3.11 NOISE

"Noise" is generally defined as unwanted sound. The effects of noise on people range from annoyance and inconvenience to temporary or permanent hearing loss. Since the human ear is not equally sensitive to sound at all frequencies, a specific frequency-dependent rating scale was devised to relate noise to human sensitivity. Sound wave intensity is measured in decibels (dB). An A-weighted dB (dBA) scale performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. The basis for compensation is the faintest sound audible to the average ear at the frequency of maximum sensitivity. This A-weighted dB scale has been chosen by most authorities for purposes of environmental noise regulation.

Typical sounds in most communities range from 40 dBA (very quiet) to 100 dBA (very loud) or higher. Conversation is roughly 60 dBA at 3 to 5 feet. As background noise levels exceed 60 dBA, speech intelligibility becomes increasingly difficult. Noise becomes physically discomforting at 110 dBA. The above sound levels are stated in terms of short-term maximum sound. Some typical noise levels are given in the following table:

TABLE 3.11-1: TYPICAL SOUND LEVELS FOR COMMON SOURCES IN A-WEIGHTED DECIBELS

Source/Location	Sound Level
Threshold of Hearing	0 dBA
Motion Picture Studio - Ambient	20 dBA
Library	35 dBA
Chicago Suburbs – nighttime minimum	40 dBA
Wind in Deciduous Trees (2-14 mph)	36-61 dBA
Falling Rain (Variable Rainfall Rates)	41-63 dBA
Tomato Field on California Farm	44 dBA
Small Town/Quiet Suburb	47-53 dBA
Private Business Office	50 dBA
Light Traffic at 100 ft Away	50 dBA
Average Residence	50 dBA
Large Retail Store	60 dBA
Accounting Office	60 dBA
Boston - Inside House on Major Avenue	68 dBA
Average Traffic on Street Corner	75 dBA
Inside Sports Car (50 mph)	80 dBA
Los Angeles - ¾ mile from Jet Landing	86 dBA
Inside New York Subway Train	95 dBA
Loud Automobile Horn (at 1 m)	115 dBA

Source: EPA 1974, IEEE 1974, Miller 1978

Additional units of measurement have been developed to evaluate the long-term characteristics of sound. The equivalent noise level (L_{eq}) is a single-number representation of the fluctuating sound level in decibels over a specified period of time. The L_{eq} of a time-varying sound is equivalent or equal to the level of a constant unchanging sound.

Other noise descriptors include L_{10}, L_{50}, and L_{90}. These descriptors indicate what percentage of time a certain noise level would be exceeded. For example, a L_{50} of 65 dBA indicates that 50% of the time, noise levels would be greater than 65 dBA at a certain location.

A number of government agencies have adopted the day-night averaged noise level or L_{dn} as their noise metric to evaluate noise compatibility. The L_{dn} represents a time-weighted 24-hour average noise level based on the A-weighted decibel. "Time-weighted" refers to the fact that noise occurring during certain sensitive time periods (nighttime, when other background sounds are relatively subdued) is adjusted for occurring at those times. L_{dn} includes an additional 10 dBA adjustment for noise events occurring during nighttime (10 p.m. to 7 a.m.). In effect, the L_{dn} is roughly equivalent to the L_{eq} over a 24-hour period, with "penalties" added to noise events occurring late at night and early in the morning. A 10 dBA change in noise level is perceived by most people as a doubling of sound level. The smallest perceivable change in noise levels is 3 dBA. An increase of 5 dBA is more clearly noticeable by the human ear.

The U.S. Environmental Protection Agency (EPA) has an outdoor activity noise guideline of 55 dBA (EPA 1974). This value represents the sound energy averaged over a 24-hour period; it has a 10 dBA nighttime weighting (between 10:00 p.m. and 7:00 a.m.) (EPRI 1982).

Ambient, or background noise, is the all-encompassing noise associated with a given environment (usually a composite of sounds from many near and far sources). Outdoors, average nighttime ambient noise is, in general, lower than daytime ambient levels by approximately 5 dB. This difference, however, is widely affected by the characteristics of the area and environment. Ambient noise is usually most critical at nighttime during the summer, when people are resting, windows are often left open, and traffic noise is usually at a minimum. Average ambient daytime and nighttime sound levels for various types of neighborhoods are presented in Table 3.11-2.

TABLE 3.11-2: AVERAGE AMBIENT SOUND LEVELS

Type of Neighborhood	A-Weighted Ambient Sound Level (dBA)	
	Day	Night
Rural	35	35
Residential Suburban	40	35
Residential Urban	45	40
Commercial	50	45
Industrial	55	50

Operation of high voltage transmission lines and electric substation equipment can create audible noise. Transmission lines can generate a small amount of sound energy during corona activity. This audible noise from the line can barely be heard in fair weather conditions on higher voltage lines. During wet weather conditions, water drops collect on the conductor and increase corona activity so that a crackling or humming sound may be heard near the line. This noise is caused by small electrical discharges from the water drops. Audible noise would decrease with distance away from the transmission line. For substations, electrical transformers are generally the main source of audible noise (other than the associated transmission lines). Public concerns can develop concerning audible noise from electrical facilities in proximity to residences.

3.11.1 AREA OF ANALYSIS AND METHODOLOGY

The area of analysis for noise impacts consists of a 500-foot wide study corridor along the five route alternatives. Three representative transmission line configurations in the study area were selected to estimate project noise impacts:

1. Proposed 345 kV transmission line alone (e.g., along Segment C).
2. Proposed 345 kV transmission line paralleling existing 66/25 kV and 120 kV transmission lines (e.g., along Segment B near Crescent Valley).
3. Proposed 345 kV transmission line paralleling an existing 230 kV transmission line (e.g., along Segment J north of Ely).

Figures 3.11-1, 3.11-2 & 3.11-3 show diagrams of these transmission line configurations, while Figure 3.11-4 shows the locations where baseline noise measurements were taken. Configuration #1 was chosen to reflect conditions in undeveloped areas with very few houses. Configurations #2 and #3 were chosen to reflect conditions near existing transmission lines and highways.

For Configuration #1, existing noise levels were measured near the Segment C southeast of Beowawe. For Configuration #2, noise measurements were taken along Segment B near local residences outside of Crescent Valley (i.e., at the edge of the proposed right-of-way at station marker 69 + 09 : #5724). For Configuration #3, measurements were made near residences along Segment J northwest of Ely (i.e., at the edge of the proposed right-of-way near Hercules Gap). Measurements were conducted at the proposed 345 kV transmission line right-of-way edge at a 1.5-meter microphone height in accordance with Institute of Electrical and Electronics Engineers (IEEE) standards (IEEE 1992).

The project also includes the installation of additional facilities at the existing Falcon and Gonder substations. The Falcon 345/120 kV substation would have new electrical equipment installed but is not near any local residences. The Gonder 230/69 kV substation does have a few local residences nearby. The closest house just north of the substation is owned by SPPC and is intended for use by their personnel and construction contractors. The substation would be upgraded to 345 kV. New 230 kV buswork would be required to connect to the existing 230 kV ring bus. New equipment includes two 230 kV power circuit breakers, two 345/230 kV- 300 MVA transformers, two 345 kV power circuit breakers, and two 345 kV reactors to control voltage.

The Gonder substation pad and fenced area would require an approximate 6.2-acre expansion. Figures 2-5 and 2-7 in Chapter 2 show the existing and proposed configurations for the Gonder substation. The new 345/230 kV transformers would be located near the present northern property line boundary.

METHODOLOGY

Field measurements and calculations of estimated noise levels were performed by Enertech, Inc. (2000). Baseline audible noise measurements were recorded along the transmission line routes for each of the three line configurations and at the Gonder substation to identify existing conditions (see Figures 3.11-4 -5,-6,-7,-8 &-9). For general sound level measurements, a precision integrating sound level meter was used (Bruel & Kjaer Type 2236). A sound level meter consists basically of a microphone, a set of frequency weightings that alter the relative importance of the frequencies of a complex sound, an amplifier, and an RMS indicating instrument.

The standardized weighting networks are denoted A and C, with octave bands. The A weighting, most commonly used in transmission line and transformer sound measurements, approximates the human ear's response by attenuating the response of the meter to frequencies below 1 kHz. The C weighting inserts somewhat less attenuation at lower frequencies and provides a flatter response. The octave band permits measurement of the level of a very narrow range of frequencies and thus allows an accurate analysis of the noise composition.

FIGURE 3.11-1: CONFIGURATION #1: PROPOSED 345 kV TRANSMISSION LINE ALONE

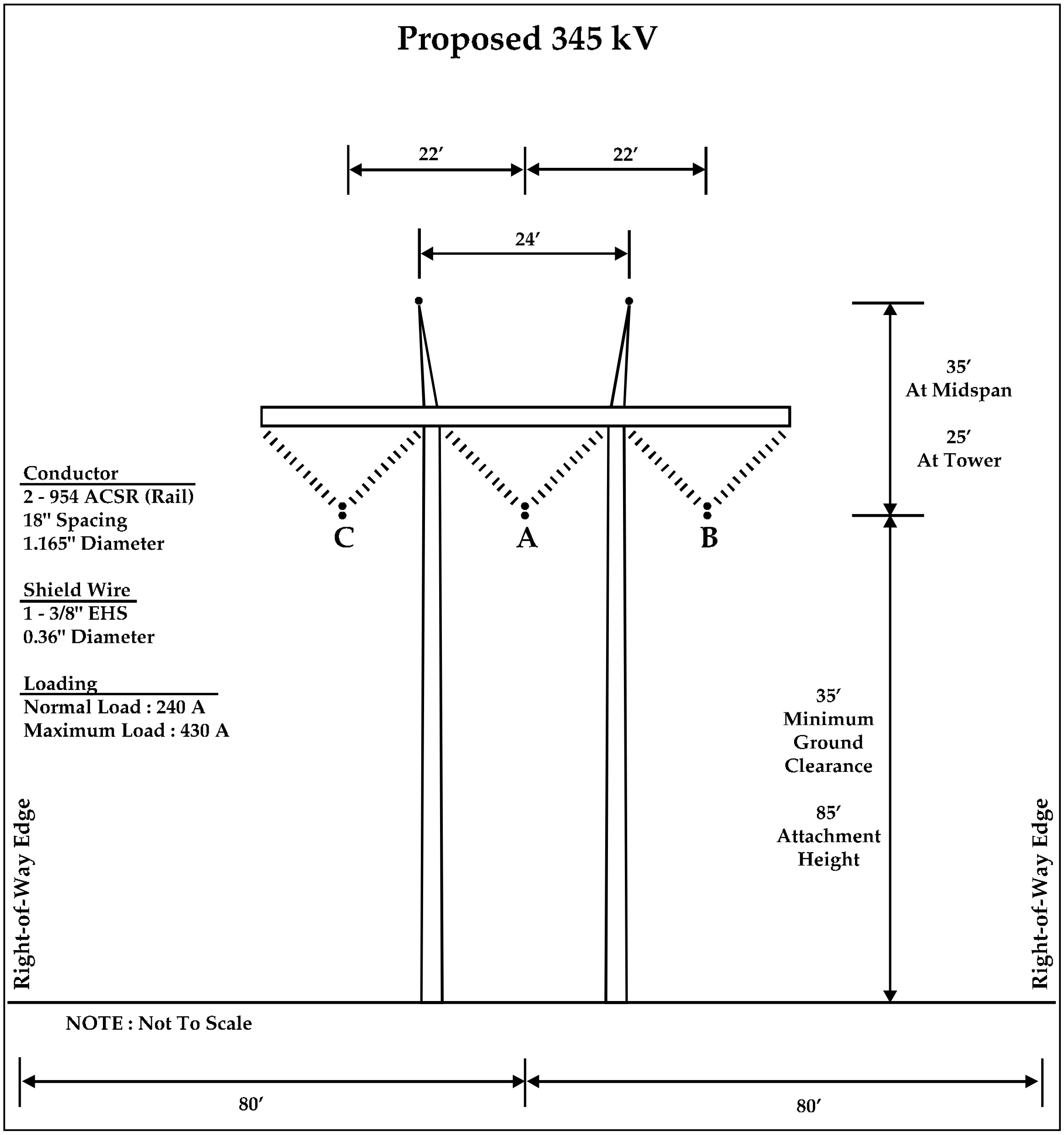


FIGURE 3.11-2: CONFIGURATION #2: PROPOSED 345 KV TRANSMISSION LINE PARALLELING EXISTING 66/25 KV AND 120 KV TRANSMISSION LINES

