14.1.3 *Mitigation*

Because the South Dakota Facility is generally compatible with the existing land uses in the area, no additional mitigation is required. As described above, the South Dakota Facility has been chosen to minimize impacts to farming operations. The Applicants will coordinate with the USFWS and NRCS in order to obtain necessary permits to cross easement lands, and determine appropriate mitigation measures for these crossings.

14.2 Displacement

14.2.1 *Existing Environment*

Displacement results from ROW acquisitions that require the use of property occupied by a residence or business. A displacement was defined by the Applicants as an impact to an occupied home or business whose structure is located within the South Dakota Facility ROW.

Residences near the South Dakota Facility were identified through field observation, analysis of aerial photography, and comments received at Applicant-sponsored public open house meetings.

14.2.2 *Potential Impacts*

No occupied homes are located within the South Dakota Facility ROW; therefore, no homes are expected to be displaced by the South Dakota Facility. One inactive gravel pit was identified within the South Dakota Facility ROW. The gravel pit is located in Section 2 of Lura Township (T120N R52W). During negotiation of land rights agreements, the Applicants will work with the owners of any businesses located within the South Dakota Facility ROW, such as the inactive gravel pit, to minimize impacts. The South Dakota Facility will not displace any businesses.

14.2.3 *Mitigation*

No mitigation is proposed because no displacement of residences or businesses is occurring.

14.3 Noise

14.3.1 *Existing Environment*

Noise is defined as unwanted sound. Noise may include a variety of sounds of different intensities across the entire frequency spectrum. Noise is measured in units of decibels (dB) on a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted decibel (dBA) scale corresponds to the frequency sensitivity range for human hearing. Noise levels capable of being heard by humans are measured in dBA. A noise level change of 3 dBA is barely perceptible to average human hearing. A 5 dBA change in noise levels, however, is clearly noticeable. A 10 dBA change in noise levels is perceived as a doubling or halving of noise loudness, while a 20 dBA change is considered a dramatic change in loudness.

Cumulative noise increases occur on a logarithmic scale. If a noise source is doubled, there is a 3 dBA increase in noise, which is barely discernible to the human ear. For cumulative increases resulting from sources of different magnitudes, the rule of thumb is that if there is a difference of greater than 10 dBA between noise sources, there will be no additive effect (i.e., only the louder source will be heard and the quieter source will not contribute to louder noise levels). Table 16 provides noise levels associated with common, everyday sources and places the magnitude of noise levels discussed here into context.

Table 16. Noise Levels Associated with Common Sources

Sound Pressure Level (dBA)	Noise Source
140	Jet Engine (at 25 meters)
130	Jet Aircraft (at 100 meters)
120	Concert
110	Pneumatic chipper (powered by compressed air or hydraulics)
100	Jointer/planer
90	Chainsaw
80	Heavy truck traffic
70	Busy business office
60	Conversational speech at 3 feet
50	Library
40	Bedroom
30	Secluded woods
20	Whisper

Source: A Guide to Noise Control in Minnesota, MPCA (revised, 1999)

The State of South Dakota does not regulate noise from transmission lines (corona noise) with measureable standards. Also, corona noise does not contain high levels of low frequency noise. Generally, background noise levels in rural areas vary between 40 and 50 dBA, while in suburban areas these levels increase to 50 to 60 dBA. In urban areas, noise levels vary between 60 and 70 dBA (FRA 2006). Most of the South Dakota Facility area has background levels consistent with rural areas. Windy conditions in the South Dakota Facility area tend to increase ambient noise levels compared to other rural areas. Additionally, higher levels exist near roads and other areas of human activity. Exhibit 2 shows noise sensitive land uses in the South Dakota Facility area. These were conservatively estimated to be homes within 1,000 feet of the South Dakota Facility.

14.3.2 *Potential Impacts*

Construction activities will generate short-term and intermittent noise. Construction noise will affect nearby residences on a short-term basis. During operation, transmission lines produce noise under certain conditions, called corona noise. The level of noise depends on conductor conditions, voltage level, and weather conditions. In foggy, damp, or rainy weather, transmission lines can create a crackling sound due to a small amount of electricity ionizing the moist air near the conductors. During heavy rain, the background noise level of the rain is usually greater than the noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, snow, and other times when there is moisture in the air, transmission lines will produce audible noise approximately equal to household background levels.

