
EXHIBIT I: ANTICIPATED NOISE AND INTERFERENCE WITH COMMUNICATION SIGNALS

Describe the anticipated noise emission levels and any interference with communication signals which will emanate from the proposed facilities.

I.1 Corona and Audible Noise

Noise emanating from a transmission line is caused by corona. Corona is the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware due to very high electric field strength. Certain electromagnetic effects are inherently associated with overhead transmission of electrical power at high voltage. These effects are produced by the electric and magnetic fields (EMF) of the transmission line with one of the primary effects being corona discharge. Corona effects are manifested as audible noise (AN), radio interference, and television interference. These particular effects will be minimized by line location, line design, and construction practices. Results presented in this exhibit are based on consideration of the various possible construction configurations along the alternative routes. Corona may result in AN being produced by a transmission line.

The amount of corona produced by a transmission line is a function of the voltage of the line, the diameter of the conductors, the locations of the conductors in relation to each other, the elevation of the line above sea level, the condition of the conductors and hardware, and the local weather conditions. Corona typically becomes a design concern for transmission lines at 345 kV and above and is less noticeable from lines that are operated at lower voltages, such as this proposed 138 kV transmission line.

The electric field gradient is greatest at the surface of the conductor. Large-diameter conductors have lower electric field gradients at the conductor surface; hence, lower corona than smaller conductors, everything else being equal. The conductors for the Project would be selected to have large diameters, and thus a reduced potential to create AN. Irregularities (such as nicks and scrapes on the conductor surface or sharp edges on suspension hardware) concentrate the electric field at these locations, increasing the electric field gradient and the resulting corona at these spots. Similarly, foreign objects on the conductor surface, such as dust or insects, can cause irregularities on the surface that are a source for corona.

Corona also increases at higher elevations where the density of the atmosphere is less than at sea level. AN varies with elevation with the relationship of $A/300$, where A is the elevation of the line above sea level measured in meters (EPRI 2005). AN at a 600-meter (1,968.5 feet) elevation would be twice the AN at 300 meters (984.25 feet) all other things being equal.

Raindrops, snow, fog, hoarfrost, and condensation accumulated on the conductor surface are also sources of surface irregularities that can increase corona. During fair weather, the number of these condensed water droplets or ice crystals is usually small and the corona effect is also small. However, during wet weather, the number of these sources increases (e.g., due to rain drops standing on the conductor) and corona effects are therefore greater. During wet or foul weather conditions, the conductor would produce

the greatest amount of corona noise; yet noise generated by heavy rain hitting the ground would typically be greater than the noise generated by corona, thus masking the AN from the transmission line.

Corona produced on a transmission line can be reduced by the design of the transmission line and the selection of hardware and conductors used for the construction of the line; for instance, the use of conductor hangers that have rounded rather than sharp edges and no protruding bolts with sharp edges would reduce corona. The conductors themselves can be made with larger diameters and handled so that they have smooth surfaces without nicks, burrs, or scrapes in the conductor strands.

The transmission line proposed here will be designed to reduce corona generation. Baseline ambient noise levels were estimated using the relationship between population density and noise levels. Populations for the majority of the area immediately adjacent to the proposed Project's facilities are urban, with a population density of 1,200 to 2,000 people per square mile; typical ambient noise levels range from 43 to 70 A-weighted decibels (dBA). Sources of noise along the alternative routes primarily relate to transportation sources and include local access traffic, aircraft from DMAFB and Tucson International Airport, traffic on I-10, and noise from the UPRR. Residential noise would also contribute to noise levels. Sensitive noise receptors such as schools, libraries, and hospital/health care facilities are located in the study area and discussed in more detail in Exhibit H.

