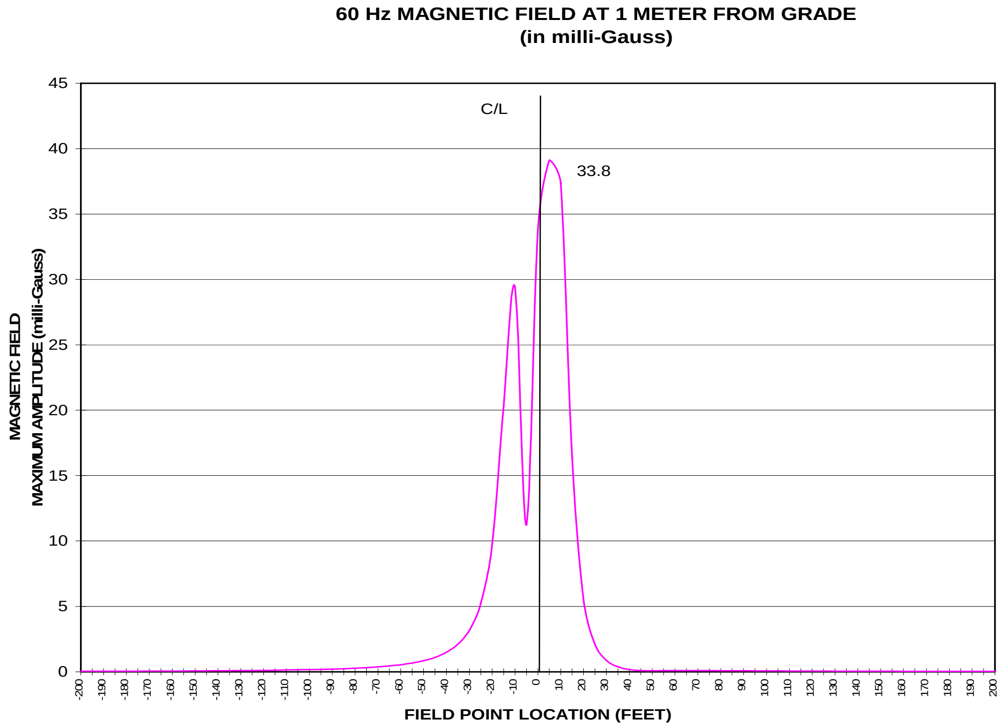

Figure AA-8 Magnetic Field Profile for Three 34.5-kV Underground Parallel Circuits

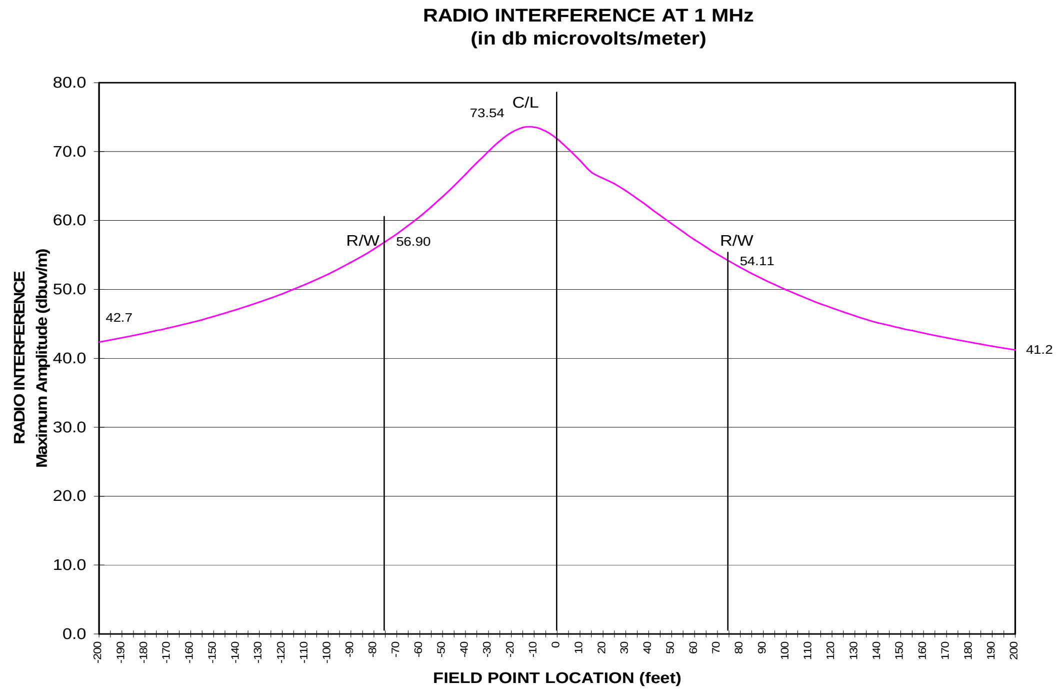

Figure AA-9 Radio Interference Profile for 230-kV Overhead Transmission Line

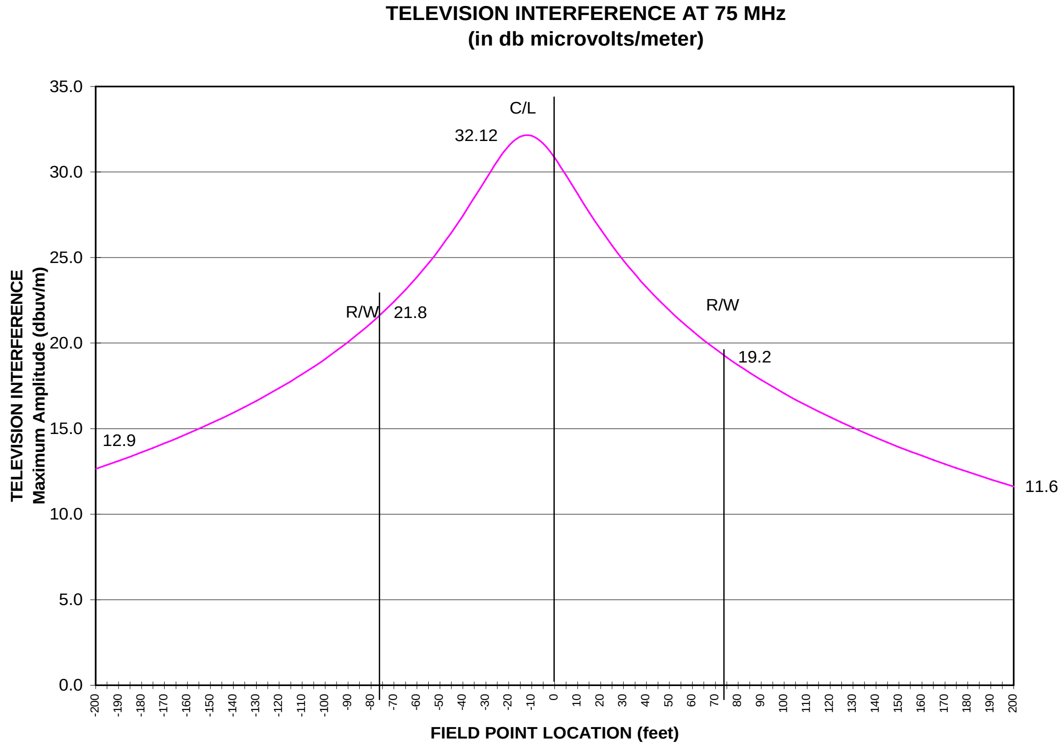

Figure AA-10 Television Interference Profile for 230-kV Overhead Transmission Line