The South Dakota Facility was modeled to evaluate audible noise from high voltage transmission lines using the Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0 (U.S. Department of Energy – Undated). The model was executed under normal and maximum operating conditions for an H-frame and mono-pole structure at the edge of the South Dakota Facility ROW, to ensure that noise was not under-predicted. Model results are expressed as a mean average sound pressure level (L50), which means that 50 percent of the data points are greater and 50 percent of the data points are less than the stated value for a given time period. Noise from the transmission line is expected to be below average rural background noise levels. Table 17 lists the calculated audible noise.

Table 17. Calculated Audible Noise ~~Levels~~(L50) at the Edge of the Transmission Line ROW

Structure Type	~~Normal Operating~~Fair Weather Condition[1]	~~Maximum Operating~~ Foul Weather ~~Condition[2]~~Condition[1]
H-Frame Structure	17.0 dBA (L50)	42.0 dBA (L50)
Mono-Pole Structure (Delta)	18.2 dBA (L50)	43.2 dBA (L50)

[1] *Results shown are the maximum at the edge of the Right-of-Way for a current of 500 amps, which is about twice the expected initial loading of the facility.*

~~*Normal Operating Condition value is based on fair weather noise level.*~~

~~[2] *Maximum Operating Condition is based on foul weather noise level.*~~

Source: Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0

14.3.3 *Mitigation*

During construction, noise levels will be minimized by ensuring that construction equipment is equipped with mufflers that are in good working order. Construction activities will generally be limited to the hours of 7 a.m. to 9 p.m. No additional mitigation measures are necessary since there will be minimal noise impacts from the operation of the South Dakota Facility.

14.4 Satellite, Cellular, Radio, TV, and GPS Reception

Corona, which consists of the breakdown or ionization of air within a few centimeters of conductors and hardware, can generate electromagnetic "noise" at the same frequencies that radio waves are transmitted. This noise can cause interference with the reception of these signals depending on the frequency and strength of the radio signal. The effects of corona "noise" can intensify during wet weather (Chen, 2012). Routine maintenance activities such as tightening loose hardware on the transmission line can help minimize corona noise.

If radio interference from transmission line corona does occur, satisfactory reception from amplitude modulated (AM) radio stations can be restored by appropriate modification of (or addition to) the receiving antenna system. Moreover, AM radio frequency interference typically occurs immediately under a transmission line and dissipates rapidly outside of the ROW.

Structure Type	Structure Material	ROW Width (feet)	Approx. Structure Height (feet)	Approx. Structure Base Diameter (feet)	Approx. Foundation Diameter (feet)	Average Span Between Structures (feet)	Pole to Pole Span on Single H-Frame Structure (feet)
Guyed Mono-Pole	Steel	150	125-155	3-4 (tangent structures) 4-6 (angle structures)	3-5	1,000 (range of 700 – 1200)	N/A
H-Frame (if necessary)	Steel	150	100-130	3-4 (tangent structures)	3-5	1,000 (range of 700 – 1200)	30

23.2 Conductor Configuration

It is anticipated that each phase will consist of two conductor bundled (2x), TP (twisted pair) 477 kcmil (thousand circular mils), 26/7, Hawk, aluminum conductor steel reinforced (ACSR) or conductors of comparable capacity.

23.3 Proposed Transmission Site and Major Alternatives

The site of the South Dakota Facility is described in Sections 2.1 and 7.0, Appendix A, and shown on Exhibit 2. Section 8.0 outlines the route identification and selection process.

23.4 Reliability and Safety

23.4.1 *Transmission Line Reliability*

In general, transmission infrastructure is built to withstand weather extremes that can be encountered within this region. With the exception of severe weather conditions such as tornadoes and extreme ice, transmission lines usually only fail when they are subjected to conditions beyond the design parameters.

Transmission lines are automatically taken out of service by the operation of protective relaying equipment when a fault is detected on the system. Such interruptions are usually only momentary. Scheduled maintenance outages are also infrequent on high voltage transmission lines. As a result, the average annual availability of transmission infrastructure is very high, in excess of 99 percent.

23.4.2 *Safety*

The South Dakota Facility will be designed to meet the local, state, NESC and the Applicants' standards regarding clearance to ground, clearance to crossing utilities, clearance to buildings, strength of materials, and ROW widths. Construction crews will comply with local, state, NESC and the Applicants' standards regarding installation of facilities and standard construction practices. The Applicants' and industry safety procedures will be followed during and after installation of the transmission line.

The South Dakota Facility will be equipped with protective devices to safeguard the public from the transmission line if an accident occurs and a structure or conductor falls to the ground. The protective devices are breakers and relays located where the transmission line connects to the substation. The protective equipment will de-energize the transmission line should such an event occur. In addition, the substation will be fenced and access limited to authorized personnel. The costs associated with these measures have not been tabulated separately from the overall facility costs since these measures are standard practice for the Applicants.

23.4.3 *Electric and Magnetic Fields*

The term electromagnetic field (EMF) refers to electric and magnetic fields that are coupled together such as in high-frequency radiating fields. For the lower frequencies associated with power lines, EMF should be separated into electric fields (EFs) and magnetic fields (MFs), which arise from the flow of electricity and the voltage of a line and are measured in kilovolts per meter (kV/m) and milliGauss (mG), respectively. The intensity of the electric field is proportional to the voltage of the line, and the intensity of the magnetic field is proportional to the current flow through the conductors. Transmission lines operate at a power frequency of 60 hertz (cycles per second). See

Tables 22 through 23B, below, for more information.

23.4.3.1 **Electric Fields**

The electric field from a transmission line can couple with a conductive object, such as a vehicle or a metal fence, which is in close proximity to the line. This will induce a voltage on the object, and the magnitude of this voltage is dependent on many factors, including the weather condition, object shape, object size, object orientation, object to ground resistance, object capacitance, and location along the ROW. If the object is insulated or semi-insulated from the ground and a person touches it, a small current could pass through the person's body to the ground. This might be accompanied by a spark discharge and mild shock, similar to what can occur when a person walks across a carpet and touches a grounded object or another person.

To ensure that any discharge does not reach unsafe levels, the NESC requires that any discharge be less than 5 milliamperes (mA). Based on the Applicants' transmission line operating experience, the discharge from any large mobile object—such as a bus, truck, or farm machinery—parked under or adjacent to the line would be unlikely to reach levels considered to be an annoyance, and will be less than the 5 mA NESC limit. The Applicants will also ensure that any fixed object, such as a fence or other large permanent conductive object close to or parallel to the line, will be grounded such that any discharge would be less than the 5 mA NESC limit.

Currently, there are no state regulations within South Dakota for maximum electric field limits for transmission line siting. The facilities will comply with the recommended NESC standards.

23.4.3.2 **Magnetic Fields**

Current passing through any conductor, including a wire, produces a magnetic field in the area around the wire. The magnetic field associated with an HVTL surrounds the conductor and decreases rapidly with increasing distance from the conductor. Considerable research has been conducted to determine whether exposure to power-frequency (60 hertz) magnetic fields causes biological responses and health effects.

EMF research expert Dr. Peter A. Valberg provided testimony in 2010 (Valberg, 2010) on EMF calculation and potential health effects, and the conclusions of his 2009 literature review (Valberg, 2009) of the status of scientific research on potential health effects. He summarized scientific research on HVTLs and MFs as:

> [T]hese studies do not change the factual conclusion that power-line MF exposure is not an established cause of health effects, as has been detailed throughout this report. As has been noted, the overall weight of evidence, combing the epidemiology with laboratory-animal and mechanistic research, fails to support a role for power-line MF in disease risk... [overall] the scientific research literature to date remains an insufficient basis for assigning any actual health risk to power-line MF exposure levels.

23.4.3.3 <u>Recent Research on EMF Exposure and Human Health</u>

Many organizations have conducted recent research on EMFs from extremely low frequency (ELF) source to study their potential effects on human health and safety as a follow-up to studies conducted primarily in the 1980s and 1990s which correlated EMFs and adverse health risks.

In 2007, the World Health Organization (WHO, 2007) made the following statement regarding effects of EMFs on health:

> Given both the weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukemia, and the limited impact on public health if there is a link, the benefits of exposure reduction on health are unclear. Thus, the costs of precautionary measure should be very low.