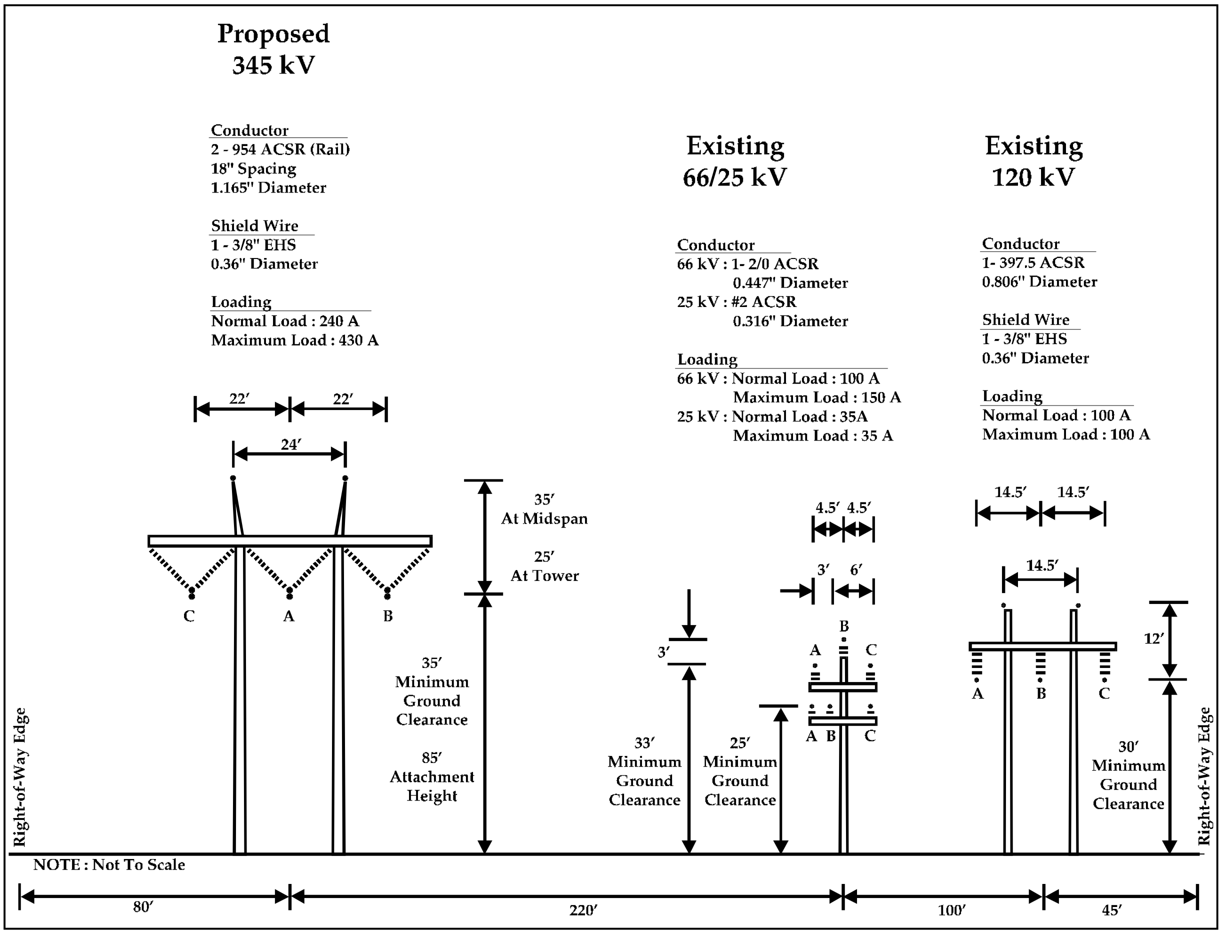


FIGURE 3.11-3: CONFIGURATION #3: PROPOSED 345 KV TRANSMISSION LINE PARALLELING EXISTING 230 KV TRANSMISSION LINE

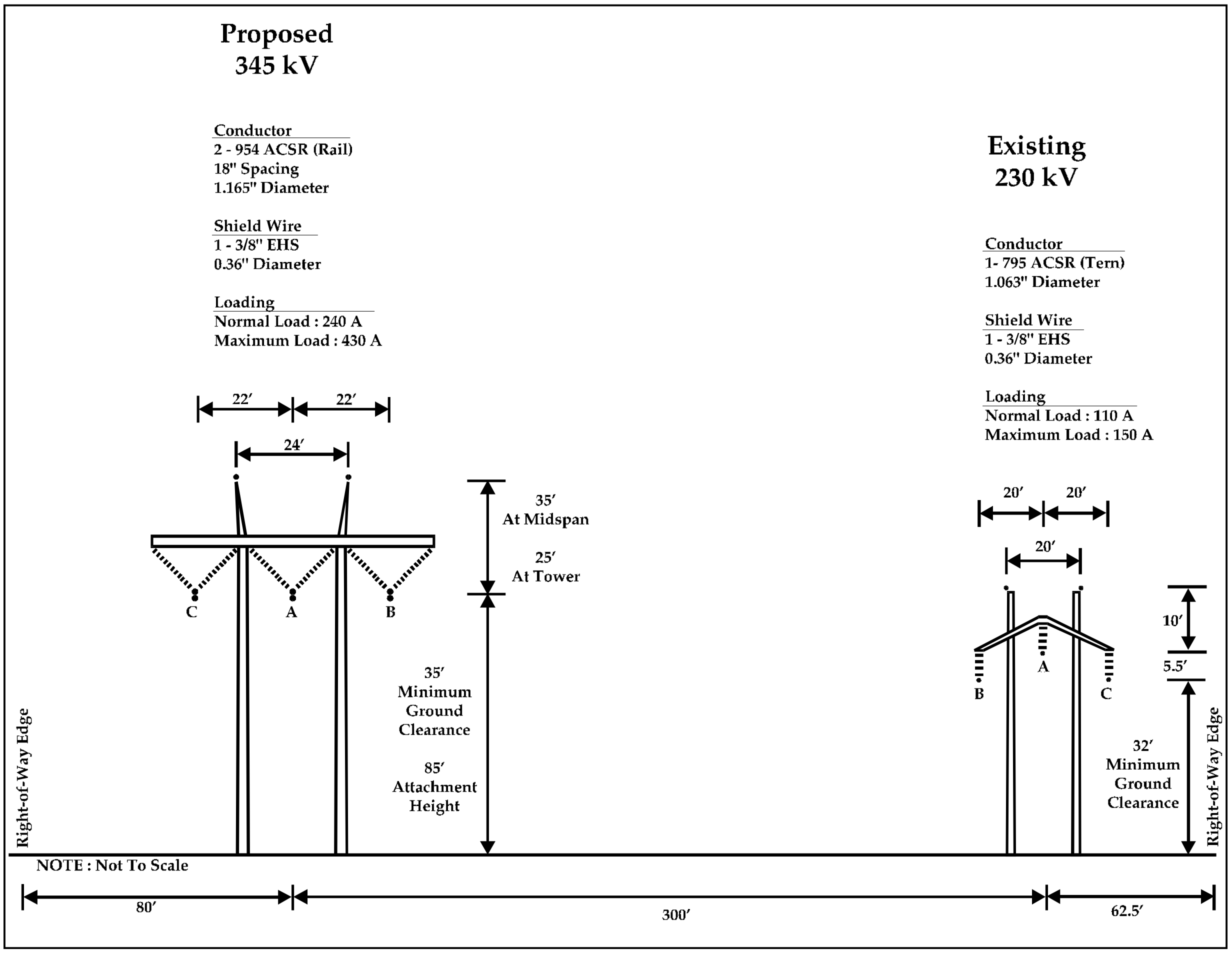


FIGURE 3.11-4: BASELINE NOISE MONITORING LOCATIONS

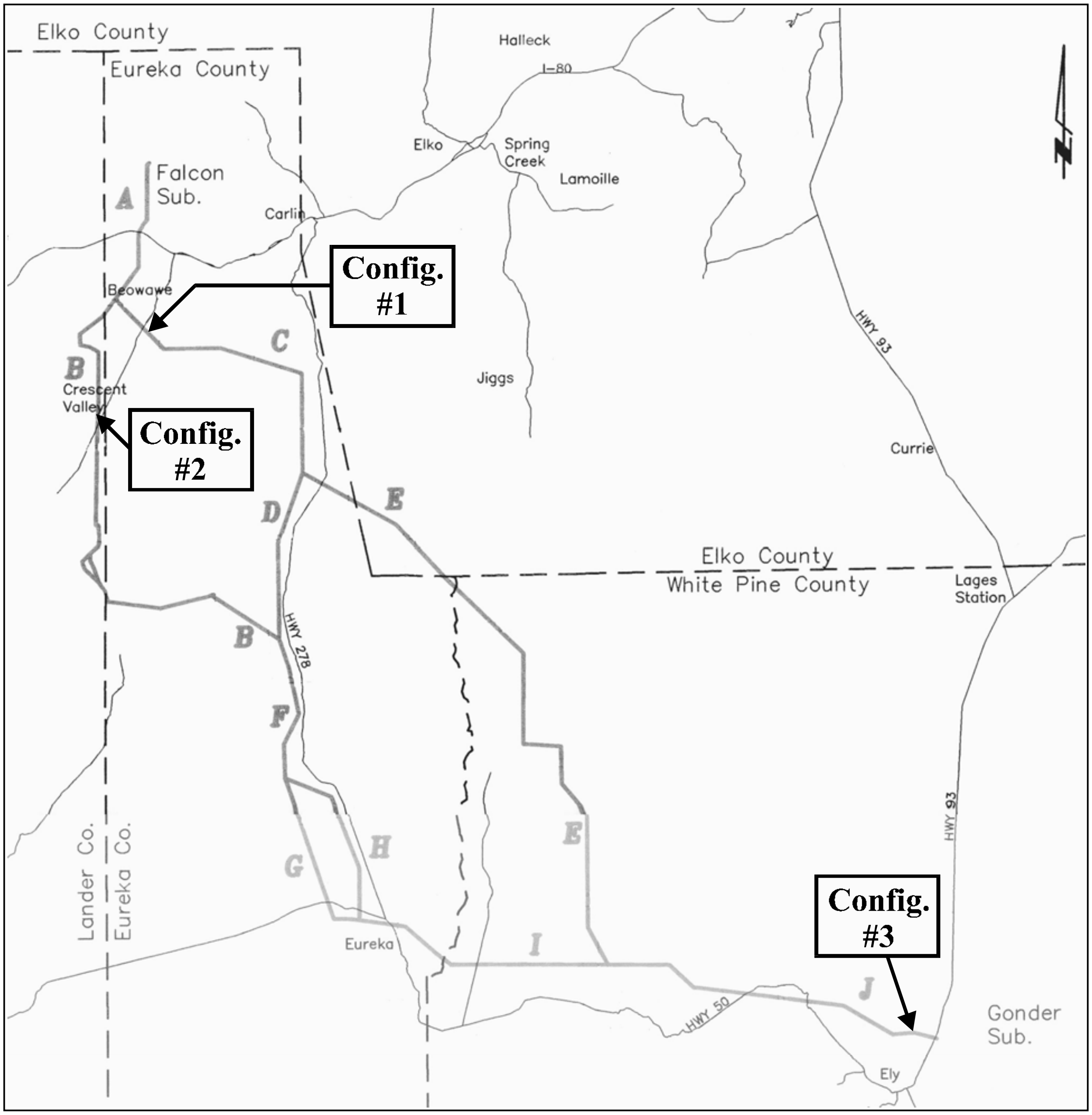


FIGURE 3.11-5: AUDIBLE NOISE MEASUREMENTS ALONG PROPOSED 345 KV TRANSMISSION LINE ROUTE SOUTHEAST OF BEOWAWE, NEVADA (CONFIGURATION #1)

FIGURE 3.11-6: AUDIBLE NOISE MEASUREMENTS ALONG PROPOSED 345 KV TRANSMISSION LINE ROUTE AT CRESCENT VALLEY, NEVADA (CONFIGURATION #2)

FIGURE 3.11-7: AUDIBLE NOISE MEASUREMENTS ALONG PROPOSED 345 KV TRANSMISSION LINE ROUTE AT ELY, NEVADA (CONFIGURATION #3)

FIGURE 3.11-8: AUDIBLE NOISE MEASUREMENTS OF A 345/125 KV TRANSFORMER AT MIRA LOMA SUBSTATION IN RENO, NEVADA

FIGURE 3.11-9: AUDIBLE NOISE MEASUREMENTS AT GONDER SUBSTATION IN ELY, NEVADA

In cases where a transmission line is proposed to be constructed, audible noise values can be calculated using computer modeling software. These programs allow the transmission line configuration information and other parameters to be entered into the program. The software then calculates what the audible noise would be at a defined location, based upon the input data. Computer models have been developed by the Bonneville Power Administration (BPA 1977), and computational results compare well with actual measurement data.