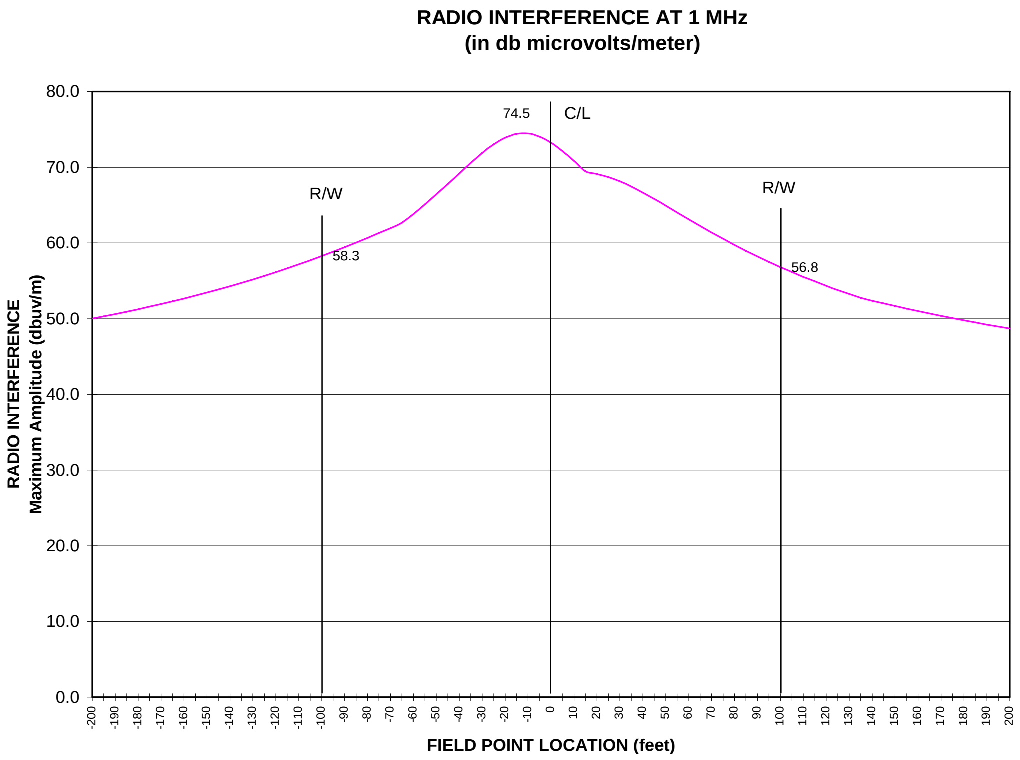

Figure AA-11 Radio Interference Profile for 500-kV Overhead Transmission Line

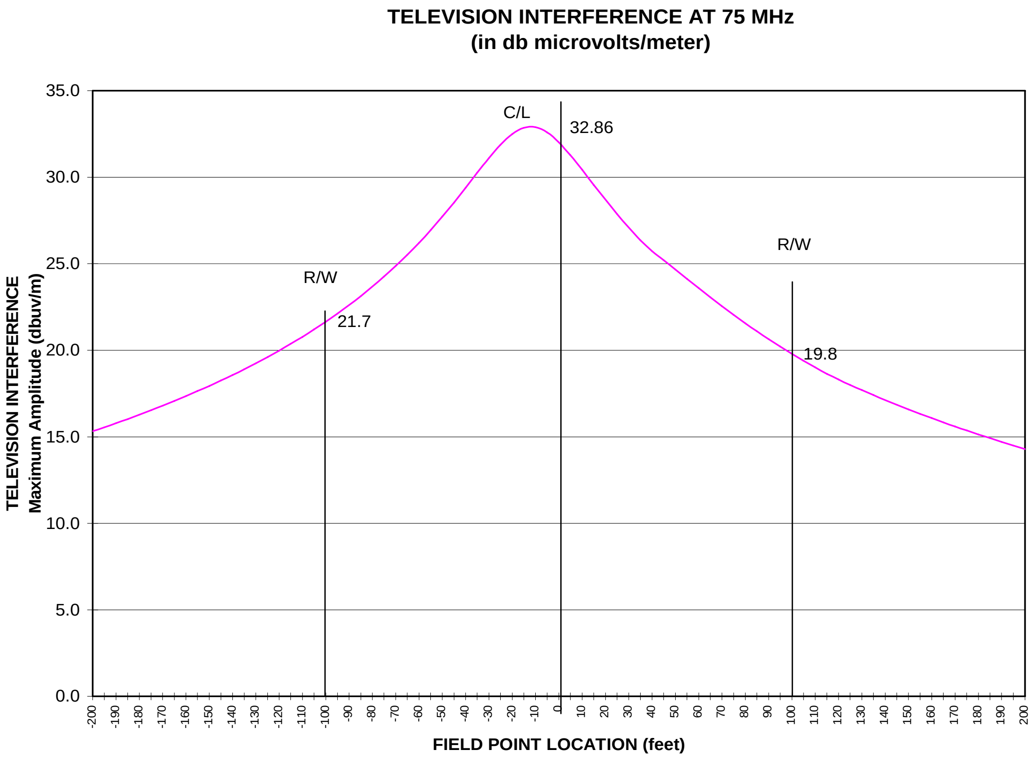

Figure AA-12 Television Interference Profile for 500-kV Overhead Transmission Line

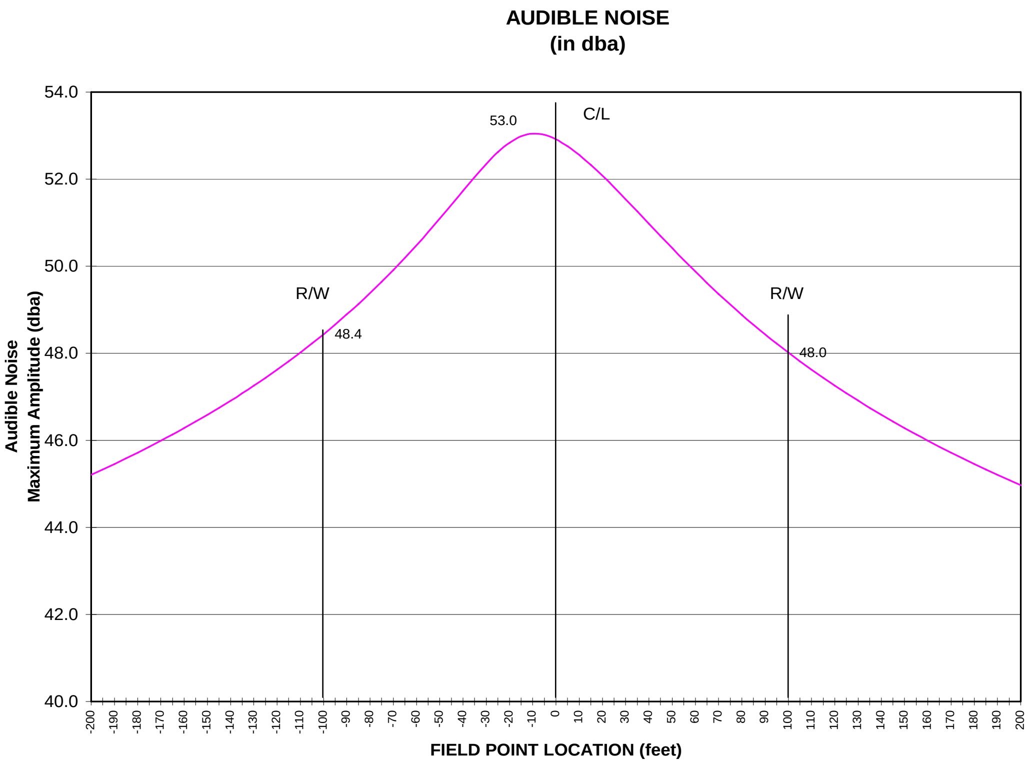

Figure AA-13 Audible Noise Interference Profile for 500-kV Overhead Transmission Line