The 2009 President's Cancer Panel heard testimony concerning ELF, radio frequency (RF), and MFs and discussed that prior to 1996, the epidemiologic studies shared weaknesses that once recognized and accounted for, along with the testimony heard, "U.S. environmental organizations... generally conclude that the link between ELF-MF and cancer is controversial or weak." (Reuben, 2010).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) reviewed scientific studies performed since its last published guidelines in 1998 that established exposure limitations to EMFs and published their recommendations in 2010 (ICNIRP, 2010), concluding:

> [S]cientific data available so far do not indicate that low frequency electric and/or magnetic fields affect the neuroendocrine system in a way that these would have an adverse impact on human health. There is no substantial evidence for an association between ELF exposure and diseases such as Parkinson's disease, multiple sclerosis, and cardiovascular diseases. The evidence for an association between low frequency exposure and Alzheimer's disease and amyotrophic lateral sclerosis is inconclusive. The evidence for an

association between low frequency exposure and developmental and reproductive effects is very weak.

In addition, the 2010 ICNIRP recommendations stated "evidence that prolonged exposure to ELF-MF is causally related with an increased risk of childhood leukemia is too weak to form the basis for exposure guidelines."

There is no federal standard for transmission line electric fields, nor state standards in South Dakota. EMF levels for the Project at the edge of the ROW are below the ICNIRP guidelines (830 mG and 4.2 kV/m) for public exposure to EMF. The Project EMF levels are also below IEEE Standard C95.6-2002 both outside and within the ROW (9,040 mG, 5 kV/m outside the ROW, and 10 kV/m within the ROW). ~~and how the calculated levels at any location within the ROW are below the ICNIRP guidelines (2,000 mG and 4.2 kV/m) for public exposure to EMF.~~ Tables 22 through 23B show~~s~~ the calculated EMF levels for the Project. The H-frame structure produced the highest levels of electric and magnetic fields.

~~Table 23 shows the calculated EMF levels for the H-frame structure on ROW and at the ROW edge. Computations were performed using Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0 (U.S. Department of Energy, undated).~~

Table 22. Maximum Calculated EMF Levels for Each Structure Type on the ROW ~~for the Project~~

Project Load Condition	Electric Field (kV/m)[1]		Magnetic Field (mG)	
	H-Frame Structure	Mono-pole Structure	H-Frame Structure	Mono-pole Structure
Normal Operating Condition[2]~~[1]~~	6.72	5.85	55.69~~7~~	39.29~~3~~
Maximum Operating Condition[3]~~[2]~~	6.72	5.85	445.51~~267.3~~	~~188.6~~314.31

[1] This value depends on voltage and is expected to be relatively constant (will vary slightly if the operating voltage changes). Results are calculated at the operating voltage of 1.05 per unit.

[2] Normal Operating Condition value is for predicted flow of ~250 Amps

[3] Maximum Operating Condition value is based on ~2,000 Amps

~~*[1] Normal Operating Condition value is for predicted flow of 140 megawatt (MW) (~250 Amps).*~~

~~*[2] Maximum Operating Condition value is based on 1200 Amps (line rating).*~~

Source: Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0

Table 23A. Maximum Calculated EMF Levels for the H-Frame Structure

Project Load Condition	Electric Field (kV/m)[1]		Magnetic Field (mG)	
	On ROW	Edge ROW	On ROW	Edge ROW
Normal Operating Condition[2]	6.72	1.93	55.69~~7~~	15.34
Maximum Operating Condition[3]	6.72	1.93	445.51~~267.3~~	~~73.6~~122.74

[1] This value depends on voltage and is expected to be relatively constant (will vary slightly if the operating voltage changes). Results are calculated at the operating voltage of 1.05 per unit

[2] Normal Operating Condition value ise for predicted flow of ~250 Ampsis for predicted flow of 140 megawatt (MW) (~250 Amps).

[3] Maximum Operating Condition value is based on ~12,000 Amps (line rating).

Source: Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0

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Table 23B. Maximum Calculated EMF Levels for the Single-Pole Structure

Project Load Condition	Electric Field (kV/m)[1]		Magnetic Field (mG)	
	On ROW	Edge ROW	On ROW	Edge ROW
Normal Operating Condition[2]	5.85	1.25	39.29	8.47
Maximum Operating Condition[3]	5.85	1.25	314.31	67.72

1 This value depends on voltage and is expected to be relatively constant (will vary slightly if the operating voltage changes). Results are calculated at the operating voltage of 1.05 per unit

2 Normal Operating Condition value is for predicted flow of ~250 Amps

3 Maximum Operating Condition value is based on ~2,000 Amps

Source: Bonneville Power Administration's Corona and Field Effects Program CORONAII version 3.0

To date, the most exhaustive research done on HVTL and cancer was conducted over a 35-year span with one of the largest study groups of persons near HVTLs ever used for EMF research in March of 2013 (Shaddick et al., 2013). Their case-controlled study investigating cancer risks and ELF-MF from high-voltage lines concluded that their "results do not support an epidemiologic association of adult cancers with residential magnetic fields in proximity to high-voltage overhead power lines."

While the general scientific consensus is that electric fields pose no risk to humans, the question of whether exposure to magnetic fields potentially can cause biological responses or even health effects continues to be the subject of research and debate despite current scientific evidence showing no correlation with distance to HVTL and adverse health effects. In addressing this issue, the Applicants provide information on EMF to the public, interested customers and employees to assist them in making an informed decision on EMF. The Applicants will provide measurements for landowners, customers, and employees who request them. In addition, the Applicants have followed the "prudent avoidance" guidance suggested by most public agencies. This includes using structure designs that minimize magnetic field levels and attempting to site facilities in locations with lower residential densities.

EMF will be strongest directly under the transmission line and decrease with increasing distance from the transmission line toward the ROW edge. The Applicants conducted an analysis of calculated EMF levels for the Project (as shown in Tables 22 through 23B). As load changes on the transmission line, the electric current flow changes; therefore, the MFs change.

At the maximum-load operating condition on the ROW edge, the EF is 1.9 kV/m and the MF is 122.7 mG. The results of the Applicants' analysis show that calculated EMF levels for the South Dakota Facility under maximum operating conditions and normal operating conditions on the edge of the ROW are below the published guidelines from ICNIRP and IEEE.

23.4.4 *Stray Voltage*

"Stray voltage" is a condition that can occur on the electric service entrances to structures from distribution lines—not transmission lines. More precisely, stray voltage is a voltage that exists between the neutral wire of the service entrance and grounded objects in buildings such as barns and milking parlors.

Transmission lines do not, by themselves, create stray voltage because they do not connect to businesses or residences. However, transmission lines can induce stray voltage on a distribution circuit that is parallel to and immediately under the transmission line. Appropriate measures will be taken to address stray voltage concerns on a case-by-case basis.

23.4.5 *Farming Operations, Vehicle Use, and Metal Buildings Near Power Lines*

All current farming operations in the area are compatible with the construction and operation of the South Dakota Facility.

Insulated electric fences used in livestock operations can pick up an induced charge from transmission lines. Shocks can be caused when a charger is disconnected. This can be prevented by either shortening an insulator with a wire or installing an electric filter.

Farm equipment, passenger vehicles, and trucks may be safely used under and near power lines. The power lines will be designed to meet or exceed minimum clearance requirements over roads, driveways, cultivated fields, and grazing lands as specified by the NESC. Recommended clearances within the NESC are designed to accommodate a relative vehicle height of 14 feet.

There is a potential for vehicles under HVTLs to build up an electric charge. If this occurs, the vehicle can be grounded by attaching a grounding strap to the vehicle long enough to touch the earth. The Applicants do not recommend refueling vehicles directly under or within 100 feet of a power line 200 kV or greater.

Buildings are permitted near transmission lines but are generally prohibited within the ROW. Any person with questions about new or existing metal structures near the ROW may contact the Applicants for further information about proper grounding requirements.

23.4.6 *Right-of-Way or Condemnation Requirements*

The schedule for contacting landowners will be developed by the Applicants and formal option easement negotiations began in the summer of 2013. The Project will require the acquisition of easements to cross private property and the coordination with appropriate agencies where the line shares ROW with other public utilities or public roads. The majority of affected landowners are aware of the South Dakota Facility. Land rights agents will continue to work with the landowners to answer questions about the South Dakota Facility and to obtain permission for route surveys, environmental surveys, and soil investigations to