To analyze project impacts, baseline noise measurement data were then combined with the calculated noise values to estimate a resulting audible noise level for the proposed 345 kV transmission line. For the proposed Gonder substation upgrade and expansion, the two main impacts on audible noise would be the addition of two 345/230 kV transformers and the extension of the substation property line toward existing residences. Audible noise lateral profile measurements were conducted around an existing energized 345/125 kV transformer in Reno, Nevada to characterize noise levels from the energized transformer.

Figure 3.11-8 presents a photograph of audible noise lateral profile characterization measurements at the Mira Loma Substation in Reno, Nevada where an energized 345/125 kV transformer was measured. These lateral profile characterization measurements were combined with existing ambient substation measurements (both daytime and nighttime measurements) at the existing substation property line and at the proposed expansion property line to estimate resulting audible noise levels due to the project.

REGULATORY FRAMEWORK

Noise Regulations and Guidelines

A number of government agencies have established noise standards and guidelines to protect citizens from potential hearing damage and various other adverse physiological and social effects associated with noise. The EPA has identified noise levels affecting health and welfare. One of the functions of their noise standards is to provide guidance for state and local governments when developing their own standards. A 24-hour exposure level of 70 dB has been set to prevent any measurable hearing loss over a lifetime.

In addition, an outdoor level of 55 dB and indoor level of 45 dB was set to ensure there is no activity interference or annoyance. These levels are averages of acoustical energy over long periods of time. They do not correspond to a single event level or peak level. For example, it is permissible to reach levels above 70 dB as long as there is sufficient amount of relatively quite time. Noise levels for various areas depend on the use of the area. A level of 45 dB is set for indoor residential areas, hospitals, and schools, and a level of 55 dB is set for areas of outside human activity.

3.11.2 AFFECTED ENVIRONMENT

The affected area is mostly rural or rural residential. There are no major stationary noise sources along the proposed transmission line segments. Traffic noise is the primary noise source in the area. Noise analyses customarily focus on potential impacts to "sensitive receptors" (i.e., noise-sensitive land uses such as residences, hotels, churches, auditoriums, schools, libraries, hospitals, and parks). To identify potential "sensitive receptors" that could be impacted by project noise, a land use survey was conducted by Stantec in July 2000 using a helicopter and global positioning system.

This survey identified approximately 30 buildings (mostly residences) within 1,000 feet and 280 buildings within 1.5 miles of the Crescent Valley (a) route (as measured from the proposed centerline). The Crescent Valley (b) route has approximately 34 buildings within 1,000 feet and 335 buildings within 1.5

miles. The Pine Valley (a) route has approximately 18 buildings within 1,000 feet and 213 units within 1.5 miles, while the Pine Valley (b) route has about 22 buildings within 1,000 feet and 288 units within 1.5 miles. The Buck Mountain route has about 13 buildings within 1,000 feet and 173 buildings within 1.5 miles. Segments A, B, H, I, and J are the only ones with homes within 1,000 feet of the centerline (Stantec 2000).

EXISTING NOISE

Audible noise measurements were conducted along the proposed 345 kV transmission line route for each of the three possible line configurations. Measurements were conducted on July 18 and 19, 2000 to characterize existing noise levels. Two types of measurements were conducted at each location: (1) a set of spot measurements including the A-scale, C-scale, and selected octave bands; and (2) a 2-hour series of measurements on the A-scale only. Table 3.11-3 presents the results of the spot measurements, while Table 3.11-4 presents the 2-hour series measurements. The presence or absence of wind, and the range of wind speed and gusting winds, contributed significantly to the level of measured audible noise.

TABLE 3.11-3: SPOT MEASUREMENTS OF SOUND LEVELS ALONG PROPOSED 345 KV TRANSMISSION LINE ROUTE (AT THE PROPOSED ROW EDGE)

Configuration/Location/ Date/Time of Day/ Weather Conditions	Existing Measured Audible Noise Sound Levels - dB										
	Scale		Selected Octave Bands								
	A	C	31.5	63	125	250	500	1K	2K	4K	8K
#1 : No Existing Lines Segment "C" (Southeast of Beowawe) July 18, 2000 @ 1:30 PM (88 °, 10 – 12% humidity, 2 – 7 mi/hr winds gusting)	25	59	62	55	43	27	22	13	12	12	15
#2 : Existing 66/25/120 kV Segment "B" (Crescent Valley) July 18, 2000 @ 10:15 AM (84°, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	23	54	50	31	32	16	15	10	10	11	13
#3 : Existing 230 kV Segment "J" (Ely/Hercules Gap) July 19, 2000 @ 11:15 AM (89°, 10 – 12% humidity, 2 – 7 mi/hr winds gusting)	27	60	53	46	32	23	14	13	11	12	13

Measurement Height : 5-Foot

Audible noise measurements were conducted at the existing Gonder substation property line and at the proposed expansion property line (544 feet north of the existing northern property line). Daytime measurements were conducted on July 19, 2000 (3:00 – 5:30 PM) to characterize existing daytime noise levels. Nighttime measurements were conducted on July 20, 2000 (12:00 – 2:30 AM) to characterize existing nighttime noise levels.

TABLE 3.11-4: 2-HOUR MEASUREMENTS OF SOUND LEVELS ALONG PROPOSED 345 KV TRANSMISSION LINE ROUTE (AT THE PROPOSED ROW EDGE)

Configuration/Location/ Date/Time of Day/ Weather Conditions	Existing Measured Audible Noise Sound Levels A-Scale – dBA		
	L50	L90	L10
#1 : No Existing Lines Segment "C" (Southeast of Beowawe) July 18, 2000, 1:30 – 3:30 PM (88 º, 10 – 12% humidity, 2 – 7 mi/hr winds gusting)	29	23.5	42
#2 : Existing 66/25/120 kV Segment "B" (Crescent Valley) July 18, 2000, 10:15 AM – 12:15 PM (84º, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	21.5	> 20	30
#3 : Existing 230 kV Segment "J" (Ely/Hercules Gap) July 19, 2000, 11:15 AM – 1:15 PM (89º, 10 – 12% humidity, 2 – 7 mi/hr winds gusting)	24	> 20	43

Range: 20 to 100 dBA
Measurement Height: 5-Feet

Two types of measurements were conducted at each location and for each measurement period: (1) a set of spot measurements including the A-scale, C-scale, and selected octave bands; and (2) a 1-hour series of measurements on the A-scale only. Table 3.11-5 presents the results of the spot measurements, while Table 3.11-6 presents the 1-hour series measurements. Gonder substation is located in proximity to Highway 93. This main highway is a significant source of ambient noise in local area, both during daytime and nighttime measurements.

TABLE 3.11-5: SPOT MEASUREMENTS OF SOUND LEVELS ALONG EXISTING AND PROPOSED GONDER SUBSTATION PROPERTY LINE

Location Description/ Date/Time of Day/ Weather Conditions	Existing Measured Audible Noise Sound Levels – dB										
	Scale		Selected Octave Bands								
	A	C	31.5	63	125	250	500	1K	2K	4K	8K
Existing Property Line July 19, 2000 @ 4:20 PM (90 º, 10 – 12% humidity, 2 – 5 mi/hr winds gusting)	49	66	55	61	67	50	41	35	25	20	21
Existing Property Line July 20, 2000 @ 1:20 AM (47º, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	42	56	46	54	57	47	37	28	21	17	18
Proposed Property Line July 19, 2000 @ 3:10 PM (90 º, 10 – 12% humidity, 2 – 5 mi/hr winds gusting)	41	59	60	53	56	40	31	23	35	18	13
Proposed Property Line July 20, 2000 @ 12:05 AM (58º, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	40	62	57	51	61	35	33	20	12	12	12

Measurement Height: 5-Feet

TABLE 3.11-6: 1-HOUR MEASUREMENTS OF SOUND LEVELS ALONG EXISTING AND PROPOSED GONDER SUBSTATION PROPERTY LINE

Configuration/Location/ Date/Time of Day/ Weather Conditions	Existing Measured Audible Noise Sound Levels A-Scale – dBA		
	L50	L90	L10
Existing Property Line July 19, 2000, 4:20 – 5:20 PM (90 º, 10 – 12% humidity, 2 – 5 mi/hr winds gusting)	50.5	49.5	51.5
Existing Property Line July 20, 2000, 1:20 – 2:20 AM (47º, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	40.5	39.5	42.0
Proposed Property Line July 19, 2000, 3:10 – 4:10 PM (90 º, 10 – 12% humidity, 2 – 5 mi/hr winds gusting)	43.5	40.5	52.5
Proposed Property Line July 20, 2000, 12:05 – 1:05 AM (58º, 10 – 12% humidity, 2 – 4 mi/hr calm winds)	36.5	33.5	43.0

Range: 20 to 100 dBA
Measurement Height: 5-Feet

3.11.3 ENVIRONMENTAL CONSEQUENCES

SIGNIFICANCE CRITERIA

Project noise impacts would be considered significant if:

- Project construction activities would result in noticeable (3 dBA or greater) increases in noise levels.
- Project operation would result in an ambient noise level increase of 3 dBA or more at sensitive receptors.

ENVIRNONMENTAL IMPACTS – COMPARISON OF ALTERNATIVES

Impacts Common to all Route Alternatives

Construction Noise and Ground Vibration Impacts

Construction Equipment Noise

Short-term noise increases associated with the operation of off-highway construction equipment during the construction period would be anticipated on and around the transmission line corridor, substations, and material yards. The EPA has found that the noisiest equipment types operating at construction sites typically range from 88 to 101 dBA at a distance of 50 feet. Table 3.11-7 presents noise levels typically generated by construction equipment.

Noise from localized point sources, such as construction equipment, typically decreases at a rate of approximately 6 dB per doubling of distance from the source. For this analysis, sound levels generated during the various construction activities were estimated based on this noise attenuation rate and the equipment noise levels presented in Table 3.11-7. Assuming the simultaneous operation of the noisiest pieces of equipment, short-term construction-generated noise levels would likely range from a low of approximately 89 dBA at 50 feet during initial site preparation and final reclamation activities to a high of 91 dBA at 50 feet during tower foundation excavation. Based on these same assumptions, activities occurring at the material yards could generate noise levels of up to 91 dBA at 50 feet.

TABLE 3.11-7: TYPICAL CONSTRUCTION EQUIPMENT SOUND LEVELS

Equipment	Typical Sound Level @ 50 ft (in dBA)
Dump truck	88
Portable air compressor	81
Concrete mixer (truck)	85
Scraper	88
Dozer	87
Paver	89
Generator	76
Rock drill	98
Pump	76
Pneumatic tools	85
Backhoe	85

Source: EPA 1974.

Assuming maximum construction-generated noise level of 91 dBA at 50 feet and an average exterior or interior structural attenuation of 15 dBA, inhabitants of residential dwellings within approximately 2,000 feet of the construction areas and material yards could experience increases in ambient noise levels of greater that 10 dBA. If construction activities occur during the more noise-sensitive periods of the day (i.e., evening and nighttime hours), resultant increases in ambient noise levels could result in sleep disruption to occupants of these residential dwellings. Because the project does not restrict construction activities to the less noise-sensitive hours of the day, construction-generated noise would be considered to have a major short-term impact to nearby noise-sensitive land uses.

Project-related construction would generate heavy-duty truck traffic during the various construction periods. Generally, long-term traffic noise levels along roadways would not noticeably increase until a substantial number of additional vehicle trips occur. Noticeable increases of 3 dBA (CNEL/L_{dn}) often require a doubling of roadway traffic volumes. However, high single-event noise exposure would increase with the increased volumes of heavy-duty truck traffic along local truck routes and the ROW associated with construction activities. Although these events could result in noticeable annoyance, they would not be considered significant noise impacts because they would not cause average daily noise levels to exceed 60 dBA (Ldn/CNEL) at the outdoor areas of residential or other noise-sensitive land uses. Construction-related traffic would be a short-term impact on local roadways and along the ROW during the 15 months of construction. As a result, short-term increases in traffic noise would be considered a minor impact.

Helicopters would be used to pull the sock line along the entire route and to deliver tower and transmission line equipment to isolated areas that are inaccessible by land travel. Most of these locations would be far removed from concentrations of residential or other noise sensitive land uses, but the few scattered residences near the transmission line construction areas would experience some helicopter noise. Flyby noise would also occur in transit between the staging areas and tower sites. Since noise from the use of helicopters during construction would be short-term, this would be a minor impact.

❑ ***Impact Noise-1: Short-term Construction Noise***

Construction activities associated with the transmission line and substation upgrades would result in temporary noise impacts. Noise would be generated by blasting, construction equipment, and also vehicle trips associated with construction activities. Assuming a maximum noise level of 91 dBA at 50 feet, construction activities occurring during the more noise-sensitive periods of the day (i.e., evening and nighttime hours) may result in potential sleep disruption to occupants or residential dwelling located within approximately 2,000 feet of the construction sites and material yards, and within 3,000 feet of blasting areas. This would be considered a significant, but short-term noise impact.

❑ ***Mitigation Measure Noise-1***

Noise control practices would be implemented during construction of the project by the construction contractors. Specific mitigation measures include:

- In areas adjacent to sensitive receptors (e.g., residences within 2,000 feet of construction sites and material yards, and within 3,000 feet of blasting areas), SPPC's construction contractors would be required to limit noisy demolition and construction activities to Monday through Saturday from 7:00 a.m. to 7:00 p.m. The specified hours of construction would not apply to construction work that does not substantially exceed exterior ambient noise levels as measured 10 feet from the exterior property line of the sensitive receptor. It also does not apply to driving on access roads.
- Construction equipment shall be equipped with mufflers. Prior to the use of construction equipment on the construction sites, the contractor shall demonstrate to the BLM Environmental Monitor that construction equipment that would be used on the project site is equipped with manufacturer recommended mufflers or equivalent mitigation.

Blasting

In addition to noise generated by equipment, construction of the tower foundations may require blasting for the removal of large boulders. Unlike equipment noise, which is based on units of A-weighted decibels and represents the root-mean-square energy value of the noise, the units used to describe blast noise are typically C-weighted peak values (dBC_{peak}). The C-weighting is used to more closely approximate the human perception of low frequency sound that is experienced with louder noise, such as blasting. The "peak" value is used to characterize impulse events of short duration (typically less than 0.5 second).

No standard criteria have been established for assessing impacts associated with impulse noise, such as blasting. However, a number of sources are available to assess the effects that blasting activities would have on nearby land uses, as identified below (Greene 1997).

Noise levels generated by blasting activities are dependent on a number of factors, including the type and amount of explosive used, the depth of the explosive is placed, the material within which the explosive is placed, and meteorological conditions. Maximum noise levels generated by large blasting operations (e.g., 375 pounds of explosive per blast) have been measured at approximately 120 dBC_{peak} (Greene 1997). Noise levels generated by smaller blasting activities, such as the blasting of boulders, would be anticipated to result in noise levels substantially less than 120 dBC_{peak}. In comparison to the various thresholds established for land use compatibility and human safety (as identified in Table 3.11-8), intermittent noise levels of less than 120 dBC_{peak} would not result in damage to nearby structures nor result in a threat to public health and safety. However, depending on the distance to nearby land uses, impulse noise may result in a short-term (i.e., less than 0.5 second) increase in ambient noise levels. Increases exceeding the background noise by more than approximately 10 dB are potentially startling or sleep disturbing. If blasting activities occur during the more noise-sensitive periods of the day (e.g., evening and nighttime hours), resultant noise levels would likely result in increased annoyance and potential sleep disruption to occupants of the nearby residences located within approximately 3,000 feet of the site.

TABLE 3.11-8: BLASTING NOISE THRESHOLDS

IMPULSE NOISE THRESHOLDS		
Threshold (dB_{peak})	Threshold Descriptor	Source
154	Window Testing Threshold	Industry Standard
145	Window Breakage Threshold	U.S. Bureau of Mines
136.5	Noise/Land Use Compatibility; Damage Claim Threshold	U.S. Department of Army
140	Occupational Exposure	U.S. Dept. of Health and Human Services; OSHA
145 – 167	Hearing Loss Threshold (Dependent on Duration of Exposure)	Committee on Hearing and Bio-Acoustics

Sources: U.S. Dept of Health and Human Services (2001); Greene (1997); EPA (1974)

Ground-borne Vibration

Construction activities create seismic waves that radiate along the surface of the earth and down into the earth. These surface waves can be felt as ground vibration. Ground vibration can result in effects ranging from annoyance of people to damage of structures. The rate or velocity at which these particles travel, inches-per-second, is the commonly accepted descriptor of the vibration amplitude, referred to as the peak particle velocity (ppv).

There are no regulatory standards pertaining to ground-borne vibration and noise. The architectural damage risk level typically suggested by most agencies is 0.2 inches per second (in/sec) for continuous vibration. The U.S. Bureau of Mines (USBM) has established thresholds that can be applied to determine architectural damage risks associated with impulse vibration, such as those generated during blasting. For impulse vibrations at low frequencies, threshold velocities of ground vibration are restricted to lower levels. As vibration frequency increases, higher threshold velocities are allowed. Based on thresholds established by the USBM, the architectural damage risk levels would range from a minimum of 0.5 in/sec at 4 Hertz (Hz) to a maximum of 2 in/sec at 40 Hz. Below these thresholds, there is virtually no risk of building damage.

Equipment required for the construction of the towers and substations typically generates vibration velocities of approximately 0.089 in/sec, or less, at 25 feet. Assuming that blasting of boulders may be required for the placement of tower footings, the resultant peak particle velocity at the edge of the transmission line right-of-way would not be anticipated to exceed 0.5 in/sec. Because construction of the transmission line and substation would not require the use of equipment or activities that would generate groundborne vibration of sufficient velocity or duration that would cause damage to nearby existing structures, construction-generated ground-borne vibration would be considered to have a minor impact.

Transmission Line Noise Impacts

The Falcon to Gonder 345 kV transmission line would be designed to comply with the National Electrical Safety Code. Therefore, the project should not create significant or unusual impacts in area of audible noise. However, during corona activity transmission lines can generate a small amount of sound energy. This audible noise can increase during foul weather conditions. Water drops may collect on the surface of the conductors and increase corona activity so that a crackling or humming sound may be heard near a transmission line.

Transmission line audible noise is measured in decibels using a special weighting scale, the "A" scale that responds to different sound characteristics in a manner similar to the response of the human ear. Corona-induced noise tends to be broadband and can sometimes have a pure tone as well (usually at 120 Hz). Audible noise levels on well-designed 345 kV lines are usually not noticeable. For example, a typical calculated rainy weather audible noise for a 345 kV transmission line at the right-of-way edge is about the same or less than ambient levels in a library or typical daytime residential environments, and much less than background noise for wind and rain.

Estimated audible noise levels due to corona were calculated by Enertech (2000) for each of three transmission line configurations using computer modeling (BPA 1977). Table 3.11-9 presents a summary of the calculated audible noise levels for both fair weather and rainy weather conditions. Figures 3.11-10 3.11-11 & 3.11-12 present graphs of the calculated audible noise for the proposed configurations.

TABLE 3.11-9: CALCULATED AUDIBLE NOISE LEVELS FOR THE PROPOSED 345 KV TRANSMISSION LINE (AT THE PROPOSED ROW EDGE)

Configuration #	Location	Calculated Audible Noise	
		Fair L50 (dBA)	Rain L50 (dBA)
#1 : Proposed 345 kV	Either ROW Edge	28.0	53.0
#2 : 345/66/25/120 kV	345 kV ROW Edge	28.0	53.0
	120 kV ROW Edge	20.7	45.7
#3 : 345/230 kV	345 kV ROW Edge	28.4	53.4
	230 kV ROW Edge	27.5	52.5

FIGURE 3.11-10: CALCULATED AUDIBLE NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE ALONE

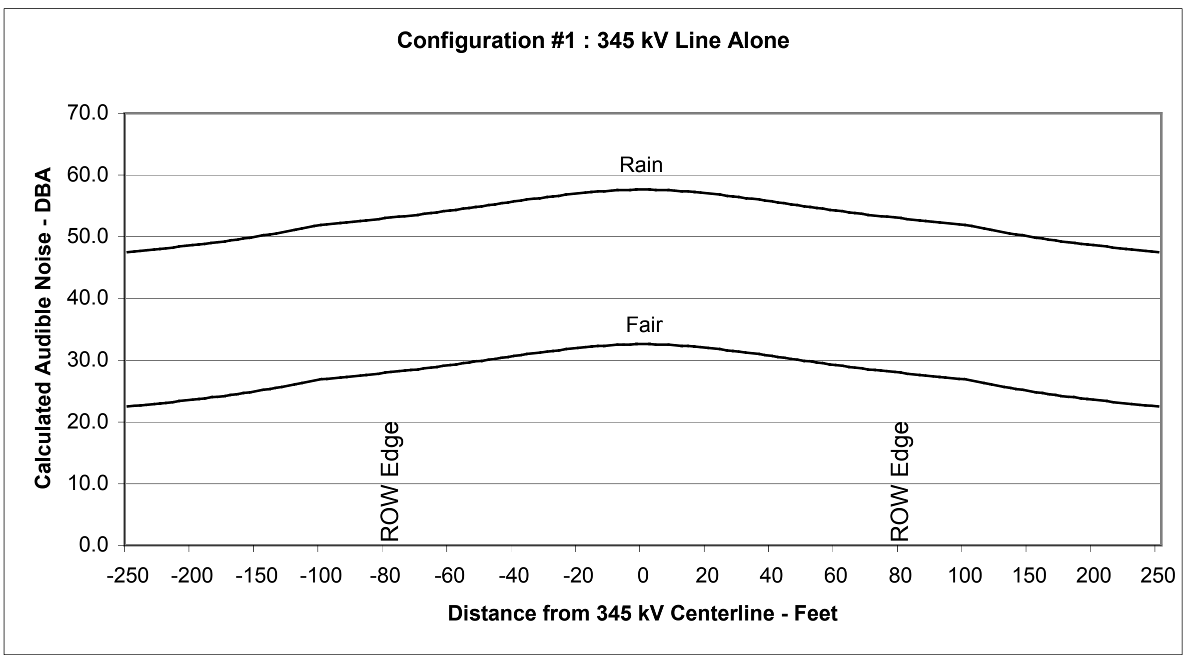


FIGURE 3.11-11: CALCULATED AUDIBLE NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING 66/25 KV AND 120 KV TRANSMISSION LINES

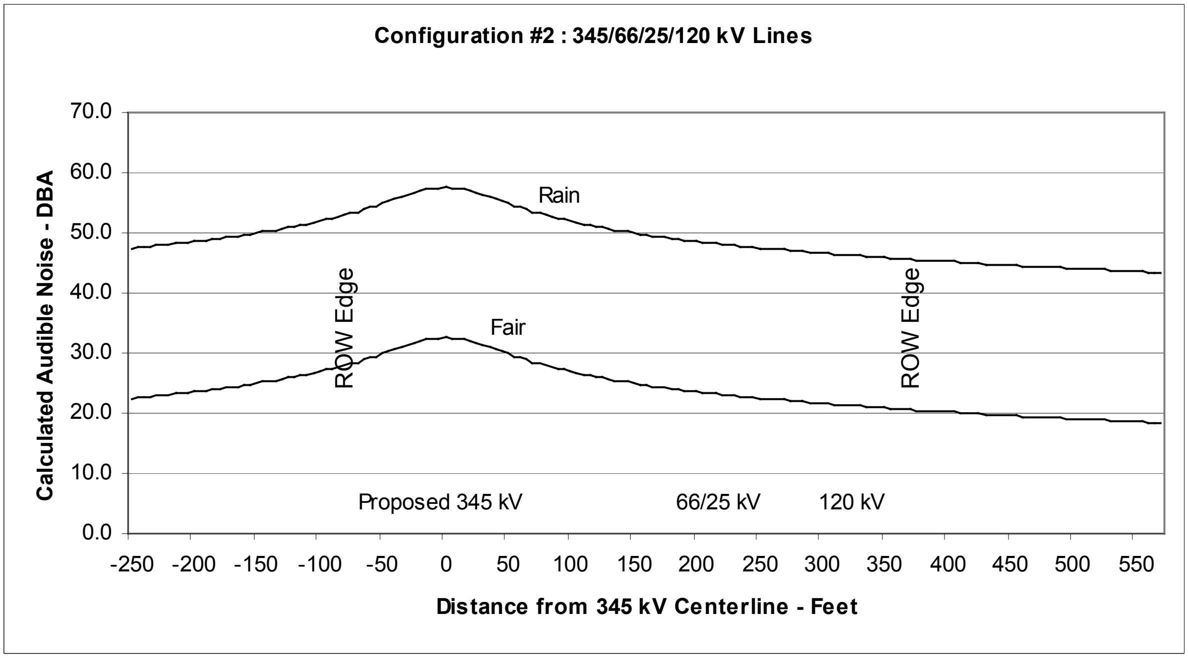
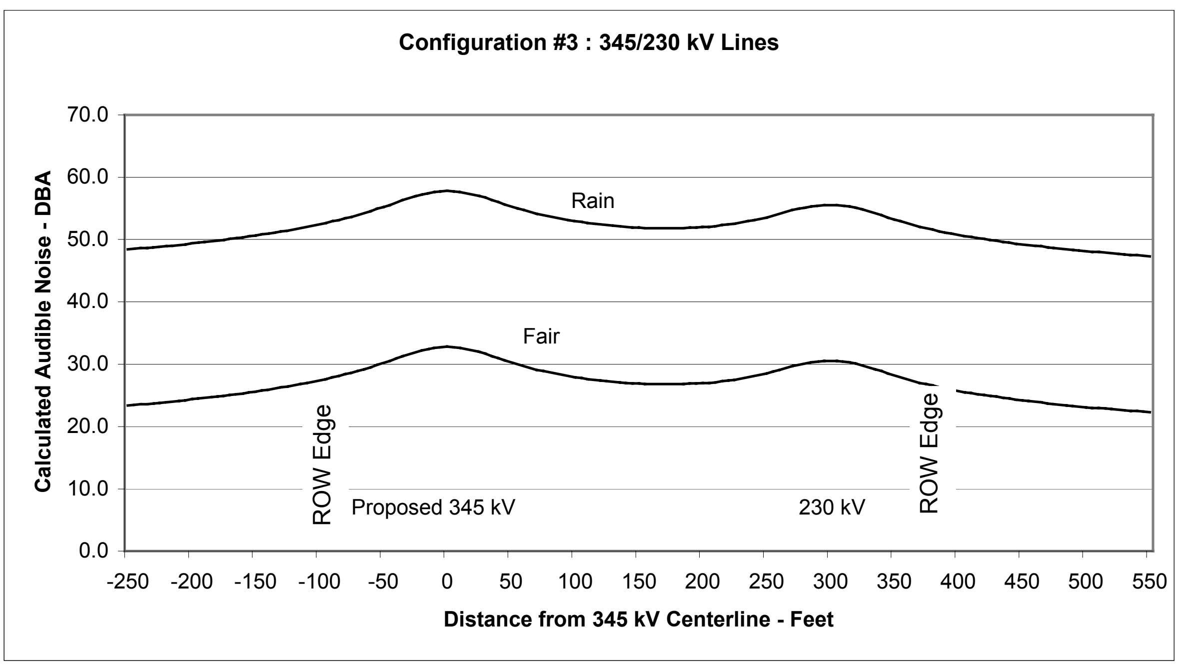


FIGURE 3.11-12: CALCULATED AUDIBLE NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING A 230 KV TRANSMISSION LINE



The ambient measured fair weather noise levels were combined with the calculated 345 kV transmission line noise values at the proposed right-of-way edge to estimate a resulting ambient noise level (IEEE

1998: 15). Because noise values are logarithmic units, they are combined on an energy basis using a logarithmic formula of addition. Table 3.11-10 presents these analysis results. As shown, the calculated increase in audible noise at the right-of-way edge is about 2.6 to 7.4 dBA, depending upon the configuration. Wind conditions contributed significantly to the ambient fair weather measurement values.

TABLE 3.11-10: COMBINED AMBIENT AND CALCULATED NOISE LEVELS FOR THE PROPOSED 345 kV TRANSMISSION LINE (AT THE PROPOSED ROW EDGE)

Configuration #	Fair Weather L50 Audible Noise Sound Levels - dBA		
	Measured Ambient	Calculated 345 kV	Combined Estimate
#1 : Proposed 345 kV	29.0	28.0	31.6
#2 : 345/66/25/120 kV	21.5	28.0	28.9
#3 : 345/230 kV	24.0	28.4	29.7

Ambient measured fair weather noise levels ranged from about 21.5 to 29 dBA at the right-of-way edge of the transmission line route. Wind conditions contributed significantly to the ambient fair weather measurement values. Calculated audible noise levels for the transmission line ranged from about 28 to 28.4 dBA, depending upon the configuration. The estimated increase in audible noise at the right-of-way edge is about 2.6 to 7.4 dBA, depending upon the configuration. The calculated audible noise sound level at the right-of-way edge for the proposed 345 kV transmission line alone is about 31.6 dBA, for the proposed line with the 66/25 and 120 kV lines is about 28.9 dBA, and for the proposed line with the 230 kV line is about 29.7 dBA. These calculated levels are below the EPA outdoor activity noise guideline of 55 dBA (EPA 1974).

For wet weather conditions, calculated audible noise levels at the right-of-way edge were about 53 dBA. These calculated levels are still below the EPA outdoor activity noise guideline of 55 dBA and are similar to the range of audible noise levels measured in general rain conditions (41-63 dBA) (EPA 1974, IEEE 1974, Miller 1978).

The combined estimate of the ambient plus project noise levels is a maximum of 31.6 dBA at the ROW edge. Noise levels would decrease with farther distance from the transmission line. Since the addition of the transmission line could result in an increase of more that 3 dBA over current outdoor noise levels along the proposed right-of-way, it would be considered a significant impact under the criteria established in this EIS. However, it should be noted that noise levels would be generally within range of the 55 dBA outdoor activity guideline set by the EPA.

❑ ***Impact Noise-2: Transmission Line Noise***

The operation of the transmission line would generate some audible humming, crackling, or hissing noises. The noise would be most noticeable during wet or humid weather. This would be considered a significant impact on people living or working near the right-of-way, but it could be mitigated to less than significant by the following measure.

❑ ***Mitigation Measure Noise-2***

After the transmission line is constructed and operational, SPPC would conduct follow-up monitoring to measure actual outdoor and indoor noise levels in homes/buildings on or immediately near the right-of-way edge. SPPC would then implement appropriate mitigation measures on a case-by-case basis.

Substation Noise Impacts

Because of its remote location, the Falcon substation improvements would not create a significant noise impact. Although the Gonder substation does have a few local residences in the vicinity, they are far enough away that they would not experience a notable increase in noise from the proposed substation expansion and improvements. The substation would be upgraded to 345 kV. New 230 kV buswork would be required to connect to the existing 230 kV ring bus. New equipment includes two 230 kV power circuit breakers, two 345/230 kV- 300 MVA transformers, two 345 kV power circuit breakers, and two 345kV reactors to control voltage. Around the Gonder substation, the main new source of audible noises would be the addition of the two 345/230 kV transformers.

Transformer noise is caused by vibration of its core (called magnetostriction), and this excitation produces pure tone components of transformer noise at the harmonics of the 60 Hz power-frequency, such as 120 Hz, 180 Hz, 360 Hz, etc. (EPRI 1979:3). To characterize audible noise levels near this classification of transformer, lateral profile measurements were conducted around an existing energized 345/125 kV transformer in Reno, Nevada at the Mira Loma substation on July 17, 2000 from 11:00 a.m. to 1:30 p.m.

These lateral profile characterization measurements were conducted on three accessible sides of an energized transformer (at 280 MVA with fans on) to characterize sound level attenuation as a function of distance away from the transformer. Table 3.11-11 presents a tabular summary of the lateral profile measurement data. Ambient audible noise measurements were also performed at each corner of the Mira Loma Substation prior to and after the lateral profile measurements. The manufacturer's guaranteed sound rating for this type of 345/230 kV transformer is 77 dB (energized) to 80 dB (fans on and energized at 300 MVA).

As shown in the previous Figure 2-7 in Chapter 2, the proposed location of the two new 345/230 kV transformers would be centrally located within the substation expansion (near the present existing northern fence line). Measured audible noise levels from the Mira Loma substation transformer show that the levels decrease from about 75 dBA near the transformer down to about 51 dBA at 200 to 300 feet away. Since the sound level of a transformer should decrease as the inverse square of the distance from the transformer, estimated sound levels should be further reduced to levels which currently exist at the existing northern property line (about 40 to 50 dBA). These calculated levels should also be below the EPA outdoor activity noise guideline of 55 dBA.

❑ ***Impact Noise-3: Substation Noise***

Electrical equipment at the substations would generate noise during operation of the project. Transformers and generators at the two substations would produce noise and add to the ambient noise levels. However, the Falcon substation is located in a remote area away from any buildings, and the Gonder substation improvements would not create a noticeable increase in ambient noise levels at the property boundary closest to existing residences. Thus, substation noise would not be significant.

Maintenance Noise Impacts

As part of routine maintenance over the life of the project, once a year two SPPC inspectors would drive along the transmission line on ATVs to conduct a visual inspection. Occasionally, vehicles and equipment may be needed to make repairs or respond to emergencies. These activities would create only short-term and infrequent noise, which would be a minor impact.

Computer Interference

Personal computer monitors using cathode ray tubes (CRTs) can be susceptible to magnetic field interference. The magnetic fields that occur in the normal operation of the electric power system can be of sufficient intensity to affect computer monitors under certain conditions. Magnetic field interference results in disturbances to the image displayed on the CRT monitor, often described as screen distortion, "jitter," or other visual defects (Banfi 2000). In most cases it can be annoying, and at its worst, it can prevent use of the monitor. The extent of interference depends on 60 Hz magnetic field intensity, monitor orientation, monitor design, and the monitor's vertical refresh rate.

TABLE 3.11-11: SUMMARY OF 345/125 KV TRANSFORMER NOISE MEASUREMENTS AT MIRA LOMA SUBSTATION (IN DB)

Initial Ambient Measurements :

	A	C	63	125	250	1K	4K	8K
Location #1	40.0	68.5	57.5	48.5	40.0	31.0	20.0	13.0
Location #2	41.5	59.0	55.0	52.0	42.5	31.5	22.5	13.0
Location #3	48.5	60.5	59.0	52.0	49.5	39.5	27.5	18.5
Location #4	50.5	63.0	60.5	58.5	52.5	46.0	29.5	20.0

Profile Measurements - Side "A" :

	A	C	63	125	250	1K	4K	8K
10 Foot	74.0	78.0	70.0	71.0	70.5	69.5	58.0	51.5
50 Foot	65.5	72.0	67.0	64.0	60.5	60.5	48.0	40.5
100 Foot	59.5	65.5	60.5	62.0	56.0	55.0	42.0	33.5
150 Foot	56.5	63.5	57.5	58.0	53.5	53.5	39.0	28.5
200 Foot	53.5	63.5	56.0	56.5	50.0	50.0	37.5	25.5
250 Foot	52.0	60.0	56.0	56.0	49.0	48.5	34.0	22.5

Profile Measurements - Side "B" :

	A	C	63	125	250	1K	4K	8K
10 Foot	72.5	78.0	74.5	71.0	71.0	68.0	56.5	47.5
50 Foot	61.0	71.0	70.0	66.0	59.5	55.5	45.5	39.5
100 Foot	55.5	68.0	63.0	63.0	55.5	50.5	41.0	34.0
150 Foot (Bus)	53.0	66.0	63.0	61.5	51.5	47.5	38.5	34.0
200 Foot	52.0	65.5	62.0	58.0	51.0	45.5	35.0	31.0
250 Foot	49.5	63.0	60.0	56.5	49.0	43.0	35.0	25.5
300 Foot	46.5	61.0	56.5	55.0	49.0	40.0	31.0	22.0

Profile Measurements - Side "C" :

	A	C	63	125	250	1K	4K	8K
10 Foot	78.5	84.5	79.5	79.5	78.5	73.0	62.0	56.0
50 Foot	64.0	73.0	72.5	65.0	62.5	59.5	47.5	42.0
100 Foot	58.5	70.0	68.5	65.0	58.0	54.0	41.5	35.5
150 Foot (Bus)	55.5	67.0	61.5	62.5	56.0	51.5	39.5	30.5
200 Foot	53.5	67.5	61.5	60.5	58.5	49.0	36.5	26.0

Concluding Ambient Measurements :

	A	C	63	125	250	1K	4K	8K
Location #1	40.5	58.0	53.5	52.5	41.5	31.0	17.5	13.0
Location #2	45.0	59.5	56.5	54.0	49.5	34.5	21.5	14.0
Location #3	53.5	67.5	61.5	61.5	54.5	45.5	35.0	21.0
Location #4	52.5	64.0	61.5	60.5	54.0	47.0	33.0	22.5

Computer monitors that use cathode ray tubes, or CRTs, could experience image jitter lines in proximity to the proposed 345 kV transmission line (within approximately 60 feet of the right-of-way edge for normal loading and within approximately 110 feet of the right-of-way for maximum loading conditions). This image distortion does not occur on liquid crystal display (LCD) monitors common on most portable computers (ESAA 1996). Computer monitor interference is a recognized problem in the video monitor industry. As a result, there are manufacturers who specialize in monitor interference solutions and shielding enclosures. Possible solutions to this problem include relocation of the monitor, use of magnetic shield enclosures, software programs to adjust the monitor's vertical refresh rate, and replacement of cathode ray tube monitors with liquid crystal displays.

❑ ***Impact Noise-4: Computer Monitor Interference***

Computer monitors that use cathode ray tubes, or CRTs, could experience image jitter lines in proximity to the proposed 345 kV transmission line (within approximately 60 feet of the right-of-way edge for normal loading and within approximately 110 feet of the right-of-way for maximum loading conditions). This image distortion does not occur on LCD monitors common on most portable computers (ESAA 1996). Although this is not a significant environmental or noise impact, it can be annoying; at its worst, it can prevent use of the monitor.

❑ ***Mitigation Measure Noise-4***

After the transmission line is constructed and operational, if computer monitor interference is reported by people within 110 feet of the right-of-way, SPPC would implement appropriate mitigation measures on a case-by-case basis. Possible solutions include relocation of the monitor, use of magnetic shield enclosures, software programs to adjust the monitor's vertical refresh rate, and replacement of cathode ray tube monitors with liquid crystal displays.

Radio and TV Interference

Overhead transmission lines do not, as a general rule, interfere with radio or TV reception. There are two potential sources for interference: corona and gap discharges. As described earlier, corona discharges can sometimes generate unwanted radio frequency electrical noise. Corona-generated radio frequency noise decreases with distance from a transmission line and also decreases with higher frequencies (when it is a problem, it is usually for AM radio and not the higher frequencies associated with TV signals). Gap discharges are different from corona. Gap discharges can develop on transmission lines at any voltage and are more frequently found on smaller distribution lines. They can take place at tiny electrical separations (gaps) that can develop between mechanically connected metal parts. A small electric spark discharges across the gap and can create unwanted electrical noise. The severity of gap discharge interference depends on the strength and quality of the transmitted radio or TV signal, the quality of the radio or TV set and antenna system, and the distance between the receiver and transmission line.

Shortwave (high frequency or HF) radio bands utilize amplitude modulation (AM) transmissions that are susceptible to broadband pulse-type noise such as transmission line corona and gap discharge. There are many factors that govern how significant shortwave radio interference can be, including transmission line configuration, distance away from the transmission line, antenna design, receiver performance, signal strength, and weather conditions. An electric utility would typically address shortwave radio interference problems on an individual case-by-case basis, since many different parameters influence reception along different portions of the transmission line route. For example, if a broken piece of hardware on a tower were the source of interference, it would be located and repaired.

Field calculations were performed using a computer program originally developed by BPA (BPA 1977). Calculated radio and TV interference levels in fair weather and in rain at the edge of the right-of-way for the proposed 345 kV transmission line are typical for lines of this voltage class. There has been a significant amount of work done to quantify radio and TV noise and provide design methods to mitigate this phenomenon during design (e.g., EPRI 1982, IEEE 1971, 1972, 1976). The potential for interference would depend, among other things, on the signal strength, receiver design, antenna, and transmission line noise level in the signal bandwidth.

A signal-to-noise ratio (SNR) can be calculated and reception can be evaluated using the reception guidelines of the Federal Communications Commission (FCC). In general, the 345 kV transmission line should not cause radio and TV interference in fair weather due to corona noise. In wet weather, it is possible that AM radio reception for weak signals can be adversely affected by corona-induced noise on the right-of-way. The extent of interference cannot be evaluated without knowledge of local signal strengths to facilitate calculation of anticipated SNRs.

Figures 3.11-13, 3.11-14 and 3.11-15 present the calculated radio noise levels for each of the three transmission line configurations (the proposed 345 kV line alone, the proposed 345 kV line paralleling an existing 66/25 kV and 120 kV lines, and the proposed 345 kV line paralleling an existing 230 kV line). Figures 3.11-16, 3.11-17 and 3.11-18 present the calculated TV noise interference levels for each configuration. The calculated levels indicate a potential for some level of radio frequency interference, especially during wet weather conditions when calculated levels approach 81 dB at transmission line center and about 63 dB at the right-of-way edge (calculated fair weather levels approach 64 dB at centerline and about 46 dB at the right-of-way edge). Calculated TV interference noise levels were lower (38 dBuV/m at centerline and 28 dBuV/m at the right-of-way edge during wet weather conditions). Calculations were performed for an altitude of 6,250 feet with a radio interference antenna height of 6.6 feet and a TV antenna height of 9.8 feet under fair and rain conditions. The reference frequency for the calculations is 1 MHz for radio noise and 75 MHz for TV noise. Results are presented in dB above a reference level of 1 uV/m.

There are three potential mechanisms for radio and TV interference sources on transmission lines: (1) corona, (2) gap discharge, and (3) signal re-radiation. The potential for interference from these three mechanisms depends on many factors, including broadcast frequency, signal strength, broadcast reception path, receiver design, types and locations of antenna and related equipment, seasonal weather conditions, the sunspot cycle, and transmission line configuration and design details.

FIGURE 3.11-13: CALCULATED RADIO NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE ALONE

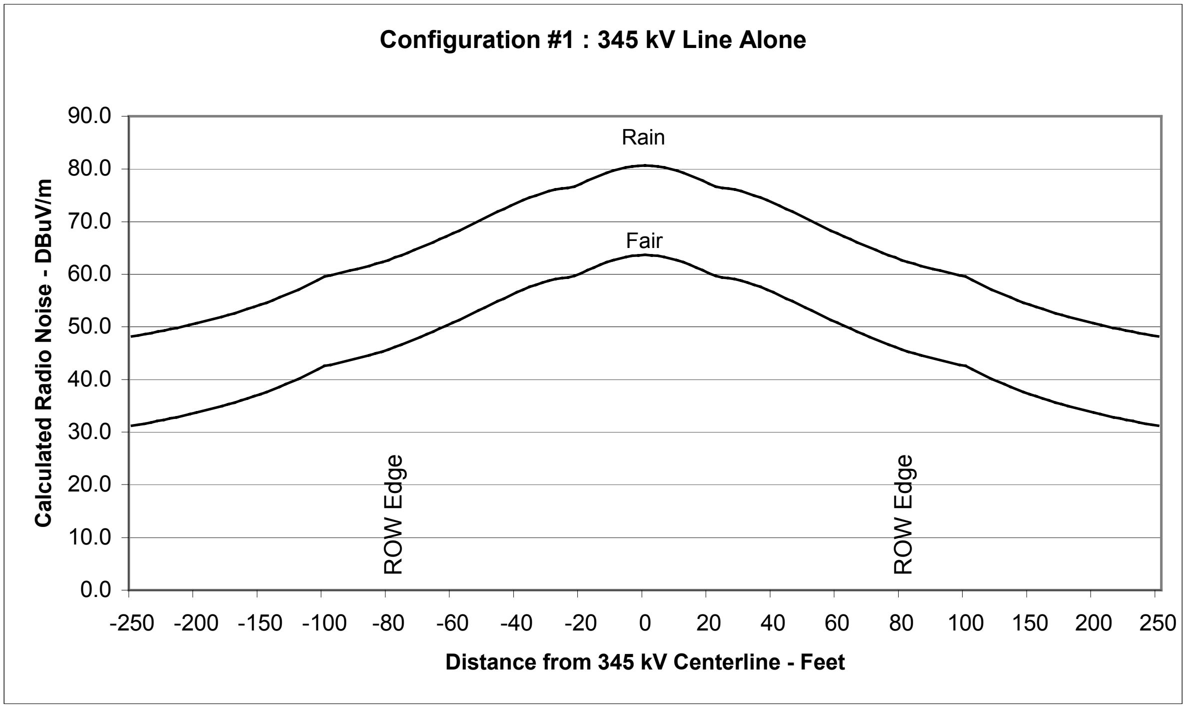


FIGURE 3.11-14: CALCULATED RADIO NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING 66/25 KV AND 120 KV TRANSMISSION LINES