ATTACHMENT AA-1

AC Electric and Magnetic Field Analysis

```
     ÛßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßÛ
     Û      C O R O N A   A N D   F I E L D      Û
     Û E F F E C T S   P R O G R A M   V E R. 3  Û
     Û   Source: Bonneville Power Administration  Û
     ÛÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÛ



                                INPUT DATA LIST




                  7/10/2007          11:14:59
 ***************** GOLDEN HILLS WIND FARM*************
 FIGURE 1 230-KV SHIELDED 795 KCMIL ACSR DRAKE 200 MVA-502A PER PHASE
 1,0, 3, 4,0.0,   2.00,   1.00,    .00


 (ENGLISH UNITS OPTION)


 (GRADIENTS ARE COMPUTED BY PROGRAM)


 PHYSICAL SYSTEM CONSISTS OF  4 CONDUCTORS, OF WHICH  3 ARE ENERGIZED PHASES


 OPTIONS: 'COMB'
   5.000,  5.000, 10.000,   .000,  1.000, 75.000,  3.280,  2.000,  3.280
 'CIR1-A  ','A',  -10.00,   48.00, 1,   1.108,    .000, 140.000,    .000,    .502,    .000
 'CIR1-B  ','A',   10.00,   39.00, 1,   1.108,    .000, 140.000,-120.000,    .502,    .000
 'CIR1-C  ','A',  -12.00,   30.00, 1,   1.108,    .000, 140.000, 120.000,    .502,    .000
 'SH-1    ','A',   -1.00,   67.00, 1,    .500,    .000,    .000,    .000,    .000,    .000
  41 -200.0    5.0
  40    5.0    5.0
   0     .0     .0
1COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD
 ***************** GOLDEN HILLS WIND FARM*************
 FIGURE 1 230-KV SHIELDED 795 KCMIL ACSR DRAKE 200 MVA-502A PER PHASE





              DIST. FROM             MAXIMUM  SUBCON   NO. OF      SUBCON   VOLTAGE  PHASE    CURRENT  CORONA
           CENTER OF TOWER  HEIGHT   GRADIENT  DIAM.   SUBCON      SPACING    L-N    ANGLE             LOSSES
                (FEET)      (FEET)   (KV/CM)   (IN)                (IN)      (KV)  (DEGREES)  (kAmps)  (KW/MI)


 CIR1-A         -10.00       48.00    16.48     1.11       1         .00    140.00      .00      .50    5.197
 CIR1-B          10.00       39.00    16.06     1.11       1         .00    140.00  -120.00      .50    4.387
 CIR1-C         -12.00       30.00    16.69     1.11       1         .00    140.00   120.00      .50    5.648
 SH-1            -1.00       67.00     2.65      .50       1         .00       .00      .00      .00     .000
 AN MICROPHONE HT.=  5.0 FT, RI ANT. HT.=  5.0 FT, TV ANT. HT.= 10.0 FT, ALTITUDE=      .0 FT
 RI FREQ=  1.000 MHZ, TV FREQ=  75.000 MHZ, WIND VEL.(OZ)= 2.000 MPH, GROUND CONDUCTIVITY =   2.0 MMHOS/M
 E-FIELD TRANSDUCER HT.=  3.3FT, B-FIELD TRANSDUCER HT.=  3.3FT


 LATERAL DIST       AUDIBLE NOISE   RADIO INTERFERENCE        TVI              OZONE
     FROM          (RAIN)   (FAIR)   (RAIN)    (FAIR)         TOTAL       FOR RAIN RATE OF        ELECTRIC     MAGNETIC
   REFERENCE        L50      L50      L50       L50           RAIN    1.00 IN/HR AT 0. FT LEVEL     FIELD       FIELD
    (FEET)          DBA      DBA      DBUV/M   DBUV/M        DBUV/M            PPB                  KV/M        GAUSS
    -200.0          39.7     14.7      43.0     26.0            10.4            .000000               .042      .00169
    -195.0          39.8     14.8      43.3     26.3            10.6            .000000               .045      .00177
    -190.0          40.0     15.0      43.6     26.6            10.9            .000000               .047      .00186
    -185.0          40.1     15.1      44.0     27.0            11.1            .000000               .050      .00196
    -180.0          40.2     15.2      44.3     27.3            11.4            .000000               .053      .00207
    -175.0          40.4     15.4      44.7     27.7            11.6            .000000               .056      .00219
    -170.0          40.5     15.5      45.0     28.0            11.9            .000000               .060      .00231
    -165.0          40.7     15.7      45.4     28.4            12.2            .000000               .064      .00245
    -160.0          40.8     15.8      45.8     28.8            12.4            .000000               .068      .00260
    -155.0          41.0     16.0      46.2     29.2            12.7            .000000               .073      .00277
    -150.0          41.1     16.1      46.7     29.7            13.0            .000000               .078      .00295
    -145.0          41.3     16.3      47.1     30.1            13.4            .000000               .084      .00315
    -140.0          41.5     16.5      47.6     30.6            13.7            .000000               .091      .00337
    -135.0          41.6     16.6      48.0     31.0            14.0            .000000               .098      .00361
    -130.0          41.8     16.8      48.5     31.5            14.4            .000000               .106      .00388
    -125.0          42.0     17.0      49.1     32.1            14.7            .000000               .115      .00418
    -120.0          42.2     17.2      49.6     32.6            15.1            .000000               .125      .00452
    -115.0          42.4     17.4      50.2     33.2            15.5            .000000               .137      .00490
    -110.0          42.6     17.6      50.8     33.8            15.9            .000000               .150      .00533
    -105.0          42.9     17.9      51.4     34.4            16.4            .000000               .165      .00582
    -100.0          43.1     18.1      52.1     35.1            16.8            .000000               .183      .00638
     -95.0          43.3     18.3      52.8     35.8            17.3            .000000               .203      .00703
     -90.0          43.6     18.6      53.5     36.5            17.8            .000000               .226      .00777
     -85.0          43.8     18.8      54.2     37.2            18.4            .000000               .254      .00864
     -80.0          44.1     19.1      55.0     38.0            18.9            .000000               .286      .00966
     -75.0          44.4     19.4      55.9     38.9            19.5            .000000               .326      .01085
     -70.0          44.7     19.7      56.7     39.7            20.2            .000000               .374      .01227
     -65.0          45.0     20.0      57.6     40.6            20.9            .000000               .434      .01396
     -60.0          45.4     20.4      58.5     41.5            21.6            .000000               .509      .01599
     -55.0          45.7     20.7      59.7     42.7            22.4            .000000               .607      .01845
     -50.0          46.1     21.1      61.2     44.2            23.3            .000000               .734      .02141
     -45.0          46.5     21.5      62.8     45.8            24.2            .000000               .899      .02499
     -40.0          46.9     21.9      64.4     47.4            25.2            .000000              1.113      .02930
     -35.0          47.3     22.3      66.1     49.1            26.3            .000000              1.379      .03440
     -30.0          47.6     22.6      67.8     50.8            27.3            .000000              1.688      .04027
     -25.0          48.0     23.0      69.3     52.3            28.4            .000000              2.005      .04667
     -20.0          48.3     23.3      70.5     53.5            29.3            .000000              2.256      .05305
     -15.0          48.5     23.5      71.2     54.2            29.8            .000000              2.351      .05854
     -10.0          48.6     23.6      71.3     54.3            29.9            .000000              2.224      .06223
```

