EXHIBIT I

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EXHIBIT I – ANTICIPATED NOISE AND INTERFERENCE WITH COMMUNICATION SIGNALS

As stated in R14-3-219 of the Rules of Practice and Procedure Before Power Plant and Transmission Line Siting Committee Exhibits to Application, Exhibit I:

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

INTRODUCTION

The following analysis describes the anticipated noise impacts and interference with communication signals within the study area. The study area for noise is 1 mile on either side of the right-of-way (ROW) centerline of the Project (2 miles in total). This study area is consistent with the analysis area used in the Final Environmental Impact Statement (Final EIS) (see Figure 3.3-2).

The Project is an upgrade of an existing transmission line owned and operated by Western Area Power Administration (WAPA). The 64-mile route will include the replacement of wood H-frame poles with steel monopoles in approximately 52 miles of existing transmission line ROW. The Project will also include four realignments outside the current ROW, totaling approximately 12 miles (Vail Lateral realignment [segment U4 in the Final EIS], Old Vail Road realignment [segment U3aPC in the Final EIS], Tumamoc Hill realignment [segments TH1a and TH1 Option in the Final EIS], and Marana Airport realignment [segment MA-1 in the Final EIS]).

The Project will generate noise during the construction and operation phases. Construction (i.e., either the tear-down and rebuild-in-place method, or construction of new facilities adjacent to the existing facilities and removal of the existing transmission facilities) will result in audible noise from Project equipment and vehicles. Operation and maintenance (e.g., corona noise) activities will be similar in noise level to construction-related activities, but will occur less frequently, include fewer individual noise point sources such as pieces of equipment and vehicles, and be of shorter duration.

CONSTRUCTION NOISE

Some level of noise will result from transmission line construction, operation, and maintenance. During construction, equipment used for assembly and erection of structures, and wire pulling and splicing 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.

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 kilovolts (kV) and above and is less noticeable from lines that are operated at lower voltages, such as this proposed 230 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 (Electric Power Research Institute [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 raindrops 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 lines proposed here will be designed to reduce corona generation. Baseline ambient noise levels were estimated using the relationship between population density and noise levels.

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 the existing ROW and 115-kV WAPA transmission line, as well as other existing power lines; therefore, additional radio interference as a result of the Project’s implementation is not expected.

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 upgrade line will be 230 kV, television interference is not expected.

ELECTRIC AND MAGNETIC FIELDS

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 I-1 demonstrates examples of EMF levels from various electrical sources (see also Figure I-1).

Table I-1. EMF Strength of Various Electrical Sources at Various Disturbances (after

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: NIEHS 2020).
[2] 138-kV power line right-of-way is 100 feet wide; 0-feet values represent directly below the lines at lowest point of sag.

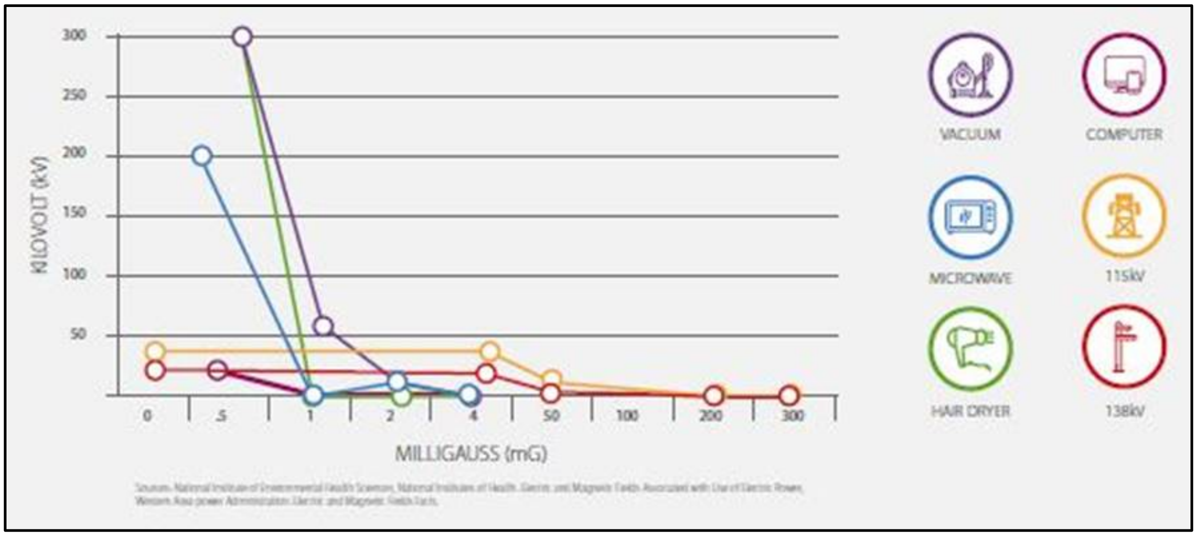

Figure I-1. EMFs from Various Sources

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 ROW.