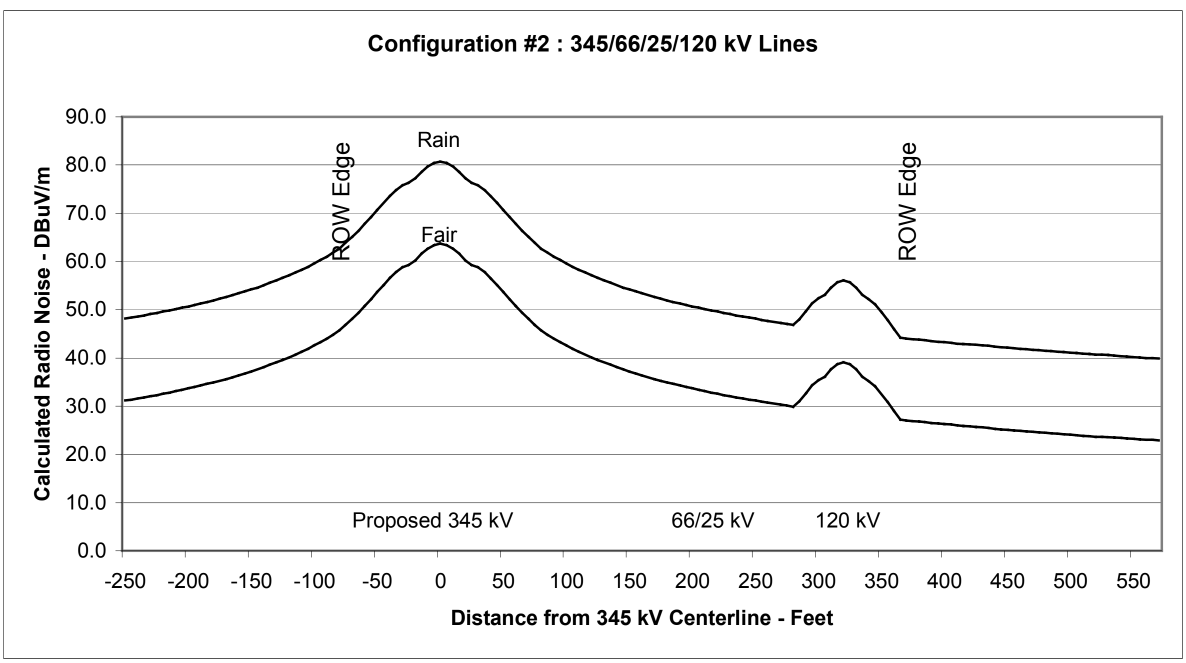


FIGURE 3.11-15: CALCULATED RADIO NOISE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING A 230 KV TRANSMISSION LINE

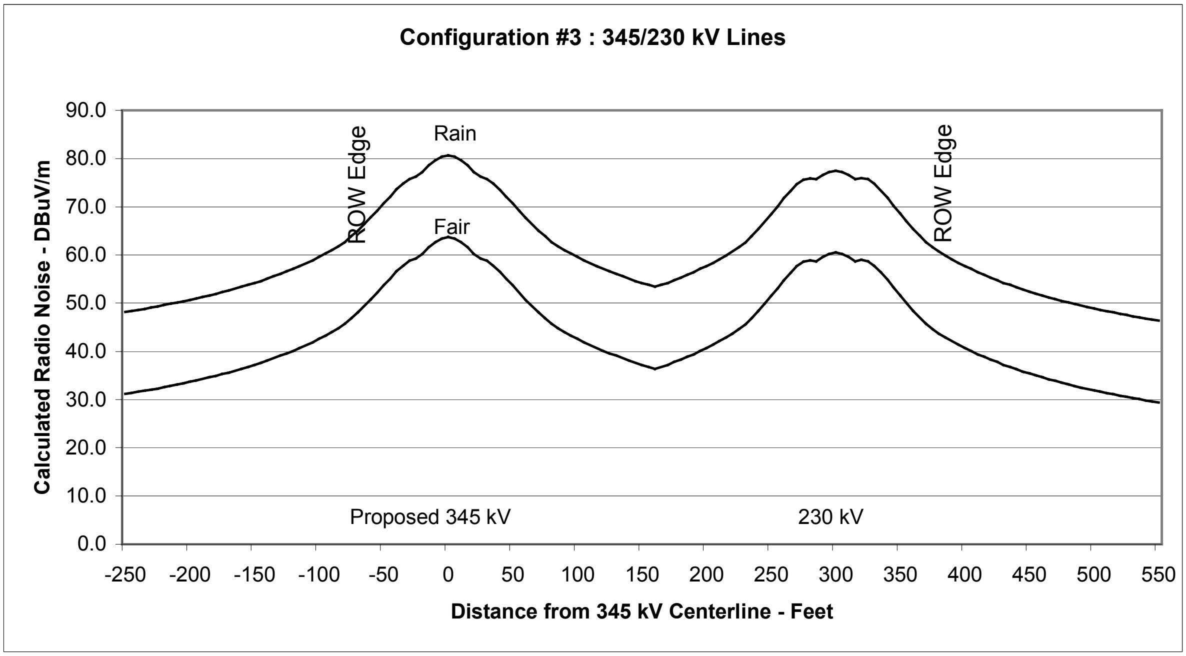


FIGURE 3.11-16: CALCULATED TV INTERFERENCE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE ALONE

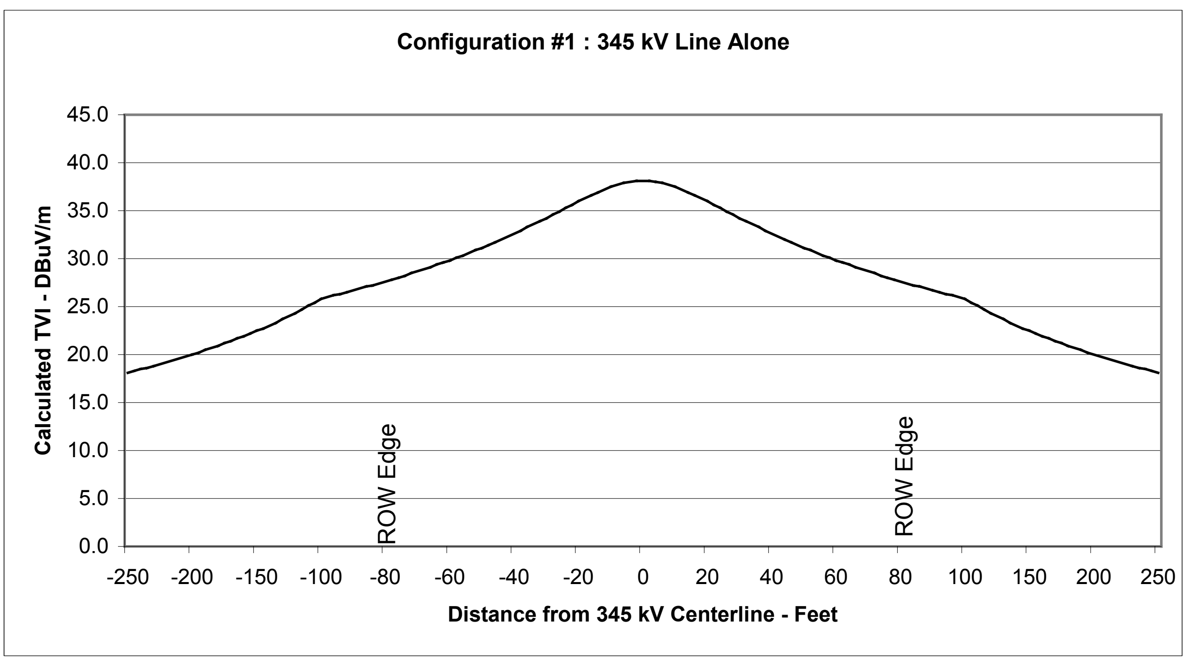


FIGURE 3.11-17: CALCULATED TV INTERFERENCE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING 66/25 KV AND 120 KV TRANSMISSION LINES

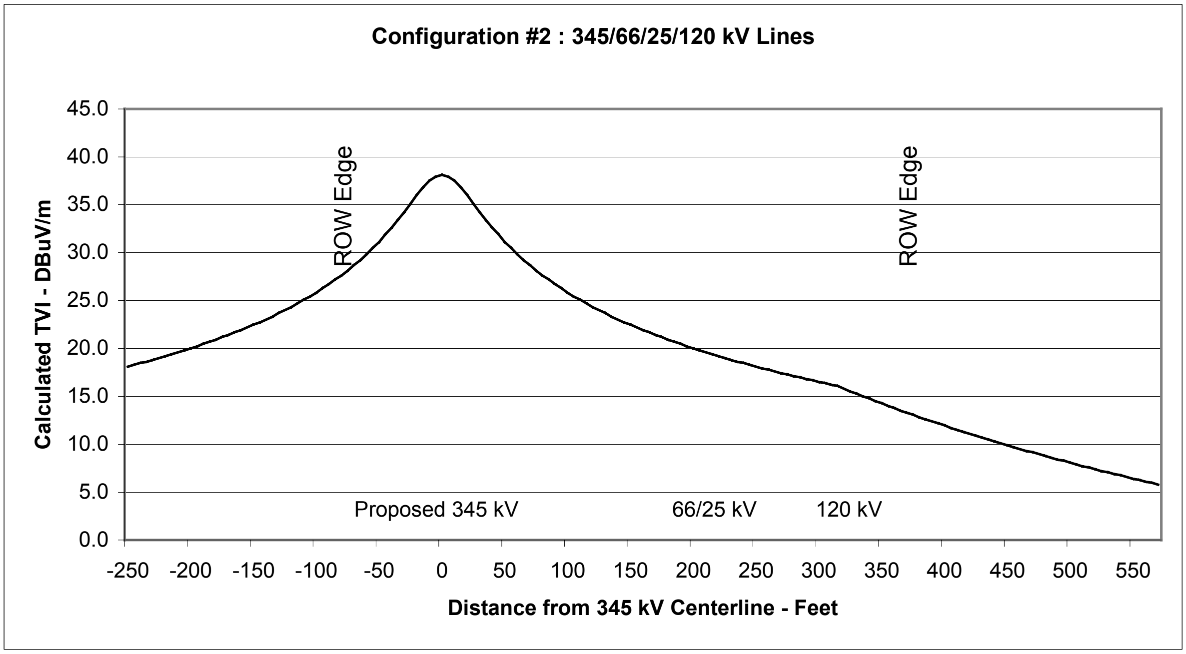
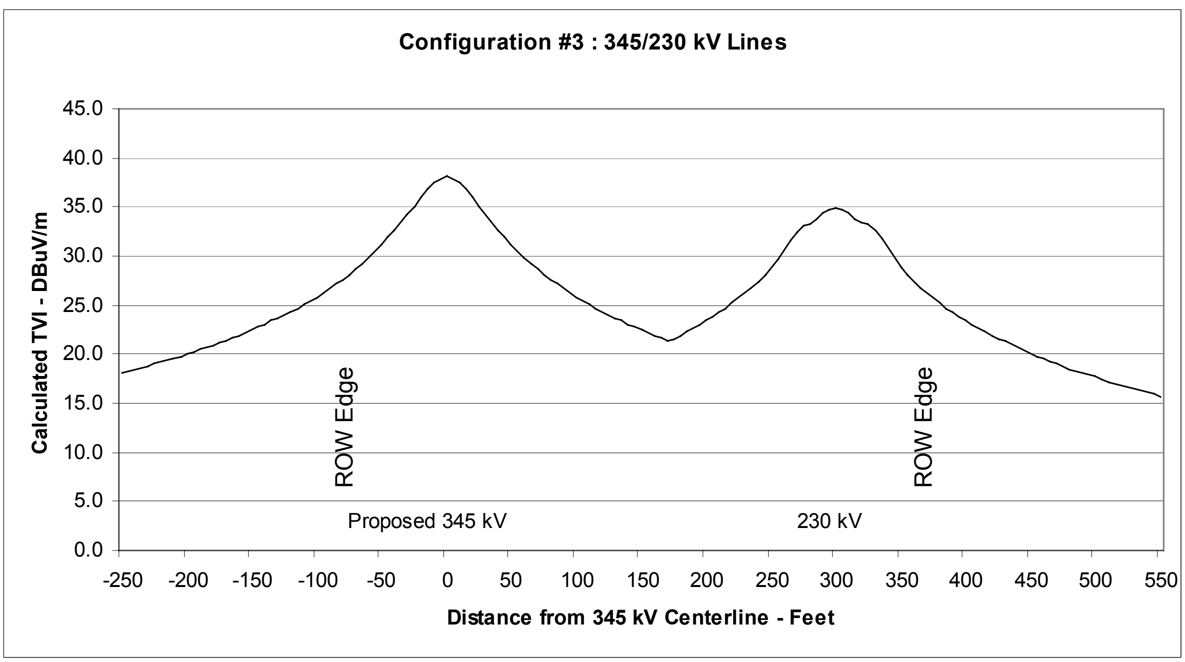


FIGURE 3.11-18: CALCULATED TV INTERFERENCE PROFILE FOR THE PROPOSED 345 KV TRANSMISSION LINE PARALLELING A 230 KV TRANSMISSION LINE



Frequency band uses/allocations in the United States are regulated by the FCC using standards adopted by the International Telecommunication Union (ITU), an agency of the United Nations. The ITU has designated three administrative regions for the world, with the United States located within Region #2. Within each region, frequency bands are allocated for different uses. Table 3.11-12 presents a summary of the frequency range allocations for the United States (Region #2) with their associated usage designations. For example, AM radios frequencies fall within the range of 535 to 1605 kHz, while TV stations can range from 54 MHz (channel 2) up through 806 MHz (channel 69) but not through a range of contiguous frequencies.