-5.0	48.6	23.6	70.7	53.7	29.4	.000078	1.900	.06352
.0	48.4	23.4	69.6	52.6	28.6	.017142	1.514	.06242
5.0	48.2	23.2	68.1	51.1	27.6	.072063	1.267	.05938
10.0	47.9	22.9	66.4	49.4	26.5	.128221	1.262	.05499
15.0	47.6	22.6	66.2	49.2	25.4	.173321	1.356	.04981
20.0	47.3	22.3	65.6	48.6	24.4	.206830	1.411	.04433
25.0	47.0	22.0	64.8	47.8	23.6	.234492	1.393	.03896
30.0	46.6	21.6	63.8	46.8	23.0	.266582	1.312	.03395
35.0	46.3	21.3	62.7	45.7	22.2	.297081	1.194	.02948
40.0	45.9	20.9	61.5	44.5	21.5	.319252	1.061	.02557
45.0	45.6	20.6	60.3	43.3	20.8	.332315	.930	.02222
50.0	45.2	20.2	59.1	42.1	20.0	.338060	.807	.01937
55.0	44.9	19.9	57.9	40.9	19.3	.338585	.698	.01696
60.0	44.6	19.6	56.7	39.7	18.7	.335605	.604	.01492
65.0	44.3	19.3	55.7	38.7	18.0	.330363	.522	.01319
70.0	44.0	19.0	54.6	37.6	17.4	.323721	.453	.01172
75.0	43.8	18.8	53.6	36.6	16.9	.316265	.395	.01047
80.0	43.5	18.5	52.7	35.7	16.5	.308390	.345	.00939
85.0	43.3	18.3	51.8	34.8	16.0	.300357	.303	.00846
90.0	43.0	18.0	51.0	34.0	15.6	.292340	.268	.00766
95.0	42.8	17.8	50.2	33.2	15.2	.284451	.237	.00696
100.0	42.6	17.6	49.6	32.6	14.8	.276763	.212	.00635
105.0	42.4	17.4	49.1	32.1	14.4	.269318	.189	.00581
110.0	42.2	17.2	48.5	31.5	14.1	.262142	.170	.00534
115.0	42.0	17.0	48.0	31.0	13.8	.255245	.154	.00492
120.0	41.8	16.8	47.6	30.6	13.4	.248631	.139	.00455
125.0	41.6	16.6	47.1	30.1	13.1	.242297	.126	.00421
130.0	41.4	16.4	46.7	29.7	12.8	.236237	.115	.00391
135.0	41.2	16.2	46.2	29.2	12.5	.230440	.106	.00364
140.0	41.1	16.1	45.8	28.8	12.2	.224897	.097	.00340
145.0	40.9	15.9	45.4	28.4	11.9	.219596	.089	.00318
150.0	40.8	15.8	45.0	28.0	11.7	.214526	.083	.00298
155.0	40.6	15.6	44.7	27.7	11.4	.209674	.077	.00280
160.0	40.5	15.5	44.3	27.3	11.2	.205030	.071	.00264
165.0	40.3	15.3	44.0	27.0	10.9	.200582	.066	.00248
170.0	40.2	15.2	43.6	26.6	10.7	.196320	.062	.00234
175.0	40.1	15.1	43.3	26.3	10.4	.192234	.058	.00222
180.0	39.9	14.9	43.0	26.0	10.2	.188314	.054	.00210
185.0	39.8	14.8	42.7	25.7	10.0	.184550	.051	.00199
190.0	39.7	14.7	42.4	25.4	9.8	.180936	.048	.00189
195.0	39.5	14.5	42.1	25.1	9.6	.177462	.045	.00180
200.0	39.4	14.4	41.9	24.9	9.4	.174121	.043	.00171

```
     ÛßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßÛ
     Û       C O R O N A   A N D   F I E L D       Û
     Û E F F E C T S   P R O G R A M   V E R.  3   Û
     Û   Source: Bonneville Power Administration   Û
     ÛÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÛ



                                INPUT DATA LIST



                  7/10/2007          11:16:22
 ****************** GOLDEN HILLS WIND FARM*************
 FIGURE 2 230-KV ACSR DRAKE (200MVA-502A/ph) W/12.47-KV UB
 1,0, 6, 8,0.0,   2.00,   1.00,    .00


 (ENGLISH UNITS OPTION)


 (GRADIENTS ARE COMPUTED BY PROGRAM)


 PHYSICAL SYSTEM CONSISTS OF  8 CONDUCTORS, OF WHICH  6 ARE ENERGIZED PHASES


 OPTIONS: 'COMB'
   5.000,  5.000, 10.000,   .000,  1.000, 75.000,  3.280,  2.000,  3.280
 'CIR1-A  ','A',  -10.00,   48.00, 1,   1.108,    .000, 140.000,    .000,    .502,    .000
 'CIR1-B  ','A',   10.00,   39.00, 1,   1.108,    .000, 140.000,-120.000,    .502,    .000
 'CIR1-C  ','A',  -12.00,   30.00, 1,   1.108,    .000, 140.000, 120.000,    .502,    .000
 'CIR2-A  ','A',   -6.50,   25.00, 1,    .563,    .000,   7.600,    .000,    .232,    .000
 'CIR2-B  ','A',   -3.50,   25.00, 1,    .563,    .000,   7.600,-120.000,    .232,    .000
 'CIR2-C  ','A',    6.50,   25.00, 1,    .563,    .000,   7.600, 120.000,    .232,    .000
 'SH-1    ','A',   -1.00,   67.00, 1,    .500,    .000,    .000,    .000,    .000,    .000
 'CIR2-N  ','A',    3.50,   25.00, 1,    .563,    .000,    .000,    .000,    .000,    .000
  41 -200.0    5.0
  40    5.0    5.0
   0     .0     .0
1COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD
 ****************** GOLDEN HILLS WIND FARM*************
 FIGURE 2 230-KV ACSR DRAKE (200MVA-502A/ph) W/12.47-KV UB




              DIST. FROM             MAXIMUM  SUBCON   NO. OF      SUBCON   VOLTAGE  PHASE    CURRENT  CORONA
           CENTER OF TOWER  HEIGHT   GRADIENT  DIAM.   SUBCON      SPACING    L-N    ANGLE             LOSSES
                (FEET)      (FEET)   (KV/CM)   (IN)                (IN)      (KV)  (DEGREES)  (kAmps)  (KW/MI)


 CIR1-A         -10.00       48.00    16.27     1.11       1         .00    140.00       .00      .50    4.784
 CIR1-B          10.00       39.00    16.20     1.11       1         .00    140.00   -120.00      .50    4.649
 CIR1-C         -12.00       30.00    17.43     1.11       1         .00    140.00    120.00      .50    7.478
 CIR2-A          -6.50       25.00     5.04      .56       1         .00      7.60       .00      .23     .000
 CIR2-B          -3.50       25.00     3.15      .56       1         .00      7.60   -120.00      .23     .000
 CIR2-C           6.50       25.00     3.29      .56       1         .00      7.60    120.00      .23     .000
 SH-1            -1.00       67.00     2.88      .50       1         .00       .00       .00      .00     .000
 CIR2-N           3.50       25.00     1.34      .56       1         .00       .00       .00      .00     .000
 AN MICROPHONE HT.=  5.0 FT, RI ANT. HT.=  5.0 FT, TV ANT. HT.= 10.0 FT, ALTITUDE=      .0 FT
 RI FREQ=  1.000 MHZ, TV FREQ=  75.000 MHZ, WIND VEL.(OZ)= 2.000 MPH, GROUND CONDUCTIVITY =   2.0 MMHOS/M
 E-FIELD TRANSDUCER HT.=  3.3FT, B-FIELD TRANSDUCER HT.=  3.3FT


 LATERAL DIST       AUDIBLE NOISE   RADIO INTERFERENCE        TVI              OZONE
     FROM          (RAIN)   (FAIR)   (RAIN)     (FAIR)         TOTAL        FOR RAIN RATE OF        ELECTRIC     MAGNETIC
   REFERENCE        L50      L50      L50       L50           RAIN    1.00 IN/HR AT 0. FT LEVEL     FIELD       FIELD
    (FEET)          DBA      DBA      DBUV/M   DBUV/M        DBUV/M          PPB                  KV/M         GAUSS
    -200.0          40.7     15.7      42.3     25.3            12.7            .000000               .047      .00159
    -195.0          40.8     15.8      42.7     25.7            12.9            .000000               .050      .00167
    -190.0          41.0     16.0      43.0     26.0            13.1            .000000               .053      .00176
    -185.0          41.1     16.1      43.3     26.3            13.4            .000000               .056      .00185
    -180.0          41.2     16.2      43.7     26.7            13.6            .000000               .059      .00195
    -175.0          41.4     16.4      44.0     27.0            13.9            .000000               .063      .00205
    -170.0          41.5     16.5      44.4     27.4            14.1            .000000               .067      .00217
    -165.0          41.7     16.7      44.8     27.8            14.4            .000000               .071      .00230
    -160.0          41.8     16.8      45.2     28.2            14.7            .000000               .076      .00243
    -155.0          42.0     17.0      45.6     28.6            15.0            .000000               .081      .00258
    -150.0          42.2     17.2      46.1     29.1            15.3            .000000               .087      .00275
    -145.0          42.3     17.3      46.6     29.6            15.6            .000000               .093      .00292
    -140.0          42.5     17.5      47.1     30.1            15.9            .000000               .100      .00312
    -135.0          42.7     17.7      47.6     30.6            16.3            .000000               .108      .00334
    -130.0          42.9     17.9      48.2     31.2            16.6            .000000               .116      .00358
    -125.0          43.1     18.1      48.7     31.7            17.0            .000000               .126      .00384
    -120.0          43.3     18.3      49.4     32.4            17.4            .000000               .137      .00413
    -115.0          43.5     18.5      50.0     33.0            17.8            .000000               .149      .00446
    -110.0          43.7     18.7      50.7     33.7            18.2            .000000               .162      .00483
    -105.0          43.9     18.9      51.4     34.4            18.6            .000000               .178      .00524
    -100.0          44.1     19.1      52.2     35.2            19.1            .000000               .196      .00570
     -95.0          44.4     19.4      53.0     36.0            19.6            .000000               .216      .00622
     -90.0          44.7     19.7      53.9     36.9            20.1            .000000               .239      .00681
     -85.0          44.9     19.9      54.8     37.8            20.6            .000000               .266      .00748
     -80.0          45.2     20.2      55.8     38.8            21.2            .000000               .297      .00825
     -75.0          45.5     20.5      56.9     39.9            21.8            .000000               .333      .00914
     -70.0          45.8     20.8      58.0     41.0            22.4            .000000               .377      .01017
     -65.0          46.2     21.2      59.3     42.3            23.1            .000000               .430      .01138
     -60.0          46.5     21.5      60.6     43.6            23.9            .000000               .496      .01283
     -55.0          46.9     21.9      62.0     45.0            24.7            .000000               .578      .01460
     -50.0          47.3     22.3      63.4     46.4            25.5            .000000               .682      .01677
```