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.

The EMF values associated with this Project are expected to be comparable to other 230-kV transmission lines in the state, and are expected to be within generally accepted standards at the edge of the Project area (Figure I-2 and I-3).

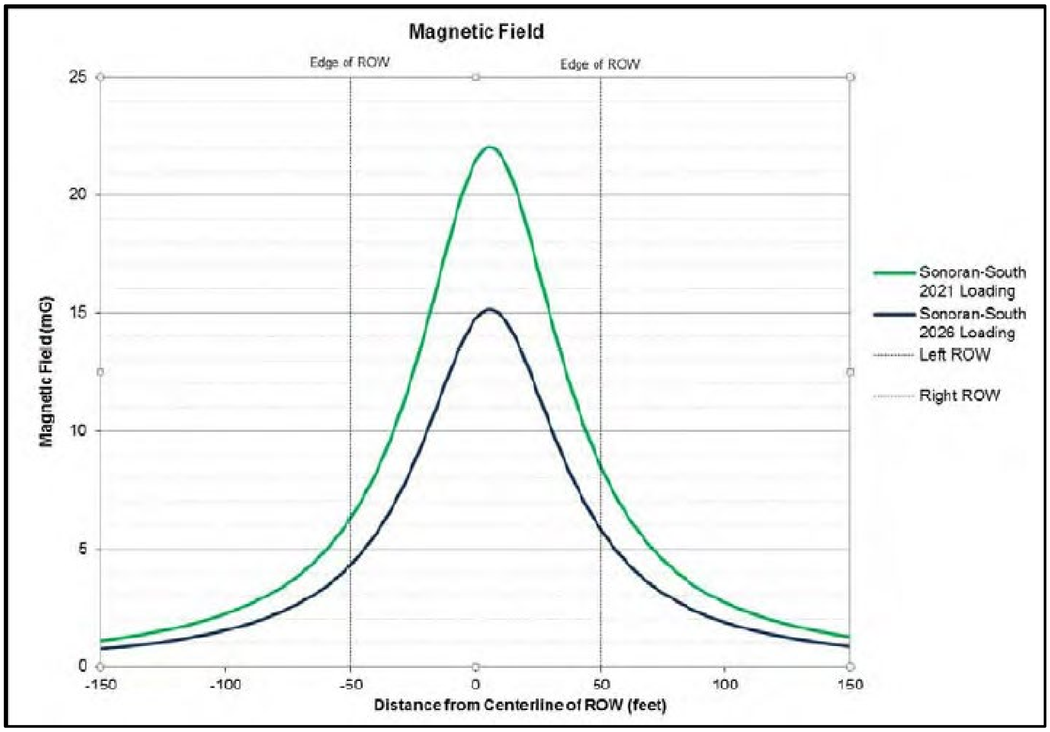

Figure I-2. Magnetic Field at Distance from Centerline

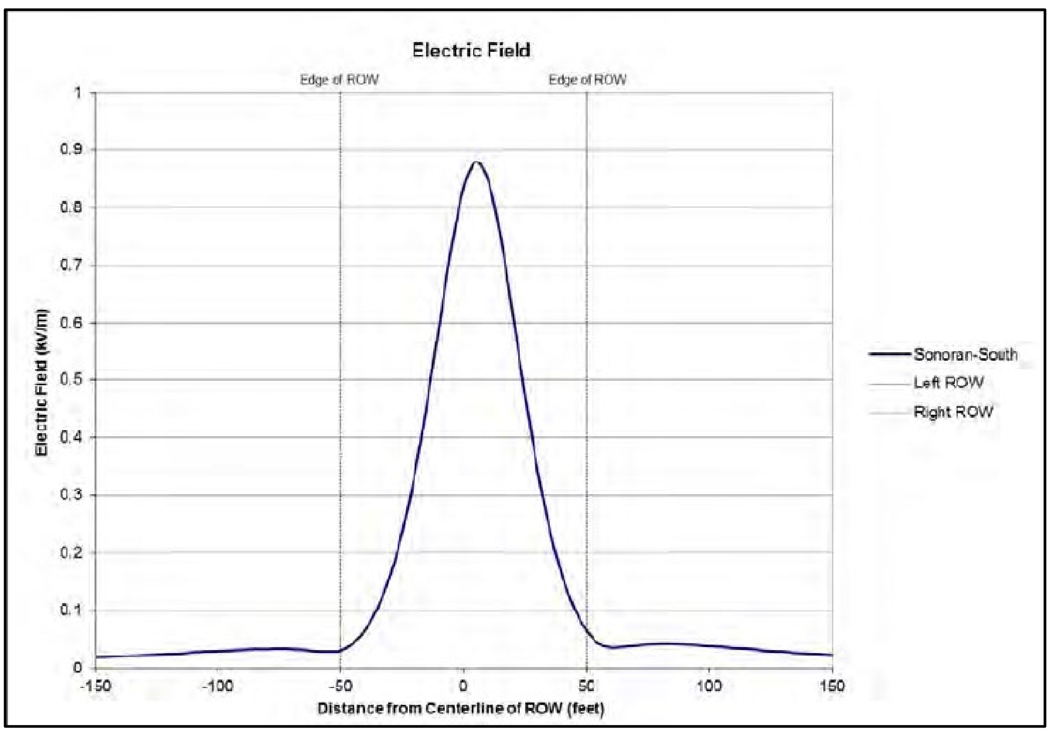

Figure I-3. Electric Field at Distance from Centerline

CONCLUSIONS

The Vail to Tortolita Project will cross areas of rural and open lands , as well as high-density areas of Tucson and surrounding communities. Residents and commercial establishments would experience short-term noise increases in these areas during construction.

Noise sensitive receptors (NSR), including any residential areas, schools and day care facilities, hospitals, long-term care facilities, places of worship, libraries, parks, and recreational areas specifically known for their solitude and tranquility (such as wilderness areas) were identified. Unmitigated noise levels could result as high as 83 A-weighted decibels (dBA) to NSR near Project construction activities (within 100 feet); however, construction noise in any single area will be short-term, temporary, limited to daytime hours, and intermittent.

During operation, noise from the Vail, Nogales, and Tortolita substations is not anticipated to change at the nearest NSR. Noise from the DeMoss Petrie substation is anticipated to increase by 2 to 8 dBA (Southline Transmission, LLC 2013). However, the DeMoss Petrie substation is located approximately 1,500 feet from residences, and is partially shielded by a long intervening brick building. Therefore, the substation improvements are not anticipated to have an additive effect on the sound level at the NSRs. [Placeholder – additional information will be evaluated and discussed during the project hearing].