Some level of noise will result from transmission line construction, operation, and maintenance. During construction, equipment used for assembly and erection of structures, wire pulling and splicing, and rehabilitation activities will generate noise. Noise from construction activities would be audible, particularly to the closest residents. This construction noise, however, would not be considered to be a major impact because construction would occur during daytime hours when tolerance to noise is higher, and would be temporary, lasting only a few days at a time in any one location. Long-term noise impacts from transmission line operation and maintenance activities are expected to be minimal.

I.2 Radio Interference

Corona-generated radio interference is most likely to affect the amplitude modulation (AM) radio broadcast band (535 to 1,605 kilohertz); frequency modulation (FM) radio is rarely affected. Only AM receivers located very near to transmission lines that are tuned to a weak station have the potential to be affected by radio interference. An example is the humming noise on an AM radio that happens when the radio is near a power line, but diminishes as the radio moves away from the line. FM radio is rarely affected by transmission lines. FM radio receivers usually do not pick up interference from transmission lines, because corona-generated radio frequency noise currents decrease in magnitude with increasing frequency and are quite small in the FM broadcast band (88 to 108 megahertz). In addition, the excellent interference rejection properties inherent in FM radio systems make them virtually immune to amplitude-type disturbances.

Residential areas located in the vicinity of the Project's alternative alignments are in close proximity to other existing power lines; therefore, additional radio interference as a result of the Project's implementation is not expected. There are 12 active communications towers licensed by the Federal Communications Commission (FCC) within the Project's study area (see Figure 2-1). Once an alternative is approved, TEP will coordinate with those tower owners in close proximity and mitigate any impacts

identified prior to construction of the transmission line. No radio interference is anticipated from the proposed Project. Potential impacts will be further assessed following design and any impacts mitigated as needed.