-45.0	47.7	22.7	65.0	48.0	26.5	.000000	.816	.01940
-40.0	48.1	23.1	66.7	49.7	27.4	.000000	.985	.02255
-35.0	48.5	23.5	68.4	51.4	28.5	.000000	1.192	.02626
-30.0	48.9	23.9	70.0	53.0	29.6	.000000	1.421	.03049
-25.0	49.3	24.3	71.5	54.5	30.6	.000000	1.636	.03503
-20.0	49.6	24.6	72.8	55.8	31.5	.000000	1.766	.03945
-15.0	49.8	24.8	73.5	56.5	32.1	.000000	1.733	.04311
-10.0	49.9	24.9	73.5	56.5	32.1	.000000	1.504	.04541
-5.0	49.9	24.9	72.9	55.9	31.7	.000112	1.135	.04608
.0	49.7	24.7	71.8	54.8	30.8	.024740	.768	.04536
5.0	49.4	24.4	70.3	53.3	29.8	.103769	.636	.04367
10.0	49.1	24.1	68.7	51.7	28.7	.181728	.814	.04123
15.0	48.8	23.8	67.0	50.0	27.7	.239062	1.021	.03837
20.0	48.4	23.4	66.1	49.1	26.6	.277453	1.156	.03530
25.0	48.0	23.0	65.3	48.3	25.7	.306156	1.199	.03201
30.0	47.7	22.7	64.3	47.3	24.8	.338180	1.167	.02861
35.0	47.3	22.3	63.2	46.2	24.0	.368019	1.085	.02532
40.0	46.9	21.9	62.0	45.0	23.3	.388866	.980	.02229
45.0	46.6	21.6	60.7	43.7	22.6	.400070	.869	.01959
50.0	46.2	21.2	59.5	42.5	21.9	.403629	.761	.01723
55.0	45.9	20.9	58.4	41.4	21.3	.401818	.664	.01520
60.0	45.6	20.6	57.2	40.2	20.7	.396470	.577	.01345
65.0	45.3	20.3	56.1	39.1	20.2	.388902	.502	.01195
70.0	45.0	20.0	55.1	38.1	19.7	.380020	.438	.01067
75.0	44.7	19.7	54.1	37.1	19.2	.370431	.384	.00956
80.0	44.5	19.5	53.2	36.2	18.7	.360539	.337	.00861
85.0	44.2	19.2	52.3	35.3	18.3	.350608	.297	.00778
90.0	44.0	19.0	51.5	34.5	17.8	.340808	.264	.00706
95.0	43.8	18.8	50.7	33.7	17.4	.331246	.235	.00643
100.0	43.5	18.5	49.9	32.9	17.1	.321987	.210	.00588
105.0	43.3	18.3	49.2	32.2	16.7	.313069	.189	.00539
110.0	43.1	18.1	48.5	31.5	16.3	.304510	.170	.00496
115.0	42.9	17.9	47.9	30.9	16.0	.296313	.154	.00458
120.0	42.7	17.7	47.3	30.3	15.7	.288476	.140	.00423
125.0	42.6	17.6	46.7	29.7	15.4	.280989	.128	.00393
130.0	42.4	17.4	46.2	29.2	15.1	.273841	.117	.00365
135.0	42.2	17.2	45.6	28.6	14.8	.267018	.108	.00340
140.0	42.0	17.0	45.1	28.1	14.5	.260503	.099	.00318
145.0	41.9	16.9	44.8	27.8	14.2	.254282	.092	.00298
150.0	41.7	16.7	44.4	27.4	13.9	.248340	.085	.00279
155.0	41.6	16.6	44.0	27.0	13.7	.242661	.079	.00263
160.0	41.4	16.4	43.7	26.7	13.4	.237230	.074	.00247
165.0	41.3	16.3	43.3	26.3	13.2	.232033	.069	.00233
170.0	41.2	16.2	43.0	26.0	12.9	.227058	.064	.00220
175.0	41.0	16.0	42.7	25.7	12.7	.222292	.060	.00208
180.0	40.9	15.9	42.3	25.3	12.5	.217722	.057	.00197
185.0	40.8	15.8	42.0	25.0	12.2	.213339	.053	.00187
190.0	40.6	15.6	41.8	24.8	12.0	.209131	.050	.00178
195.0	40.5	15.5	41.5	24.5	11.8	.205088	.048	.00169
200.0	40.4	15.4	41.2	24.2	11.6	.201203	.045	.00161

```
     ÛßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßÛ
     Û       C O R O N A   A N D   F I E L D       Û
     Û E F F E C T S   P R O G R A M   V E R.  3   Û
     Û   Source: Bonneville Power Administration   Û
     ÛÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÛ



                               INPUT DATA LIST



                  7/10/2007          14:09:03
 ***************** GOLDEN HILLS WIND FARM*************
 FIGURE 3 500-KV SHIELDED 1033 KCMIL ACSR ORTOLAN 200 MVA-231A/PHASE
 1,0, 3, 4,0.0,   2.00,   1.00,    .00


 (ENGLISH UNITS OPTION)


 (GRADIENTS ARE COMPUTED BY PROGRAM)


 PHYSICAL SYSTEM CONSISTS OF  4 CONDUCTORS, OF WHICH  3 ARE ENERGIZED PHASES


 OPTIONS: 'COMB'
   5.000,  5.000, 10.000,   .000,  1.000, 75.000,  3.280,  2.000,  3.280
 'CIR1-A  ','A',  -12.00,   65.00, 3,   1.212,  18.000, 290.000,    .000,    .231,    .000
 'CIR1-B  ','A',   12.00,   50.00, 3,   1.212,  18.000, 290.000,-120.000,    .231,    .000
 'CIR1-C  ','A',  -12.00,   35.00, 3,   1.212,  18.000, 290.000, 120.000,    .231,    .000
 'SH-1    ','A',   -1.00,   76.00, 1,    .500,    .000,    .000,    .000,    .000,    .000
  41 -200.0    5.0
  40    5.0    5.0
   0     .0     .0
1COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD
 ***************** GOLDEN HILLS WIND FARM*************
 FIGURE 3 500-KV SHIELDED 1033 KCMIL ACSR ORTOLAN 200 MVA-231A/PHASE




              DIST. FROM             MAXIMUM  SUBCON   NO. OF      SUBCON   VOLTAGE  PHASE    CURRENT  CORONA
           CENTER OF TOWER  HEIGHT   GRADIENT  DIAM.   SUBCON      SPACING    L-N    ANGLE             LOSSES
                (FEET)      (FEET)   (KV/CM)   (IN)                (IN)      (KV)  (DEGREES)  (kAmps)  (KW/MI)


 CIR1-A         -12.00       65.00    17.45     1.21       3       18.00    290.00      .00      .23   44.956
 CIR1-B          12.00       50.00    17.35     1.21       3       18.00    290.00  -120.00      .23   43.361
 CIR1-C         -12.00       35.00    17.82     1.21       3       18.00    290.00   120.00      .23   51.467
 SH-1            -1.00       76.00    13.34      .50       1         .00       .00      .00      .00     .000
 AN MICROPHONE HT.=  5.0 FT, RI ANT. HT.=  5.0 FT, TV ANT. HT.= 10.0 FT, ALTITUDE=      .0 FT
 RI FREQ=  1.000 MHZ, TV FREQ=  75.000 MHZ, WIND VEL.(OZ)= 2.000 MPH, GROUND CONDUCTIVITY =   2.0 MMHOS/M
 E-FIELD TRANSDUCER HT.=  3.3FT, B-FIELD TRANSDUCER HT.=  3.3FT


 LATERAL DIST       AUDIBLE NOISE   RADIO INTERFERENCE        TVI              OZONE
     FROM          (RAIN)   (FAIR)   (RAIN)    (FAIR)         TOTAL        FOR RAIN RATE OF        ELECTRIC     MAGNETIC
   REFERENCE        L50      L50      L50       L50           RAIN    1.00 IN/HR AT 0. FT LEVEL     FIELD       FIELD
    (FEET)          DBA      DBA      DBUV/M   DBUV/M        DBUV/M             PPB                  KV/M        GAUSS
    -200.0          45.2     20.2      50.0     33.0            15.3            .000000               .209      .00105
    -195.0          45.3     20.3      50.3     33.3            15.5            .000000               .219      .00110
    -190.0          45.5     20.5      50.6     33.6            15.8            .000000               .231      .00116
    -185.0          45.6     20.6      50.9     33.9            16.0            .000000               .243      .00122
    -180.0          45.7     20.7      51.3     34.3            16.3            .000000               .256      .00129
    -175.0          45.9     20.9      51.6     34.6            16.5            .000000               .270      .00136
    -170.0          46.0     21.0      51.9     34.9            16.8            .000000               .286      .00144
    -165.0          46.1     21.1      52.3     35.3            17.1            .000000               .302      .00153
    -160.0          46.3     21.3      52.7     35.7            17.4            .000000               .320      .00163
    -155.0          46.4     21.4      53.1     36.1            17.6            .000000               .339      .00173
    -150.0          46.6     21.6      53.5     36.5            17.9            .000000               .360      .00185
    -145.0          46.7     21.7      53.9     36.9            18.3            .000000               .383      .00197
    -140.0          46.9     21.9      54.3     37.3            18.6            .000000               .408      .00211
    -135.0          47.1     22.1      54.7     37.7            18.9            .000000               .435      .00226
    -130.0          47.3     22.3      55.2     38.2            19.3            .000000               .464      .00243
    -125.0          47.4     22.4      55.7     38.7            19.6            .000000               .496      .00262
    -120.0          47.6     22.6      56.1     39.1            20.0            .000000               .531      .00283
    -115.0          47.8     22.8      56.7     39.7            20.4            .000000               .570      .00306
    -110.0          48.0     23.0      57.2     40.2            20.8            .000000               .613      .00332
    -105.0          48.2     23.2      57.7     40.7            21.2            .000000               .661      .00362
    -100.0          48.4     23.4      58.3     41.3            21.7            .000000               .715      .00395
     -95.0          48.7     23.7      58.9     41.9            22.1            .000000               .776      .00433
     -90.0          48.9     23.9      59.5     42.5            22.6            .000000               .846      .00476
     -85.0          49.1     24.1      60.1     43.1            23.1            .000000               .929      .00525
     -80.0          49.4     24.4      60.7     43.7            23.7            .000000              1.028      .00580
     -75.0          49.6     24.6      61.3     44.3            24.3            .000000              1.151      .00645
     -70.0          49.9     24.9      62.0     45.0            24.9            .000000              1.306      .00718
     -65.0          50.2     25.2      62.7     45.7            25.5            .000000              1.505      .00803
     -60.0          50.5     25.5      63.9     46.9            26.2            .000000              1.766      .00901
     -55.0          50.8     25.8      65.1     48.1            26.9            .000000              2.106      .01014
     -50.0          51.1     26.1      66.4     49.4            27.7            .000000              2.548      .01144
     -45.0          51.4     26.4      67.8     50.8            28.5            .000000              3.110      .01292
     -40.0          51.7     26.7      69.2     52.2            29.4            .000000              3.800      .01458
     -35.0          52.0     27.0      70.6     53.6            30.3            .000000              4.605      .01640
     -30.0          52.4     27.4      71.9     54.9            31.1            .000000              5.474      .01832
     -25.0          52.6     27.6      73.0     56.0            31.9            .000000              6.305      .02022
     -20.0          52.8     27.8      73.9     56.9            32.5            .000000              6.945      .02194
     -15.0          53.0     28.0      74.4     57.4            32.9            .000000              7.230      .02324
     -10.0          53.0     28.0      74.5     57.5            32.9            .000000              7.055      .02396
```