Corona-induced radio noise and TV noise is frequency-dependent and decreases with frequency, extending from a peak in the low-medium frequency band to very low levels at about 10 - 20 MHz (EPRI 1982). These frequencies are typically well below public frequencies such as CB radio (26.9 – 27.4 MHz), FM radio (88 – 108 MHz), and TV broadcast (54 – 806 MHZ), and far below higher satellite transmission frequencies (such as satellite cable TV). However, corona-induced radio noise can fall within the AM radio frequency range (535 – 1605 kHz) and some amateur band shortwave radio frequencies (1.8 - 30 MHz). Corona-induced radio noise and TV interference is significantly increased in wet weather conditions above dry weather conditions.

Gap discharge noise is the most commonly noticed form of transmission line radio interference. Gap discharges can occur on broken or poorly fitting line hardware, such as insulators, clamps, or brackets. Unlike corona, which is more intense in wet weather, gap discharges often disappear in wet weather because the gaps are shorted out by moisture. Hardware is designed to be problem-free, but corrosion, wind motion, gunshot damage, and insufficient maintenance contribute to gap formation.

TABLE 3.11-12: FREQUENCY ALLOCATION TABLE FOR ITU – REGION #2

FREQUENCY RANGE	USAGE DESIGNATION
0 - 30 kHz	**VLF (Very Low Frequency)**
30 - 300 kHz	**LF (Low Frequency)**
300 - 3000 kHz	**MF (Medium Frequency)**
535 - 1605 kHz	AM Radio
1800 - 2000 kHz	*Amateur Band (160-meter)*
3 - 30 MHz	**HF (High Frequency)**
3.5 - 4.0 MHz	*Amateur Band (80-meter)*
7.0 - 7.3 MHz	*Amateur Band (40-meter)*
10.1 - 10.15 MHz	*Amateur Band (30-meter)*
14.0 - 14.35 MHz	*Amateur Band (20-meter)*
18.068 - 18.168 MHz	*Amateur Band (17-meter)*
21.0 - 21.45 MHz	*Amateur Band (15-meter)*
24.89 - 24.99 MHz	*Amateur Band (12-meter)*
26.9 - 27.4 MHz	Citizens Band Radio (CB)
28.0 - 29.7 MHz	*Amateur Band (10-meter)*
30 - 300 MHz	**VHF (Very High Frequency)**
50 - 54 MHz	*Amateur Band (6-meter)*
54 - 72 MHz	TV - VHF (Channels 2 - 4)
76 - 88 MHz	TV - VHF (Channels 5 - 6)
88 - 108 MHz	FM Radio
108 - 150 MHz	Aeronautical Navigation, Communications, Satellite, Government
144 - 148 MHz	*Amateur Band (2-meter)*
150 - 162 MHz	Emergency, Forestry, Police, Maritime, Taxi, etc.
174 - 216 MHz	TV - VHF (Channels 7 - 13)
222 - 225 MHz	*Amateur Band (1.25-meter)*
300 - 3000 MHz	**UHF (Ultra High Frequency)**
420 - 450 MHz	*Amateur Band (70-cm)*
450 - 460 MHz	Transportation, Mobile Telephone, Taxi, etc.
460 - 470 MHz	Airport, Police, Fire, Medical
470 - 806 MHz	TV - UHF (Channels 14 - 69)
806 - 896 MHz	Cellular Telephone, Aircraft Telephone
896 - 1300 MHz	Personal Communications Services, Aeronautical, Radiological, etc.
902 - 928 MHz	*Amateur Band (33-cm)*
1240 - 1300 MHz	*Amateur Band (23-cm)*
2300 - 2450 MHz	*Amateur Band (13-cm)*
3 - 30 GHz	**SHF (Super High Frequency)**
30 - 300 GHZ	**EHF (Extremely High Frequency)**

Unlike corona, gap discharge noise is characterized by relatively long periods between successive pulses of electromagnetic energy. The RF noise from gap discharges tends to be broadband due to the constantly changing impedance characteristics of the gap. Spark discharge noise extends over a larger frequency spectrum than corona; RF noise from these sparks tends to dominate those from corona, especially at frequencies above 10 – 20 MHz and can extend beyond 1,000 MHz.

Often the source of gap noise is not due to transmission lines. The large majority of interference complaints are found to be attributable to sources other than transmission lines: poor signal quality, poor antenna, door bells, and appliances such as heating pads, sewing machines, freezers, ignition systems, aquarium thermostats, fluorescent lights, etc. (IEEE 1976). Generally, interference due to gap discharges is less common on high-voltage transmission lines. The reasons that high voltage transmission lines have fewer problems include predominate use of steel structures, fewer structures, greater mechanical load on hardware, and different design and maintenance standards. (Lower voltage distribution lines tend to generate more gap discharge interference than higher voltage transmission lines.) Gap discharge interference can be avoided or minimized by proper design of the transmission line hardware parts, use of electrical bonding where necessary, and by careful tightening of fastenings during construction. Individual sources of gap discharge noise can be readily located and corrected.

Signal re-radiation is a condition sometimes created by a broadcast signal interaction with power line components. As electromagnetic waves travel away from a radio frequency broadcast antenna they may encounter man-made conductive objects like buildings or transmission lines on metallic structures. Broadcast electromagnetic waves can induce electric currents of the same frequency in a conductive structure. These induced currents would then radiate their own secondary electromagnetic waves in a phenomenon called re-radiation (IEEE 1996). The re-radiated waves would generally differ in amplitude and phase from the primary broadcast wave. The secondary re-radiated waves would combine with and alter the primary broadcast signal, potentially reducing its usefulness. Some reports indicate that transmission line signal re-radiation of AM radio broadcast signals can combine with the AM signal, causing signal enhancements up to +2 dB and signal attenuations as low as approximately –8 dB (Trueman 1981). A receiver designed to detect and process a radio frequency signal would respond to all of the electromagnetic energy in its design bandwidth, irrespective of source. This means that re-radiated waves could, depending upon receiver/antenna design and signal strength, degrade a receiver's performance and, if sufficiently strong, can result in unacceptable performance.

Depending on broadcast signal characteristics and transmission line design parameters, transmission lines may have radio frequency currents induced in the loop created by the overhead shieldwire-tower-earth path. The phase conductors are not a significant component of the re-radiation phenomenon. The dimensions of the shieldwire-tower-earth return loops could approach a significant fraction of the signal wavelength (e.g., ¼ λ) and create re-radiation interference. However, many factors can affect the magnitude of these induced currents and the associated re-radiated electromagnetic waves: transmission line configuration parameters, RF broadcast source frequency, and orientation of the transmission line. Re-radiation interference is usually noticed near the AM radio frequency ranges, especially when the broadcast antenna is located close to the transmission line.

Shortwave (high frequency or HF) radio bands utilize amplitude modulation (AM) transmissions that are susceptible to broadband pulse-type noise such as transmission line corona and gap discharge. There are many factors which govern how significant shortwave radio interference can be, including transmission line configuration, distance away from the transmission line, antenna design, receiver performance, signal strength, and weather conditions. An electric utility would typically address shortwave radio interference problems on an individual case-by-case basis, since many different parameters can influence reception along different portions of the power line route. For example, if a broken piece of hardware on a tower were the source of interference, it would be located and repaired.

❑ ***Impact Noise-5: Radio and TV Interference***

In general, the 345 kV transmission line should not cause radio and TV interference in fair weather due to corona noise. However, in wet weather, it is possible that AM radio reception for weak signals can be adversely affected by corona-induced noise on the right-of-way. Although this is not a significant environmental or noise impact, it could be annoying.

❑ ***Mitigation Measure Noise-5***

After the transmission line is constructed and operational, if shortwave radio interference is reported by people immediately along the right-of-way, SPPC would implement appropriate mitigation measures on a case-by-case basis. For example, if a broken piece of hardware on a tower were the source of interference, it could be located and repaired.

Alternative-Specific Impacts

Construction activities would result in temporary noise impacts for sensitive receptors (i.e., buildings or residences) within approximately 2,000 feet of the construction areas. Most residences and other buildings are located near Segment B, which is part of the Crescent Valley (a) and (b) route alternatives, and Segment J, which is common to all route alternatives. However, there are some other residences and buildings scattered throughout the study area (i.e., all routes) that could be affected (see Appendix D). Noise would be generated by blasting, construction equipment, and also vehicle trips associated with construction activities. This would be considered a significant, but short-term noise impact. Mitigation measures are provided to reduce the impact to a less-than-significant level. If blasting activities occur during the more noise-sensitive periods of the day (e.g., evening and nighttime hours), resultant noise levels would likely result in increased annoyance and potential sleep disruption to occupants of the nearby residences located within approximately 3,000 feet of the site. Mitigation measures are provided to reduce the impact to a less-than-significant level.

The land use field survey conducted for this project by Stantec (2000) indicates that Segment B (Crescent Valley routes only) has approximately 10 existing residential units and Segment J (all routes) has approximately 11 residential units within 200 feet of the proposed centerline that could experience noise from the transmission lines (i.e., humming or crackling noises in wet or humid weather). Impacts to these residents could be mitigated to a less-than-significant level with Mitigation Measure Noise-3.

There are approximately 6 existing buildings along Segment B (Crescent Valley routes only) and 3 existing residences along Segment J (all routes) that could potentially be impacted by computer monitor interference. While this would not be considered a significant impact, it could be resolved by Mitigation Measure Noise-4.

In wet weather, it is possible that AM radio reception for weak signals could be adversely affected by corona-induced noise on the right-of-way. At the time of the field survey, Segment B had one existing residential unit (a trailer) within the right-of-way, and Segment J had 3 residences close enough to the right-of-way edge that they could experience AM radio reception interference. Although this is not a significant impact, it could be resolved by Mitigation Measure Noise-5.

Gap discharge noise is the most commonly noticed form of transmission line radio interference. Gap discharges can occur on broken or poorly fitting line hardware, such as insulators, clamps, or brackets. Unlike corona, which is more intense in wet weather, gap discharges often disappear in wet weather because the gaps are shorted out by moisture. Hardware is designed to be problem-free, but corrosion, wind motion, gunshot damage, and insufficient maintenance contribute to gap formation.

Summary Comparison of Route Alternatives

TABLE 3.11-13: SUMMARY OF IMPACTS BY ROUTE ALTERNATIVE

Impact	Crescent Valley (a)	Crescent Valley (b)	Pine Valley (a)	Pine Valley (b)	BUCK MOUNTAIN
Impact Noise-1: Short-term Construction Noise	X	X	X	X	X
Impact Noise-2: Transmission Line Noise	X	X	X	X	X
Impact Noise-3: Substation Noise	X	X	X	X	X
Impact Noise-4: Computer Monitor Interference	X	X	X	X	X
Impact Noise-5: Radio and TV Interference	X	X	X	X	X

RESIDUAL IMPACTS

Construction noise impacts would be considered minor after mitigation, as would impacts to computer monitors, AM radio reception, and operational noise impacts. However, people traveling along or under the transmission line (or who subsequently move near the right-of-way) could experience corona noise during wet or humid weather.

NO ACTION ALTERNATIVE

Under the No Action Alternative, noise-related impacts associated with this project would not occur. However, noise-related impacts could occur in other areas as SPPC and the Nevada PUC would begin emergency planning efforts to pursue other transmission and/or generation projects to meet the projected energy shortfall.