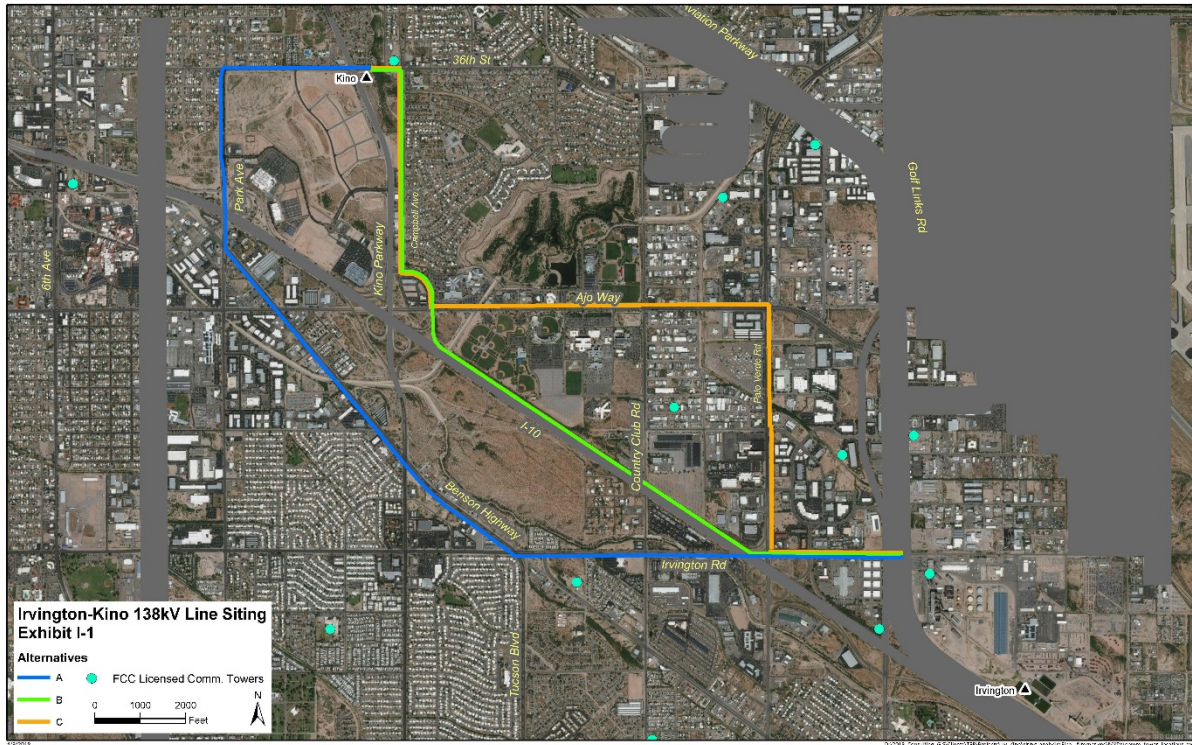


Figure 2-1. FCC Licensed Communication Tower Locations

I.3 Television Interference

Interference with traditional television reception from the transmission line’s corona effects may occur during periods of bad weather, but is usually only a concern for transmission lines of 345 kV or greater and only for receivers within 500 feet of the line. Because the voltage would not exceed 138 kV, television interference is not expected.

I.4 Electric and Magnetic Field Effects

EMF are produced by power lines. These fields would induce voltages and currents on nearby conductive objects. Electric fields are produced whenever a conductor is connected to a source of electrical voltage. An example of this is the plugging of a lamp into a wall outlet in a home. When the lamp is plugged in, a voltage is induced in the cord to the lamp, which causes an electric field to be created around the cord. Magnetic fields are produced whenever an electrical current flows in a conductor. In the lamp example, if the lamp is turned on (allowing electricity to flow to the lamp), a magnetic field is created around the lamp cord in addition to the electric field. These fields exist around overhead and underground power lines, house wiring, computers, power tools, appliances, and anything that carries or uses electricity. Table 8 demonstrates examples of EMF levels from various electrical sources (see also Figure 2-2). This information was provided in both a poster and a handout available to the public at the Open House Meetings (see Exhibits J-14 and J-15.1).

Both current and voltage are required to transmit electrical energy over a transmission line. The current, a flow of electrical charge, measured in amperes (A), creates a magnetic field. This can fluctuate with the amount of line loading at any given time. The voltage (force or pressure that causes the current to flow), measured in units of volts (V) or kV, creates an electric field. Though an electric field is present anytime a line is energized, even from one end, the magnetic field exists only when electricity flows. It is general practice to consider both fields together as EMF values in assessing the amount of effect at the outer edge of a transmission line’s right-of-way.

Table 8. EMF Strength of Various Electrical Sources at Various Distances

EMF Source ¹	Distance	Strength	Distance	Strength	Distance	Strength
Microwave Oven	0.5 feet	200 mG	1.0 feet	4 mG	4.0 feet	2 mG
Vacuum Cleaner	0.5 feet	300 mG	1.0 feet	60 mG	4.0 feet	1 mG
Hair Dryer	0.5 feet	300 mG	1.0 feet	1 mG	4.0 feet	0 mG
Electric Shaver	0.5 feet	100 mG	1.0 feet	20 mG	4.0 feet	0 mG
138-kV Transmission Line, vertical ²	0 feet	40 mG	50 feet	11 mG	300 feet	0.4 mG

¹ Appliance magnetic field strengths are median values in milliGauss (mG) for typical 60 Hz electrical current (source: USNIEHS 1999, DOE 1995)
² 138kV power line right-of-way is 100 feet wide; 0-feet values represent directly below the lines at lowest point of sag

EMF decreases in strength with increased distance from the source. In addition, electric fields are further weakened by obstacles such as walls, roofs, trees, and vegetation. However, magnetic fields are not easily shielded by most materials and are primarily reduced in strength by distance alone.