-5.0	53.0	28.0	74.1	57.1	32.6	.000004	6.444	.02399
.0	52.9	27.9	73.2	56.2	32.0	.009474	5.562	.02338
5.0	52.8	27.8	72.1	55.1	31.3	.077273	4.654	.02227
10.0	52.6	27.6	70.9	53.9	30.4	.177265	3.946	.02081
15.0	52.3	27.3	69.5	52.5	29.6	.264350	3.546	.01916
20.0	52.1	27.1	69.1	52.1	28.7	.330286	3.383	.01744
25.0	51.8	26.8	68.7	51.7	27.9	.379041	3.309	.01573
30.0	51.5	26.5	68.1	51.1	27.1	.418372	3.221	.01410
35.0	51.3	26.3	67.4	50.4	26.4	.461802	3.083	.01258
40.0	51.0	26.0	66.7	49.7	25.7	.510807	2.896	.01121
45.0	50.7	25.7	65.8	48.8	25.2	.557183	2.675	.00998
50.0	50.4	25.4	64.9	47.9	24.7	.594943	2.440	.00888
55.0	50.1	25.1	64.0	47.0	24.1	.622370	2.205	.00793
60.0	49.9	24.9	63.1	46.1	23.6	.640213	1.981	.00709
65.0	49.6	24.6	62.3	45.3	23.1	.650112	1.772	.00635
70.0	49.4	24.4	61.4	44.4	22.5	.653802	1.583	.00571
75.0	49.1	24.1	60.6	43.6	22.0	.652805	1.413	.00516
80.0	48.9	23.9	59.7	42.7	21.6	.648353	1.262	.00467
85.0	48.7	23.7	59.0	42.0	21.1	.641407	1.129	.00424
90.0	48.4	23.4	58.2	41.2	20.6	.632697	1.013	.00386
95.0	48.2	23.2	57.5	40.5	20.2	.622777	.910	.00353
100.0	48.0	23.0	56.8	39.8	19.8	.612059	.821	.00324
105.0	47.8	22.8	56.2	39.2	19.4	.600851	.742	.00298
110.0	47.6	22.6	55.5	38.5	19.0	.589382	.673	.00274
115.0	47.4	22.4	54.9	37.9	18.6	.577821	.612	.00254
120.0	47.3	22.3	54.4	37.4	18.3	.566290	.558	.00235
125.0	47.1	22.1	53.8	36.8	18.0	.554881	.511	.00218
130.0	46.9	21.9	53.3	36.3	17.7	.543657	.469	.00203
135.0	46.7	21.7	52.8	35.8	17.4	.532665	.432	.00190
140.0	46.6	21.6	52.4	35.4	17.1	.521935	.399	.00177
145.0	46.4	21.4	52.0	35.0	16.9	.511488	.369	.00166
150.0	46.3	21.3	51.7	34.7	16.6	.501336	.343	.00156
155.0	46.1	21.1	51.3	34.3	16.3	.491485	.319	.00147
160.0	46.0	21.0	51.0	34.0	16.1	.481936	.297	.00138
165.0	45.9	20.9	50.7	33.7	15.8	.472687	.278	.00130
170.0	45.7	20.7	50.4	33.4	15.6	.463734	.260	.00123
175.0	45.6	20.6	50.1	33.1	15.4	.455071	.244	.00116
180.0	45.5	20.5	49.8	32.8	15.1	.446691	.230	.00110
185.0	45.3	20.3	49.5	32.5	14.9	.438584	.217	.00105
190.0	45.2	20.2	49.2	32.2	14.7	.430743	.204	.00099
195.0	45.1	20.1	49.0	32.0	14.5	.423158	.193	.00095
200.0	45.0	20.0	48.7	31.7	14.3	.415820	.183	.00090

```
     ÛßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßÛ
     Û       C O R O N A   A N D   F I E L D       Û
     Û E F F E C T S   P R O G R A M   V E R.  3   Û
     Û   Source: Bonneville Power Administration   Û
     ÛÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÛ

                                INPUT DATA LIST


                  9/23/2005          12:23:39
 ****************** GOLDEN HILLS WIND FARM *************
 FIGURE AA-7 34.5-KV UNDERGROUND,1000KCMIL 600A, 4"spacings,48" DEEP
 1,0, 3, 3,0.0,   2.00,   1.00,    .00

 (ENGLISH UNITS OPTION)

 (GRADIENTS ARE COMPUTED BY PROGRAM)

 PHYSICAL SYSTEM CONSISTS OF  3 CONDUCTORS, OF WHICH  3 ARE ENERGIZED PHASES

 OPTIONS: 'COMB'
   5.000,  5.000, 10.000,   .000,  1.000, 75.000,  6.280,  2.000,  6.280
 'CIR1-A  ','A',    -.17,     .10, 1,   1.170,    .000,  21.920,    .000,    .600,    .000
 'CIR1-B  ','A',     .00,     .10, 1,   1.170,    .000,  21.920,-120.000,    .600,    .000
 'CIR1-C  ','A',     .17,     .10, 1,   1.170,    .000,  21.920, 120.000,    .600,    .000
  41 -200.0    5.0
  40    5.0    5.0
   0     .0     .0
1COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD
 ****************** GOLDEN HILLS WIND FARM *************
 FIGURE AA-7 34.5-KV UNDERGROUND,1000KCMIL 600A, 4"spacings,38" DEEP


              DIST. FROM             MAXIMUM  SUBCON   NO. OF      SUBCON   VOLTAGE  PHASE    CURRENT  CORONA
           CENTER OF TOWER  HEIGHT   GRADIENT  DIAM.   SUBCON      SPACING    L-N    ANGLE             LOSSES
                (FEET)      (FEET)   (KV/CM)   (IN)                (IN)      (KV)  (DEGREES)  (kAmps)  (KW/MI)

 CIR1-A            -.17         .10    13.68     1.17       1         .00     21.92      .00      .60    1.929
 CIR1-B             .00         .10    16.12     1.17       1         .00     21.92  -120.00      .60    5.600
 CIR1-C             .17         .10    13.68     1.17       1         .00     21.92   120.00      .60    1.929
 AN MICROPHONE HT.=  5.0 FT, RI ANT. HT.=  5.0 FT, TV ANT. HT.= 10.0 FT, ALTITUDE=      .0 FT
 RI FREQ=  1.000 MHZ, TV FREQ=  75.000 MHZ, WIND VEL.(OZ)= 2.000 MPH, GROUND CONDUCTIVITY =   2.0 MMHOS/M
 E-FIELD TRANSDUCER HT.=  6.3FT, B-FIELD TRANSDUCER HT.=  6.3FT

 LATERAL DIST       AUDIBLE NOISE   RADIO INTERFERENCE        TVI              OZONE
     FROM          (RAIN)   (FAIR)   (RAIN)    (FAIR)         TOTAL        FOR RAIN RATE OF        ELECTRIC     MAGNETIC
   REFERENCE        L50      L50      L50       L50           RAIN    1.00 IN/HR AT 0. FT LEVEL     FIELD       FIELD
    (FEET)          DBA      DBA      DBUV/M   DBUV/M        DBUV/M             PPB                  KV/M        GAUSS
    -200.0          36.2     11.2     -11.1    -28.1            9.0            .000000               .000      .00003
    -195.0          36.4     11.4     -10.8    -27.8            9.5            .000000               .000      .00003
    -190.0          36.5     11.5     -10.5    -27.5            9.9            .000000               .000      .00003
    -185.0          36.6     11.6     -10.2    -27.2           10.4            .000000               .000      .00003
    -180.0          36.8     11.8      -9.8    -26.8           10.9            .000000               .000      .00004
    -175.0          36.9     11.9      -9.5    -26.5           11.3            .000000               .000      .00004
    -170.0          37.0     12.0      -9.1    -26.1           11.8            .000000               .000      .00004
    -165.0          37.2     12.2      -8.7    -25.7           12.4            .000000               .000      .00004
    -160.0          37.3     12.3      -8.3    -25.3           12.9            .000000               .000      .00005
    -155.0          37.5     12.5      -7.9    -24.9           13.4            .000000               .000      .00005
    -150.0          37.7     12.7      -7.5    -24.5           14.0            .000000               .000      .00005
    -145.0          37.8     12.8      -7.0    -24.0           14.6            .000000               .000      .00006
    -140.0          38.0     13.0      -6.6    -23.6           15.2            .000000               .000      .00006
    -135.0          38.2     13.2      -6.1    -23.1           15.8            .000000               .000      .00006
    -130.0          38.4     13.4      -5.6    -22.6           16.5            .000000               .000      .00007
    -125.0          38.6     13.6      -5.0    -22.0           17.2            .000000               .000      .00007
    -120.0          38.8     13.8      -4.4    -21.4           17.9            .000000               .000      .00008
    -115.0          39.0     14.0      -3.8    -20.8           18.6            .000000               .000      .00009
    -110.0          39.2     14.2      -3.2    -20.2           19.4            .000000               .000      .00010
    -105.0          39.4     14.4      -2.5    -19.5           20.2            .000000               .000      .00010
    -100.0          39.7     14.7      -1.8    -18.8           21.0            .000000               .000      .00012
     -95.0          39.9     14.9      -1.0    -18.0           21.9            .000000               .000      .00013
     -90.0          40.2     15.2       -.2    -17.2           22.8            .000000               .000      .00014
     -85.0          40.5     15.5        .7    -16.3           23.8            .000000               .000      .00016
     -80.0          40.8     15.8       1.6    -15.4           24.8            .000000               .000      .00018
     -75.0          41.1     16.1       2.6    -14.4           25.9            .000000               .000      .00020
     -70.0          41.4     16.4       3.7    -13.3           27.1            .000000               .000      .00023
     -65.0          41.8     16.8       4.9    -12.1           28.4            .000000               .001      .00027
     -60.0          42.2     17.2       6.2    -10.8           29.7            .000000               .001      .00032
     -55.0          42.6     17.6       7.6     -9.4           31.2            .000000               .001      .00038
     -50.0          43.1     18.1       9.1     -7.9           32.8            .000000               .001      .00046
     -45.0          43.6     18.6      10.9     -6.1           34.6            .000000               .001      .00056
     -40.0          44.2     19.2      12.8     -4.2           36.5            .000000               .001      .00071
     -35.0          44.8     19.8      15.0     -2.0           38.7            .000000               .002      .00092
     -30.0          45.6     20.6      17.6       .6           41.1            .000000               .002      .00124
     -25.0          46.4     21.4      20.6      3.6           43.9            .000000               .003      .00175
     -20.0          47.5     22.5      24.3      7.3           47.1            .000000               .005      .00265
     -15.0          48.8     23.8      28.9     11.9           50.9            .000000               .009      .00440
     -10.0          50.5     25.5      34.9     17.9           55.2            .000000               .017      .00839
      -5.0          52.8     27.8      42.9     25.9           59.3            .000000               .036      .01834
        .0          54.6     29.6      49.1     32.1           61.3            .000000               .056      .03033
       5.0          52.8     27.8      42.9     25.9           59.3          53.006800               .036      .01834
      10.0          50.5     25.5      34.9     17.9           55.2          29.198730               .017      .00839
      15.0          48.8     23.8      28.9     11.9           50.9          20.602070               .009      .00440
      20.0          47.5     22.5      24.3      7.3           47.1          16.086390               .005      .00265
      25.0          46.4     21.4      20.6      3.6           43.9          13.277420               .003      .00175
      30.0          45.6     20.6      17.6       .6           41.1          11.350550               .002      .00124
      35.0          44.8     19.8      15.0     -2.0           38.7           9.941267               .002      .00092
      40.0          44.2     19.2      12.8     -4.2           36.5           8.862745               .001      .00071
      45.0          43.6     18.6      10.9     -6.1           34.6           8.008971               .001      .00056
      50.0          43.1     18.1       9.1     -7.9           32.8           7.315182               .001      .00046
      55.0          42.6     17.6       7.6     -9.4           31.2           6.739493               .001      .00038
      60.0          42.2     17.2       6.2    -10.8           29.7           6.253583               .001      .00032
      65.0          41.8     16.8       4.9    -12.1           28.4           5.837588               .001      .00027
      70.0          41.4     16.4       3.7    -13.3           27.1           5.477149               .000      .00023
      75.0          41.1     16.1       2.6    -14.4           25.9           5.161622               .000      .00020
      80.0          40.8     15.8       1.6    -15.4           24.8           4.882940               .000      .00018
```

```
 85.0          40.5     15.5        .7    -16.3            23.8           4.634880               .000      .00016
 90.0          40.2     15.2       -.2    -17.2            22.8           4.412555               .000      .00014
 95.0          39.9     14.9      -1.0    -18.0            21.9           4.212078               .000      .00013
100.0          39.7     14.7      -1.8    -18.8            21.0           4.030313               .000      .00012
105.0          39.4     14.4      -2.5    -19.5            20.2           3.864701               .000      .00010
110.0          39.2     14.2      -3.2    -20.2            19.4           3.713137               .000      .00010
115.0          39.0     14.0      -3.8    -20.8            18.6           3.573868               .000      .00009
120.0          38.8     13.8      -4.4    -21.4            17.9           3.445424               .000      .00008
125.0          38.6     13.6      -5.0    -22.0            17.2           3.326565               .000      .00007
130.0          38.4     13.4      -5.6    -22.6            16.5           3.216232               .000      .00007
135.0          38.2     13.2      -6.1    -23.1            15.8           3.113519               .000      .00006
140.0          38.0     13.0      -6.6    -23.6            15.2           3.017647               .000      .00006
145.0          37.8     12.8      -7.0    -24.0            14.6           2.927939               .000      .00006
150.0          37.7     12.7      -7.5    -24.5            14.0           2.843807               .000      .00005
155.0          37.5     12.5      -7.9    -24.9            13.4           2.764734               .000      .00005
160.0          37.3     12.3      -8.3    -25.3            12.9           2.690267               .000      .00005
165.0          37.2     12.2      -8.7    -25.7            12.4           2.620007               .000      .00004
170.0          37.0     12.0      -9.1    -26.1            11.8           2.553598               .000      .00004
175.0          36.9     11.9      -9.5    -26.5            11.3           2.490725               .000      .00004
180.0          36.8     11.8      -9.8    -26.8            10.9           2.431108               .000      .00004
185.0          36.6     11.6     -10.2    -27.2            10.4           2.374493               .000      .00003
190.0          36.5     11.5     -10.5    -27.5             9.9           2.320654               .000      .00003
195.0          36.4     11.4     -10.8    -27.8             9.5           2.269388               .000      .00003
200.0          36.2     11.2     -11.1    -28.1             9.0           2.220510               .000      .00003
```

```
     ÛßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßÛ
     Û       C O R O N A   A N D   F I E L D       Û
     Û E F F E C T S   P R O G R A M   V E R.  3   Û
     Û   Source: Bonneville Power Administration   Û
     ÛÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÛ


                                INPUT DATA LIST


                  9/23/2005          12:27:48
 ****************** GOLDEN HILLS WIND FARM *************
 FIGURE AA-8 (3)34.5-KV UG,1000KCMIL 600A
 1,0, 9, 9,0.0,   2.00,   1.00,    .00

 (ENGLISH UNITS OPTION)

 (GRADIENTS ARE COMPUTED BY PROGRAM)

 PHYSICAL SYSTEM CONSISTS OF  9 CONDUCTORS, OF WHICH  9 ARE ENERGIZED PHASES

 OPTIONS: 'COMB'
   5.000,  5.000, 10.000,   .000,  1.000, 75.000,  6.280,  2.000,  6.280
 'CIR1-A  ','A',    -.17,     .10, 1,   1.170,    .000,  21.920,    .000,    .600,    .000
 'CIR1-B  ','A',     .00,     .10, 1,   1.170,    .000,  21.920,-120.000,    .600,    .000
 'CIR1-C  ','A',     .17,     .10, 1,   1.170,    .000,  21.920, 120.000,    .600,    .000
 'CIR2-A  ','A',  -10.17,     .10, 1,   1.170,    .000,  21.920,    .000,    .600,    .000
 'CIR2-B  ','A',  -10.00,     .10, 1,   1.170,    .000,  21.920,-120.000,    .600,    .000
 'CIR2-C  ','A',   -9.83,     .10, 1,   1.170,    .000,  21.920, 120.000,    .600,    .000
 'CIR3-A  ','A',   10.17,     .10, 1,   1.170,    .000,  21.920,    .000,    .600,    .000
 'CIR3-B  ','A',   10.00,     .10, 1,   1.170,    .000,  21.920,-120.000,    .600,    .000
 'CIR3-C  ','A',    9.83,     .10, 1,   1.170,    .000,  21.920, 120.000,    .600,    .000
  41 -200.0    5.0
  40    5.0    5.0
   0     .0     .0
1COMBINED OUTPUT OF AUDIBLE NOISE, RADIO NOISE, TVI, OZONE CONCENTRATION, GROUND GRADIENT AND MAGNETIC FIELD
 ****************** GOLDEN HILLS WIND FARM *************
 FIGURE AA-8 (3)34.5-KV UG,1000KCMIL 600A



              DIST. FROM             MAXIMUM  SUBCON   NO. OF      SUBCON   VOLTAGE  PHASE    CURRENT  CORONA
           CENTER OF TOWER  HEIGHT   GRADIENT  DIAM.   SUBCON      SPACING    L-N    ANGLE             LOSSES
                (FEET)      (FEET)   (KV/CM)   (IN)                (IN)      (KV)  (DEGREES)  (kAmps)  (KW/MI)

 CIR1-A           -.17         .10    13.68     1.17       1         .00     21.92      .00      .60    1.928
 CIR1-B            .00         .10    16.12     1.17       1         .00     21.92  -120.00      .60    5.601
 CIR1-C            .17         .10    13.68     1.17       1         .00     21.92   120.00      .60    1.928
 CIR2-A         -10.17         .10    13.68     1.17       1         .00     21.92      .00      .60    1.928
 CIR2-B         -10.00         .10    16.12     1.17       1         .00     21.92  -120.00      .60    5.601
 CIR2-C          -9.83         .10    13.68     1.17       1         .00     21.92   120.00      .60    1.929
 CIR3-A          10.17         .10    13.68     1.17       1         .00     21.92      .00      .60    1.929
 CIR3-B          10.00         .10    16.12     1.17       1         .00     21.92  -120.00      .60    5.601
 CIR3-C           9.83         .10    13.68     1.17       1         .00     21.92   120.00      .60    1.928
 AN MICROPHONE HT.=  5.0 FT, RI ANT. HT.=  5.0 FT, TV ANT. HT.= 10.0 FT, ALTITUDE=      .0 FT
 RI FREQ=  1.000 MHZ, TV FREQ=  75.000 MHZ, WIND VEL.(OZ)= 2.000 MPH, GROUND CONDUCTIVITY =   2.0 MMHOS/M
 E-FIELD TRANSDUCER HT.=  6.3FT, B-FIELD TRANSDUCER HT.=  6.3FT

 LATERAL DIST       AUDIBLE NOISE   RADIO INTERFERENCE        TVI              OZONE
     FROM          (RAIN)   (FAIR)   (RAIN)    (FAIR)         TOTAL        FOR RAIN RATE OF        ELECTRIC     MAGNETIC
   REFERENCE        L50      L50      L50       L50           RAIN    1.00 IN/HR AT 0. FT LEVEL     FIELD       FIELD
    (FEET)          DBA      DBA      DBUV/M   DBUV/M        DBUV/M             PPB                  KV/M        GAUSS
    -200.0          41.0     16.0     -10.5    -27.5             9.9            .000000               .000      .00003
    -195.0          41.1     16.1     -10.2    -27.2            10.4            .000000               .000      .00004
    -190.0          41.3     16.3      -9.8    -26.8            10.9            .000000               .000      .00004
    -185.0          41.4     16.4      -9.5    -26.5            11.3            .000000               .000      .00004
    -180.0          41.5     16.5      -9.1    -26.1            11.8            .000000               .000      .00004
    -175.0          41.7     16.7      -8.7    -25.7            12.4            .000000               .000      .00005
    -170.0          41.8     16.8      -8.3    -25.3            12.9            .000000               .000      .00005
    -165.0          42.0     17.0      -7.9    -24.9            13.4            .000000               .000      .00005
    -160.0          42.1     17.1      -7.5    -24.5            14.0            .000000               .000      .00006
    -155.0          42.3     17.3      -7.0    -24.0            14.6            .000000               .000      .00006
    -150.0          42.4     17.4      -6.6    -23.6            15.2            .000000               .000      .00007
    -145.0          42.6     17.6      -6.1    -23.1            15.8            .000000               .000      .00007
    -140.0          42.8     17.8      -5.6    -22.6            16.5            .000000               .000      .00008
    -135.0          43.0     18.0      -5.0    -22.0            17.2            .000000               .000      .00008
    -130.0          43.2     18.2      -4.4    -21.4            17.9            .000000               .000      .00009
    -125.0          43.3     18.3      -3.8    -20.8            18.6            .000000               .000      .00010
    -120.0          43.6     18.6      -3.2    -20.2            19.4            .000000               .000      .00011
    -115.0          43.8     18.8      -2.5    -19.5            20.2            .000000               .001      .00012
    -110.0          44.0     19.0      -1.8    -18.8            21.0            .000000               .001      .00013
    -105.0          44.2     19.2      -1.0    -18.0            21.9            .000000               .001      .00015
    -100.0          44.5     19.5       -.2    -17.2            22.8            .000000               .001      .00016
     -95.0          44.7     19.7        .7    -16.3            23.8            .000000               .001      .00018
     -90.0          45.0     20.0       1.6    -15.4            24.8            .000000               .001      .00021
     -85.0          45.3     20.3       2.6    -14.4            25.9            .000000               .001      .00024
     -80.0          45.6     20.6       3.7    -13.3            27.1            .000000               .001      .00027
     -75.0          45.9     20.9       4.9    -12.1            28.4            .000000               .001      .00032
     -70.0          46.3     21.3       6.2    -10.8            29.7            .000000               .001      .00037
     -65.0          46.6     21.6       7.6     -9.4            31.2            .000000               .002      .00045
     -60.0          47.0     22.0       9.1     -7.9            32.8            .000000               .002      .00054
     -55.0          47.5     22.5      10.9     -6.1            34.6            .000000               .002      .00067
     -50.0          48.0     23.0      12.8     -4.2            36.5            .000000               .003      .00085
     -45.0          48.5     23.5      15.0     -2.0            38.7            .000000               .004      .00110
     -40.0          49.2     24.2      17.6       .6            41.1            .000000               .005      .00149
     -35.0          49.9     24.9      20.6      3.6            43.9            .000000               .006      .00211
     -30.0          50.7     25.7      24.3      7.3            47.1            .000000               .009      .00318
     -25.0          51.8     26.8      28.9     11.9            50.9            .000000               .014      .00524
     -20.0          53.1     28.1      34.9     17.9            55.2            .000000               .023      .00977
     -15.0          54.9     29.9      42.9     25.9            59.3            .000000               .042      .02035
     -10.0          56.6     31.6      49.1     32.1            61.3            .000000               .049      .02939
      -5.0          56.6     31.6      42.9     25.9            59.3          53.008730               .014      .01124
        .0          57.1     32.1      49.1     32.1            61.3          29.199790               .042      .03384
       5.0          56.6     31.6      42.9     25.9            59.3          73.612450               .025      .03910
      10.0          56.6     31.6      49.1     32.1            61.3          45.287280               .050      .03736
      15.0          54.9     29.9      42.9     25.9            59.3          86.889720               .042      .01640
      20.0          53.1     28.1      34.9     17.9            55.2          56.637940               .023      .00554
      25.0          51.8     26.8      28.9     11.9            50.9          43.822540               .014      .00210
```

```
 30.0          50.7     25.7      24.3      7.3            47.1          36.301160               .009      .00088
 35.0          49.9     24.9      20.6      3.6            43.9          31.228940               .006      .00038
 40.0          49.2     24.2      17.6       .6            41.1          27.529600               .005      .00016
 45.0          48.5     23.5      15.0     -2.0            38.7          24.690750               .004      .00009
 50.0          48.0     23.0      12.8     -4.2            36.5          22.432440               .003      .00009
 55.0          47.5     22.5      10.9     -6.1            34.6          20.586900               .002      .00010
 60.0          47.0     22.0       9.1     -7.9            32.8          19.046700               .002      .00010
 65.0          46.6     21.6       7.6     -9.4            31.2          17.739440               .002      .00010
 70.0          46.3     21.3       6.2    -10.8            29.7          16.614360               .001      .00010
 75.0          45.9     20.9       4.9    -12.1            28.4          15.634740               .001      .00009
 80.0          45.6     20.6       3.7    -13.3            27.1          14.773250               .001      .00009
 85.0          45.3     20.3       2.6    -14.4            25.9          14.009160               .001      .00008
 90.0          45.0     20.0       1.6    -15.4            24.8          13.326360               .001      .00008
 95.0          44.7     19.7        .7    -16.3            23.8          12.712180               .001      .00007
100.0          44.5     19.5       -.2    -17.2            22.8          12.156510               .001      .00007
105.0          44.2     19.2      -1.0    -18.0            21.9          11.651130               .001      .00006
110.0          44.0     19.0      -1.8    -18.8            21.0          11.189340               .001      .00006
115.0          43.8     18.8      -2.5    -19.5            20.2          10.765580               .001      .00006
120.0          43.6     18.6      -3.2    -20.2            19.4          10.375220               .000      .00005
125.0          43.3     18.3      -3.8    -20.8            18.6          10.014370               .000      .00005
130.0          43.2     18.2      -4.4    -21.4            17.9           9.679704               .000      .00005
135.0          43.0     18.0      -5.0    -22.0            17.2           9.368411               .000      .00004
140.0          42.8     17.8      -5.6    -22.6            16.5           9.078061               .000      .00004
145.0          42.6     17.6      -6.1    -23.1            15.8           8.806557               .000      .00004
150.0          42.4     17.4      -6.6    -23.6            15.2           8.552074               .000      .00004
155.0          42.3     17.3      -7.0    -24.0            14.6           8.313024               .000      .00004
160.0          42.1     17.1      -7.5    -24.5            14.0           8.088006               .000      .00003
165.0          42.0     17.0      -7.9    -24.9            13.4           7.875791               .000      .00003
170.0          41.8     16.8      -8.3    -25.3            12.9           7.675290               .000      .00003
175.0          41.7     16.7      -8.7    -25.7            12.4           7.485534               .000      .00003
180.0          41.5     16.5      -9.1    -26.1            11.8           7.305662               .000      .00003
185.0          41.4     16.4      -9.5    -26.5            11.3           7.134901               .000      .00003
190.0          41.3     16.3      -9.8    -26.8            10.9           6.972560               .000      .00003
195.0          41.1     16.1     -10.2    -27.2            10.4           6.818016               .000      .00002
200.0          41.0     16.0     -10.5    -27.5             9.9           6.670707               .000      .00002
```