Project corona noise was modeled using the EPRI ENVIRO computer model. The maximum corona noise for all modeled scenarios for the proposed Project on the edge of the ROW will be 52.4 dBA (in foul weather for two double-circuit transmission lines separated by a distance of 200 feet). This value is lower than the exterior noise level guidelines of the Noise Control Act of 1972 and the proposed Project is not expected to cause a significant impact with respect to corona noise.

Because of the relatively dry nature of the area crossed by the Project, the overall level of operational noise will be minimal. Operational noise will decrease rapidly with distance from the transmission line. Furthermore, corona noise increases with aging, damaged equipment. Since the upgraded transmission line will be replacing the existing line with newer equipment, have an increased height above ground, and/or different arrangement of the equipment (e.g., vertical configuration of the circuits), corona noise from the Project at the nearest NSR is expected to decrease from currently existing line conditions. This change in noise due to the corona effect would most likely be minimal and would still be affected by other circumstances (i.e., adverse weather). The noise impacts during operations will therefore represent a minor, but long-term, impact to ambient soundscapes.

Additional information concerning noise impacts can be found in Exhibit B-1, of the Final EIS (Section 4.3 and Appendix C).

REFERENCES

Electric Power Research Institute (EPRI), 2005. EPRI AC Transmission Line Reference Book-200 kV and Above, 3rd ed. Palo Alto, California: Electric Power Research Institute.

National Institute of Environmental Health Sciences, 2020. Electric and Magnetic Fields. Available at: https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm. Accessed October 2020. Southline Transmission, LLC. 2013. Southline Transmission Project Resource Report 08: Noise. Dallas.