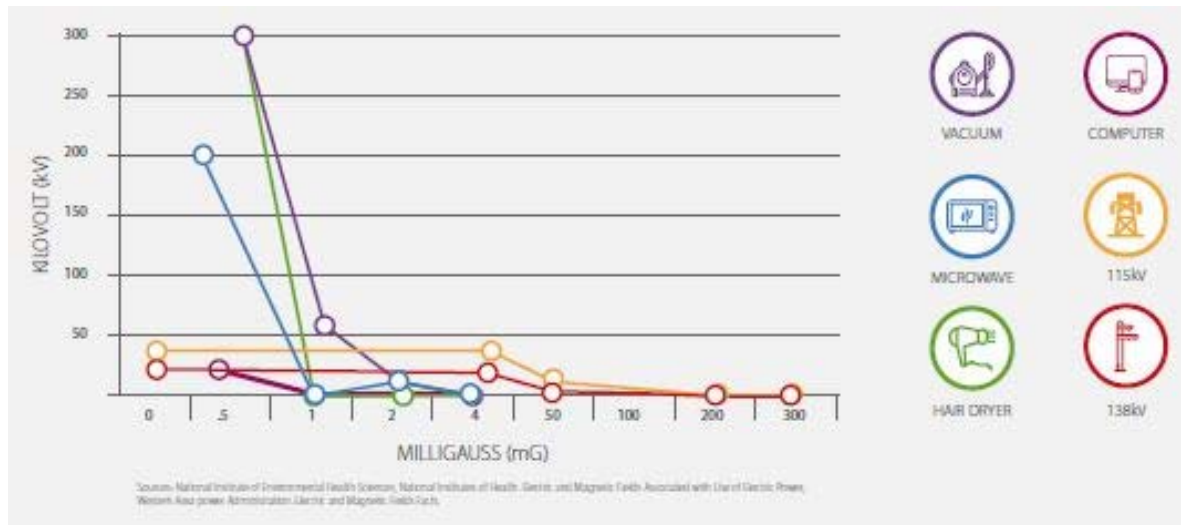


Figure 2-2. EMFs from Various Sources

The EMF values associated with this Project are expected to be comparable to other 138 kV transmission lines in the state, and are expected to be within generally accepted standards at the edge of the project area (Figure 2-3 and Figure 2-4).

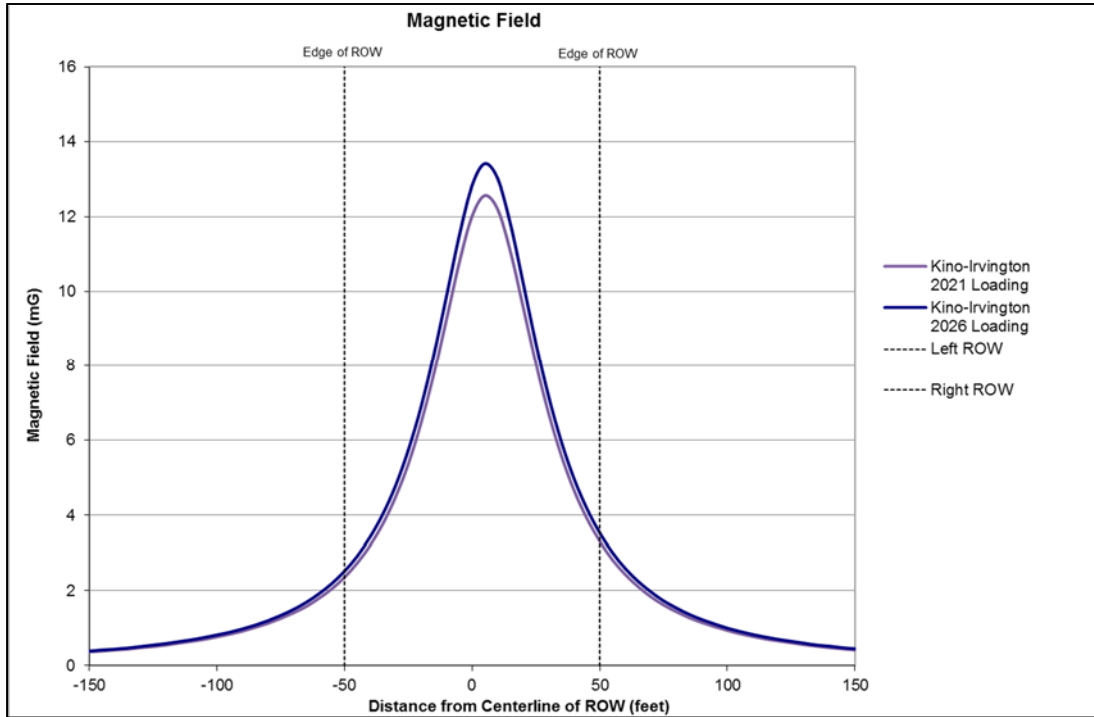


Figure 2-3. Magnetic Field at Distance from Centerline

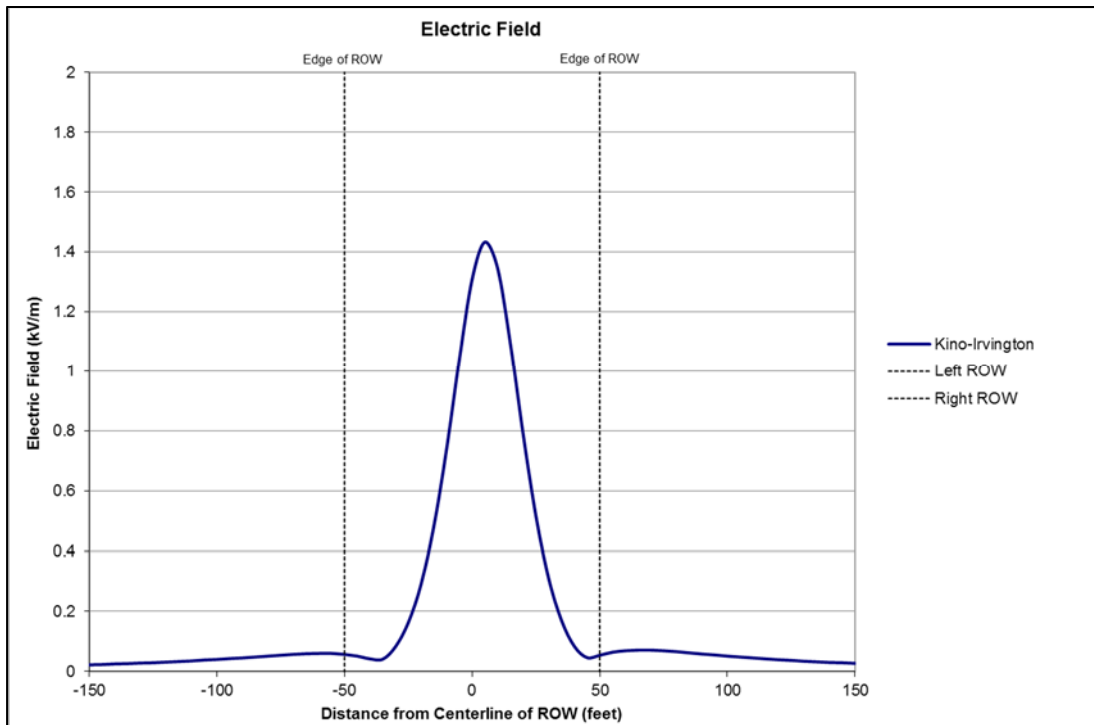


Figure 2-4. Electric Field at Distance from Centerline

I.5 References

IEEE/ANSI Standard C2-2007. National Electrical Safety Code.

National Academy of Sciences, 1977. Guidelines for Preparing Environmental Impact Statements on Noise. Washington D.C.

National Academy of Sciences, 1996. Possible Health Effects of Exposure to Residential Electric and Magnetic Fields. National Research Council.

National Institute of Environmental Health Sciences, 1999. Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields.