

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

**IN THE MATTER OF PUBLIC SERVICE COMPANY)
OF NEW MEXICO’S APPLICATION FOR A)
CERTIFICATE OF PUBLIC CONVENIENCE AND)
NECESSITY TO CONSTRUCT, OWN AND OPERATE)
THE RIO PUERCO TO PAJARITO TO PROSPERITY)
345 KV TRANSMISSION PROJECT)
)
PUBLIC SERVICE COMPANY OF NEW MEXICO,)
)
Applicant.)
_____)**

Docket No. 26-00000__

**DIRECT TESTIMONY
OF
JULIA L. MUNOZ**

February 25, 2026

NMPRC DOCKET NO. 26-00000__
INDEX TO THE DIRECT TESTIMONY OF
JULIA L. MUNOZ

WITNESS FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO

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DIRECT TESTIMONY OF
JULIA L. MUNOZ

I. INTRODUCTION AND PURPOSE

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Q. Please state your name, position, and business address.

A. My name is Julia L. Munoz. I am an Engineer IV for Public Service Company of New Mexico (“PNM” or “Company”). My business address is 2401 Aztec Road NE, Albuquerque, New Mexico 87107. I am testifying on behalf of PNM.

Q. Please summarize your educational background and professional qualifications.

A. My educational background and professional experience are summarized in PNM Exhibit JLM-1.

Q. Please describe your responsibilities as an Engineer IV.

A. As an Engineer IV, I help plan, schedule, and coordinate large and significant engineering projects and small complex projects. I provide advanced technical direction to contractors and company personnel, and function as a lead for staff engineers and professionals as appropriate.

Q. Please state the purpose of your Direct Testimony.

A. The purpose of my testimony is to support approval of the Rio Puerco to Pajarito to Prosperity 345 kV transmission project (the “Project”) from a right-of-way (“ROW”) requirements perspective. I discuss and provide support for the ROW width requirement calculations for the Project.

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1 **Q. Are you a licensed Professional Engineer (“PE”) in the State of New Mexico?**

2 **A.** Yes. I obtained my PE license in December 2024.

3

4 **Q. What is a PE stamp?**

5 **A.** A PE stamp is an official licensed stamp on an engineering drawing or plan. This indicates
6 that a licensed PE has worked on and/or reviewed the technical drawings.

7

8 **Q. Are the calculations you are sponsoring PE-stamped?**

9 **A.** Yes.

10

11 **II. DETERMINATION OF ROW WIDTH IN EXCESS OF 100 FEET**

12 **Q. What are the requirements regarding ROW widths in relation to the proposed 345**
13 **kV transmission line?**

14 **A.** The National Electrical Safety Code (“NESC”)¹ (2023) requires utilities to maintain
15 minimum clearance distances for power lines from objects and the ground. PNM must
16 maintain all clearance requirements under various wire conditions, including during wind
17 events and higher sag conditions. The Federal Energy Regulatory Commission (“FERC”)
18 also enforces federally mandatory reliability standards (developed by the North American
19 Electric Reliability Corporation, or “NERC”) that require vegetation management in and

¹ See <https://standards.ieee.org/products-programs/nesc/>.

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1 around transmission line ROW to prevent outages. PNM must be able to clear sufficient
2 widths to comply with these requirements and help ensure reliability. Below is the list of
3 requirements PNM is subject to:

- 4 1) NESC Rules 234C1a and 234C1b for horizontal clearance for transmission line
5 conductors.
- 6 2) NESC Rule 250C Extreme Wind to the edge of the ROW.
- 7 3) NERC FAC-003 Minimum Vegetation Clearance Distances.

8 In addition, PNM has transmission line design standards which are followed when
9 determining the necessary ROW width. These standards are provided in PNM Exhibit
10 JLM-4. These standards were developed by PNM subject matter experts and reflect PNM's
11 internal standards incorporating all the NESC and NERC requirements, and general
12 industry standards.

13
14 **Q. Has PNM determined the width of ROW needed for the Project?**

15 **A.** Yes. PNM has determined a maximum ROW width requirement of 150 feet for the Project.
16 PNM Exhibit JLM-2, JLM-3, and JLM-4 provide insight into the need for this 150-foot
17 ROW width. I performed and PE stamped the calculations and drawings in PNM Exhibits
18 JLM-2 and JLM-3.

19
20 **Q. Please explain why a 150-foot ROW width is required for the Project?**

21 **A.** A 150-foot ROW width is required for the following reasons:

- 22 1) To maintain required NESC and NERC clearances. PNM utilizes NESC Rules
23 234C1a, 234C1b, and 250C as well as NERC requirements to determine the

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1 appropriate ROW requirements. These rules establish minimum horizontal and
2 vertical clearance requirements for electrical conductors to buildings and
3 vegetation, respectively. The calculated required clearances depends on factors
4 such as the voltage of the line, elevation, weather conditions including wire
5 temperature, ice thickness and wind speed, and transmission structure
6 configurations. The supporting calculations are provided in PNM Exhibit JLM-2
7 and PNM Exhibit JLM-3.

8 2) To maintain PNM's line design requirement, PNM's transmission line design
9 standards recommend a 150-foot ROW width for 345 kV transmission lines. These
10 standards are provided as PNM Exhibit JLM-4.

11 3) To ensure all NESC requirements are maintained at the time of initial energization
12 and in the future as developments, businesses, and residential areas are constructed
13 near the transmission line corridor. The proposed transmission line is on the
14 outskirts of the Albuquerque area, making it a likely location for future
15 development of the permanent structures mentioned above.

16 4) For vegetation maintenance purposes. The 150-foot width allows for sufficient
17 vegetation clearing to prevent potential vegetation-related events which would
18 result in adverse impacts such as outages and reliability concerns. An example of a
19 vegetation related event is when a tree branch comes into contact with the power
20 line, potentially causing an outage.

21 5) To allow for safe inspection, maintenance and operation activities. After the line is
22 built, PNM will inspect the lines and may end up needing to perform maintenance
23 activities, requiring large equipment. The equipment and all maintenance activities

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1 should be contained in the ROW so as not to impact developments, businesses, or
2 residents that may be in the area at that time. A 150-foot-wide ROW allows for the
3 safe operation of equipment during maintenance activities.

4
5 **Q. Please explain the contents of PNM Exhibit JLM-2.**

6 **A.** Page 1 of PNM Exhibit JLM-2 shows the detailed calculations for NESC required
7 horizontal clearances from the transmission line conductor to building structures for Rules
8 234C1a and 234C1b. The calculations provided also include requirements to meet
9 horizontal clearances from the transmission line conductor under NESC 250C Extreme
10 Wind to the edge of the ROW. This additional clearance considers NERC FAC-003
11 Minimum Vegetation Clearance Distances.

12
13 The NESC clearance values include adjustment adders for voltages above 22 kV phase-to-
14 ground and altitudes above 3,300 feet. PNM uses a standard altitude of 7,300 feet across
15 its system.

16
17 Pages 2-4 of PNM Exhibit JLM-2 are supporting exhibits for the calculations of the
18 blowout analysis for the typical H-frame tangent structure expected to be used across the
19 project. While there may be additional structure types in the project, the primary new
20 construction will be H-frames with bundled (2) 795kcmil ACSR “Drake” conductor. A
21 1200-foot maximum span length is used for the analysis to accommodate final structure
22 spotting and coordination as detailed design progresses. Actual design spans will vary
23 depending on obstructions, topography changes, future design considerations, such as the

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1 Paseo del Volcan New Mexico Department of Transportation corridor, and height
2 considerations across various sections of the line. A 1200-foot span would be the maximum
3 design span used for this project. The structure heights will provide required vertical
4 clearance from the conductor under maximum operating temperature (212°F) at midspan
5 to the existing terrain as it is surveyed.

6

7 The proposed H-frame tangent was analyzed under the following load cases:

8

- NESC Rule 234C1a – Conductor at rest, 0psf wind, 60°F

9

- NESC Rule 234C1b – Conductor under 6psf wind, 60°F

10

- NESC Rule 250C – Conductor under 21.2psf wind, 60°F

11

12 To determine the conductor blowout under each load case, the structure and wires were
13 modeled in the transmission line design software Power Line Systems - Computer Aided
14 Design and Drafting (“PLS-CADD”). The results of the maximum required ROW width
15 considering conductor blowout alone are illustrated on Sheets 2-4. The controlling load
16 case for the proposed H-frame structures was NESC Rule 250C, requiring a ROW width
17 of 141.8 feet.

18

19 Page 5 of PNM Exhibit JLM-2 is a visual of the maintenance and construction equipment
20 PNM considers when setting ROW width requirements. The dimensions for the various
21 construction equipment expected to be used during construction and maintenance activities
22 vary substantially based on factors such as the type of work being performed, crew
23 availability, line outage constraints, and equipment availability. The visual is meant to

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1 provide a general setup for work at the structure or along the midspan of the line. Based on
2 assumptions of line truck dimensions and offsets from the structure and conductor, PNM
3 has determined it needs 148 feet to be able to safely maintain or construct the line. This is
4 just under the 150 feet ROW width requested.

5

6 **Q. Please explain the contents of PNM Exhibit JLM-3.**

7 **A.** PNM Exhibit JLM-3 provides Audible Noise Calculations, performed using Electric Power
8 Research Institute (“EPRI”) Redbook Application Tools. The inputs and outputs are
9 provided for transparency (the tool uses metric units). Based on the provided inputs, the
10 EPRI tool calculates an audible noise level L_{50} during rain of 50.9dbA at the edge of the
11 proposed 150-foot ROW width at 1 meter above ground (3.28 feet) and a maximum value
12 of 52.9dbA at any point in the ROW at 1 meter above ground. The EPRI tool also calculates
13 a maximum audible noise level of 42.9dbA during fair weather at the edge of the proposed
14 150-foot ROW at 1 meter above ground. This calculated value is under the EPA’s
15 recommended 55dbA limit (U.S. EPA 1974).

16

17 **Q. Please explain the contents of PNM Exhibit JLM-4.**

18 **A.** PNM Exhibit JLM-4 is PNM’s Transmission Line Design Standard document. It includes
19 design loading and clearance requirements for transmission lines. The standards use NESC
20 clearances and add PNM buffers to account for future development, changes in terrain, and
21 changes in structure configurations without resulting in violations or safety concerns. The
22 proposed 345 kV transmission line will be designed to these standards, and preliminary
23 design captures these requirements and design standards.

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Q. Are there other general construction considerations that require additional land use widths?

A. No. PNM will require temporary use areas of greater than 100 feet in width to set up wiring pulling sites at the start and end of each dead transmission line structure. However this is for construction purposes, no permanent structures will require a ROW width in excess of 150 feet once the project is constructed.

III. CONCLUSION

Q. Please summarize the key points of your testimony.

A. I performed the ROW calculations that support PNM’s request for a ROW width of 150 feet. This width is required for PNM to maintain NESC and NERC clearances and ensures safe operation and maintenance of the line. These calculations are PE Stamped.

Q. Does this conclude your testimony?

A. Yes.

GCG#534825

Julia L. Munoz Resume

PNM Exhibit JLM-1

Is contained in the following 1 page.

Julia L. Munoz
EDUCATIONAL AND PROFESSIONAL SUMMARY

Name: Julia L. Munoz

Address: Public Service Company of New Mexico
2401 Aztec Road NE
Albuquerque, NM 87107

Position: Engineer IV

Education: Bachelor of Science – Civil Engineering, University of New Mexico, 2017
Professional Engineer (PE), 2024

Employment: Employed by Public Service Company of New Mexico (PNM) since 2019

Positions held within the Company include:

Transmission Line Engineer (Engineer II-IV) (2020-Present)

Rotational Engineer (2019-2020)

GCG#534815

Right of Way Calculations

PNM Exhibit JLM-2

Is contained in the following 5 pages.

PNM Engineering
 Engineer: Julia Munoz
 Project: Pajarito-Rio Puerco 345kV Transmission Line
 Required NESC Horizontal Clearances – Rule 234C1a & 234C1b

$V_N = \text{Nominal Operating Voltage Phase – Phase (kV)}$

$V_M = \text{Maximum Transient Overvoltage Phase – Phase (kV)}$

$V_{M_G} = \text{Maximum Transient Overvoltage Phase – Ground (kV)}$

$E = \text{Design Elevation (ft)}$

$A_V = \text{NESC Rule 234G1, adder for } > 22 \text{ kV Phase – Ground (ft)}$

$A_E = \text{NESC Rule 234G2, adder for } > 3,300 \text{ ft MSL Elevation for } > 50 \text{ kV Phase – Ground (ft)}$

$X_R = \text{NESC Rule 234C1a Required Horizontal Clearance At Rest (ft)}$

$X_{@6psf} = \text{NESC Rule 234C1b Required Horizontal Clearance at 6psf (ft)}$

$X_{@21.2psf} = \text{PNM Required Horizontal Clearance at NESC 250C (21.2psf) (ft)}$

$$V_N = 345 \text{ kV}$$

$$V_M = 1.05 \times V_N = 362.25 \text{ kV}$$

$$V_{M_G} = V_M \div \sqrt{3} = 209.14 \text{ kV}$$

$$E = 7,300 \text{ ft}$$

$$A_V = (V_{M_G} - 22 \text{ kV}) \times \left(\frac{0.4 \frac{\text{in}}{\text{kV}}}{12 \frac{\text{in}}{\text{ft}}} \right) = 6.97 \text{ ft}$$

$$A_E = (V_{M_G} - 50 \text{ kV}) \times \left(\frac{0.4 \frac{\text{in}}{\text{kV}}}{12 \frac{\text{in}}{\text{ft}}} \right) \times 0.03 \times \left(\frac{E - 3,300 \text{ ft}}{1,000 \text{ ft}} \right) = 0.64 \text{ ft}$$

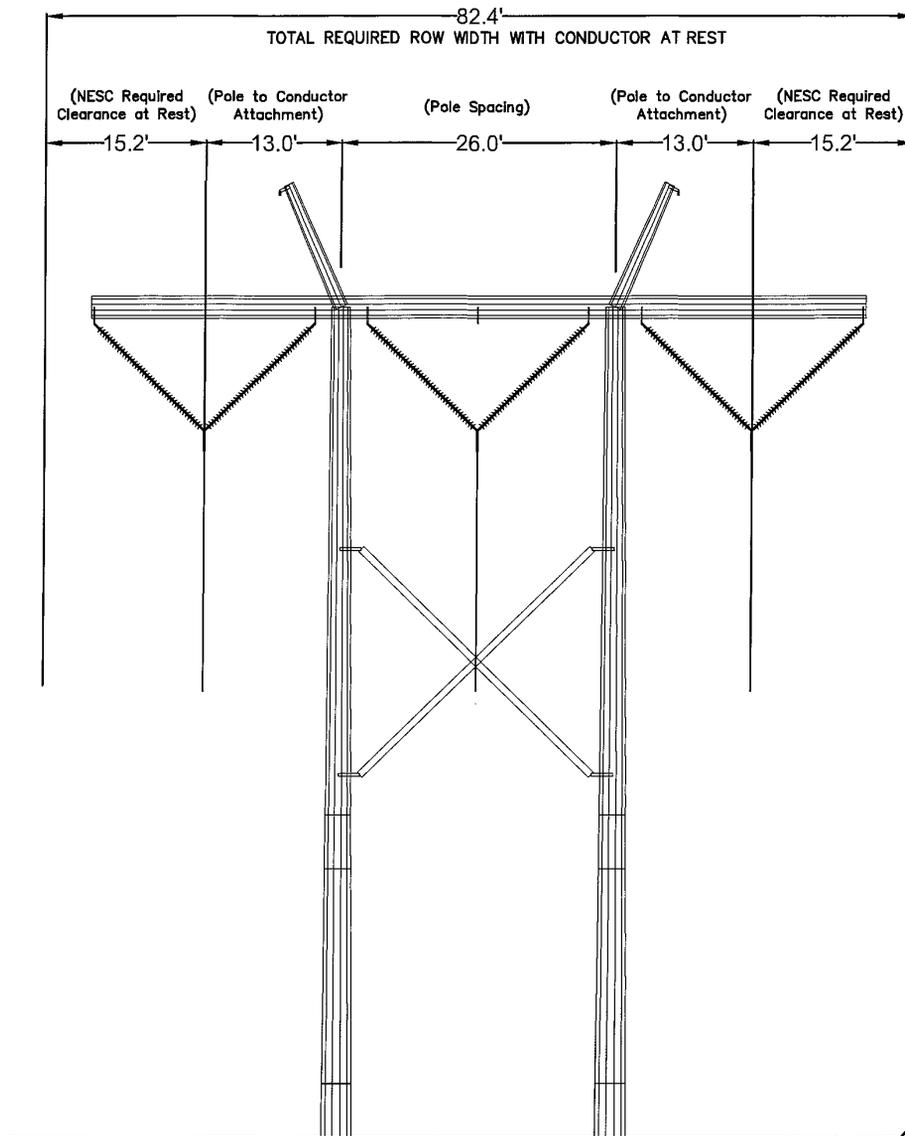
$$X_R = 7.5 \text{ ft} + A_V + A_E = 15.11 \text{ ft} \rightarrow X_R = 15.2 \text{ ft}$$

$$X_{@6psf} = 4.5 + A_V + A_E = 12.11 \text{ ft} \rightarrow X_{@6psf} = 12.2 \text{ ft}$$

$$X_{@21.2psf} = 5.0 \text{ ft}$$



| | | | |
|---|---------------|---|------------------|
| PNM | | PUBLIC SERVICE COMPANY OF NEW MEXICO | |
| PAJARITO-RIO PUERCO 345kV T-LINE HORIZONTAL BLOWOUT CALCULATIONS | | | |
| DR: | JLM | DATE: | 02/17/26 |
| ACAD: | PAJA-RIPU-ROW | APP: | JR |
| | | | PAJA-RIPU-ROW S1 |



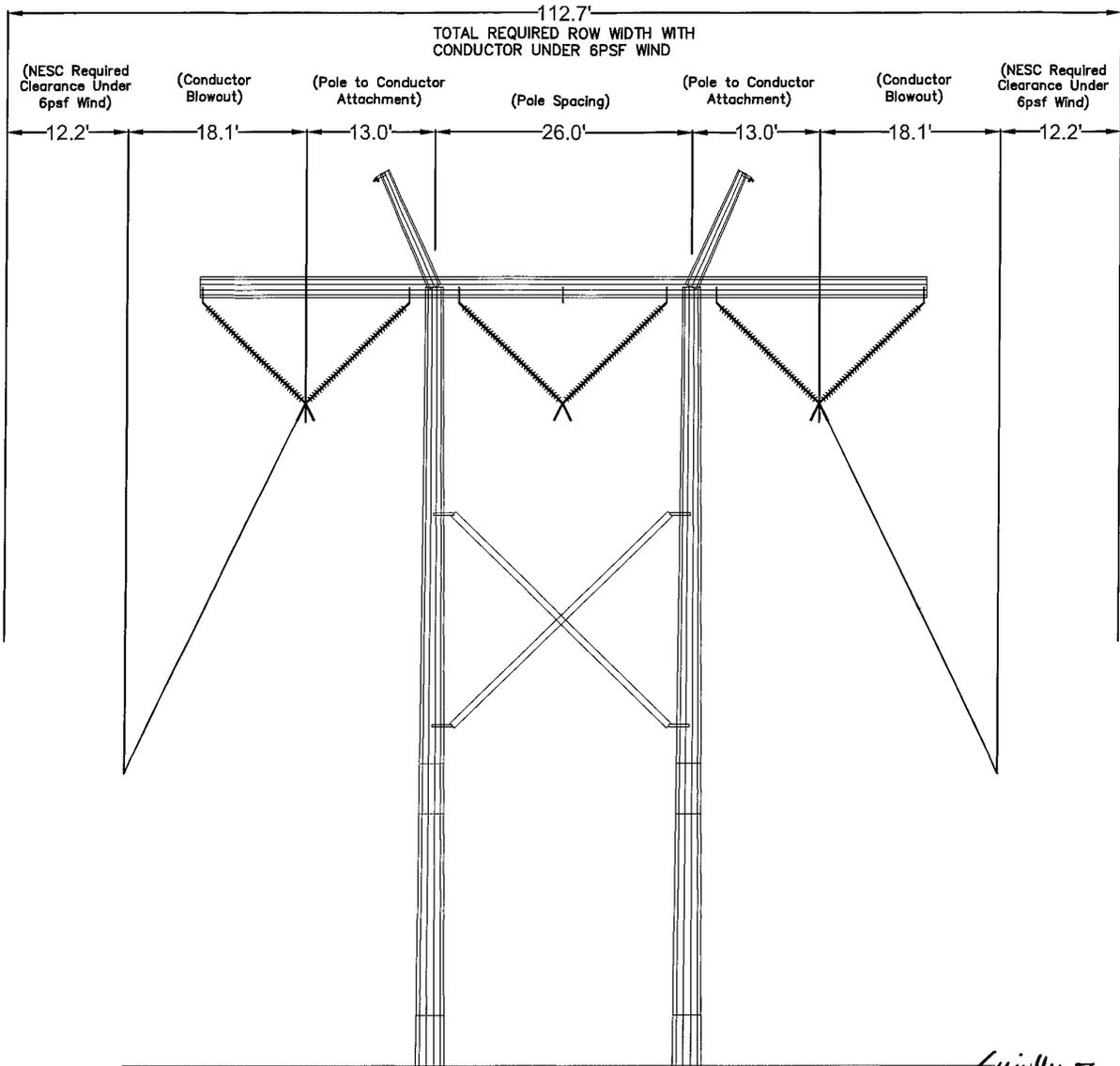
NOT TO SCALE

STRUCTURE AND CONDUCTOR INFORMATION

Nominal Operating Voltage: 345kV
 Structure Type: Single-Circuit Steel H-Frame Tangent
 Insulator Type: V-String Suspension Insulator Assembly
 Maximum Design Ruling Span: 1200ft
 Conductor Type: Bundled (2) 795kcmil ACSR "Drake"
 Weather Condition Displayed: 0psf wind at 60°F
 NESC Rule Analyzed: 234C1a



| | | | |
|---|---------------|--------------------------------------|------------------|
| PNM | | PUBLIC SERVICE COMPANY OF NEW MEXICO | |
| PAJARITO-RIO PUERCO 345kV T-LINE SINGLE-CIRCUIT H-FRAME TANGENT, AT REST | | | |
| DR: | JLM | DATE: | 02/17/26 |
| ACAD: | PAJA-RIPU-ROW | APP: | JR |
| | | | PAJA-RIPU-ROW S2 |



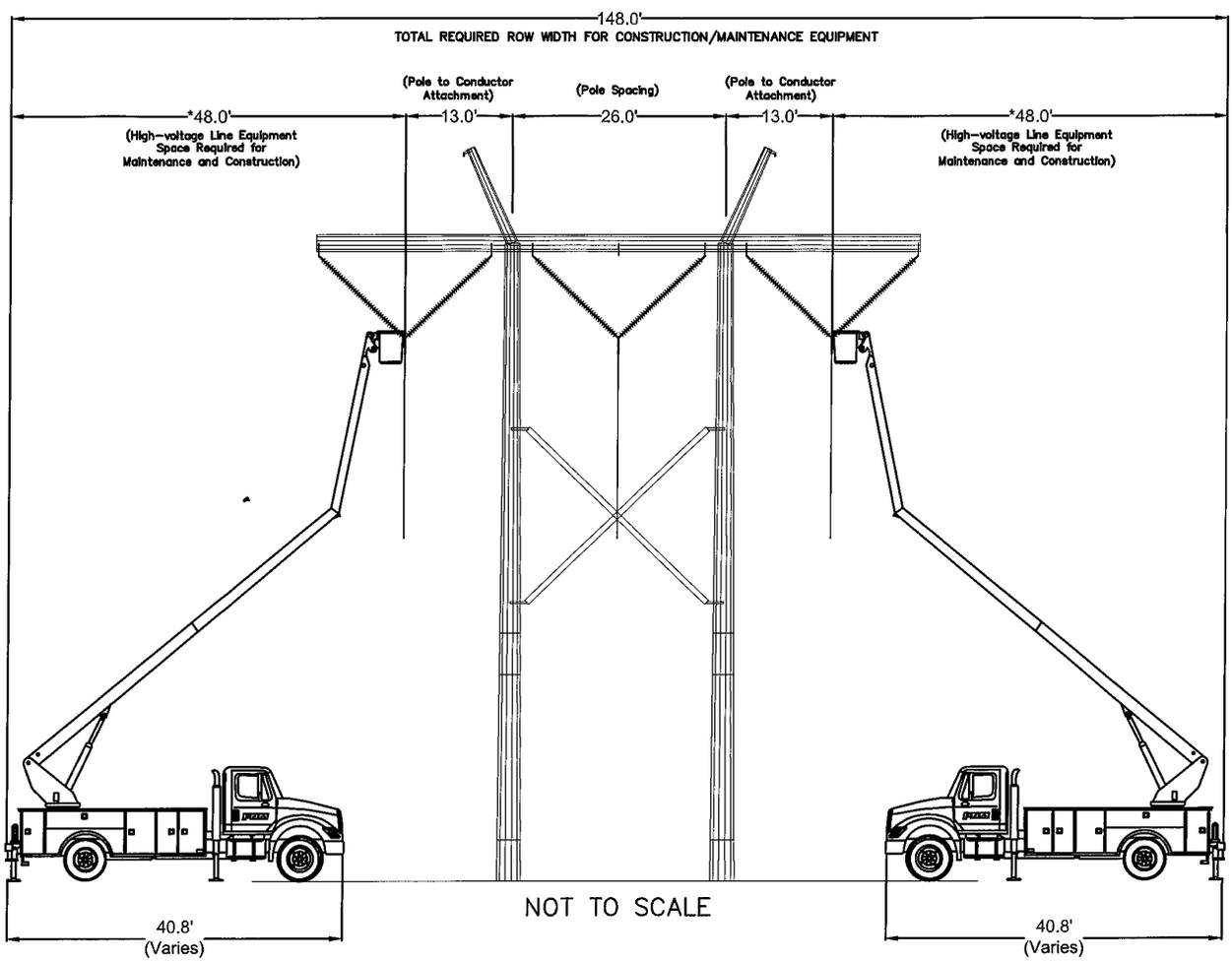
NOT TO SCALE

STRUCTURE AND CONDUCTOR INFORMATION

Nominal Operating Voltage: 345kV
 Structure Type: Single-Circuit Steel H-Frame Tangent
 Insulator Type: V-String Suspension Insulator Assembly
 Maximum Design Ruling Span: 1200ft
 Conductor Type: Bundled (2) 795kcmil ACSR "Drake"
 Weather Condition Displayed: 6psf wind at 60°F
 NESCS Rule Analyzed: 234C1b



| | | | |
|---|---------------|--------------------------------------|------------------|
| PNM | | PUBLIC SERVICE COMPANY OF NEW MEXICO | |
| PAJARITO-RIO PUERCO 345kV T-LINE SINGLE-CIRCUIT H-FRAME TANGENT, 6PSF WIND | | | |
| DR: | JLM | DATE: | 02/17/26 |
| ACAD: | PAJA-RIPU-ROW | APP: | JR |
| | | | PAJA-RIPU-ROW S3 |



Dimensions for truck location and size are approximate and will vary. ROW and access requirements can be reasonably assumed for safe operation of equipment, safety of workers, and safety of the public.

*This distance varies depending on the type of work being performed, orientation of the truck, and availability of equipment.



| | | | |
|---|---------------|------------------------|------------------|
| PNM | | PUBLIC SERVICE COMPANY | |
| PAJARITO-RIO PUERCO 345kV T-LINE SINGLE-CIRCUIT H-FRAME TANGENT, EQUIPMENT | | | |
| DR: | JLM | DATE: | 02/17/26 |
| ACAD: | PAJA-RIPU-ROW | APP: | JR |
| | | | PAJA-RIPU-ROW S5 |

Audible Noise Calculations

PNM Exhibit JLM-3

Is contained in the following 1 page.

----INPUT DATA----

| Bundle ID (#) | Number of Subconductors | Subconductor Diameter (cm) | Subconductor Spacing (cm) | Voltage-to-Ground (kV) | Phase Angle (degree) | Horizontal Coordinate (m) | Vertical Coordinate (m) |
|---------------|-------------------------|----------------------------|---------------------------|------------------------|----------------------|---------------------------|-------------------------|
| 1A | 2 | 2 81 | 45.7 | 199.2 | 0.0 | -7.93 | 19.42 |
| 1B | 2 | 2 81 | 45.7 | 199.2 | -120.0 | 0.00 | 19.42 |
| 1C | 2 | 2 81 | 45.7 | 199.2 | 120.0 | 7.93 | 19.42 |
| 1 | 1 | 1.60 | 0.0 | 0.0 | 0.0 | 5.79 | 26.72 |
| 2 | 1 | 1.60 | 0.0 | 0.0 | 0.0 | -5.79 | 26.71 |

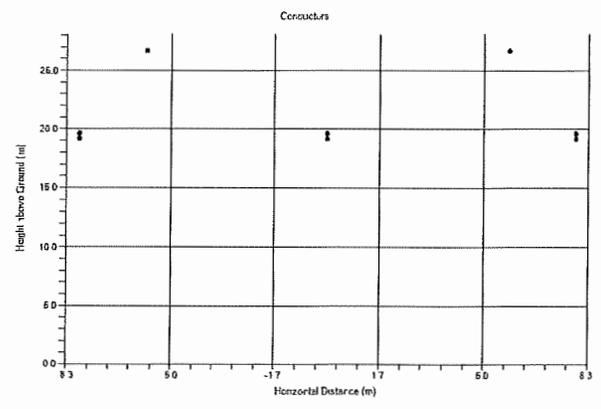
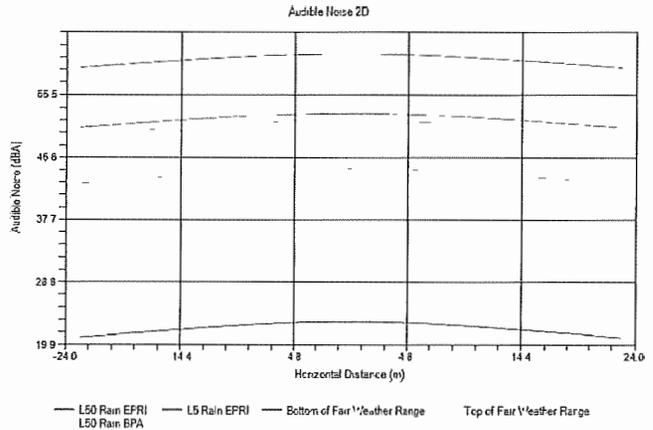
Altitude: 2225 (m)
Height Above Ground: 1 (m)

----- SURFACE GRADIENT AND GENERATED ACOUSTIC POWER (db above 1µm/m) -----

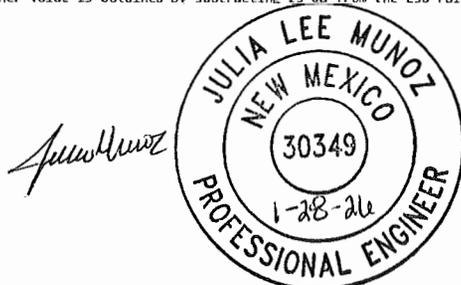
| Bundle ID (#) | Number of Subconductors | Subconductor Diameter (cm) | Surface Gradient (kV/cm) | L50 Rain EPRI | L50 Rain BPA | L5 Rain EPRI | Fair Weather Range |
|---------------|-------------------------|----------------------------|--------------------------|---------------|--------------|--------------|--------------------|
| 0A | 2 | 2 81 | 15.56 | -55.2 | -54.5 | -46.0 | -90.3 -64.5 |
| 0B | 2 | 2 81 | 16.90 | -50.4 | -50.2 | -42.6 | -78.6 -57.7 |
| 0C | 2 | 2.81 | 15.56 | -55.2 | -54.5 | -46.0 | -90.3 -64.5 |
| 1 | 1 | 1.60 | 3.98 | -252.1 | -139.1 | -182.5 | -1174.2 -440.0 |
| 1 | 1 | 1.60 | 3.98 | -251.8 | -139.1 | -182.3 | -1171.5 -439.2 |

----- AUDIBLE NOISE PROFILE -----

| X (m) | L50 Rain EPRI (dbA) | L50 Rain BPA(*) (dbA) | L5 Rain EPRI (dbA) | Fair Weather Range (dbA) |
|--------|---------------------|-----------------------|--------------------|--------------------------|
| -22.86 | 50.9 | 49.8 | 59.3 | 21.0 42.9 |
| -21.95 | 51.0 | 49.9 | 59.4 | 21.1 43.0 |
| -21.03 | 51.1 | 50.1 | 59.5 | 21.2 43.1 |
| -20.12 | 51.2 | 50.2 | 59.6 | 21.4 43.2 |
| -19.20 | 51.3 | 50.3 | 59.8 | 21.5 43.4 |
| -18.29 | 51.5 | 50.4 | 59.9 | 21.6 43.5 |
| -17.37 | 51.6 | 50.5 | 60.0 | 21.7 43.6 |
| -16.46 | 51.7 | 50.6 | 60.1 | 21.8 43.7 |
| -15.54 | 51.8 | 50.8 | 60.2 | 21.9 43.8 |
| -14.63 | 51.9 | 50.9 | 60.3 | 22.1 43.9 |
| -13.72 | 52.0 | 51.0 | 60.4 | 22.2 44.0 |
| -12.80 | 52.1 | 51.1 | 60.5 | 22.3 44.2 |
| -11.89 | 52.2 | 51.2 | 60.6 | 22.4 44.3 |
| -10.97 | 52.3 | 51.3 | 60.7 | 22.5 44.3 |
| -10.06 | 52.4 | 51.4 | 60.8 | 22.6 44.4 |
| -9.14 | 52.5 | 51.5 | 60.9 | 22.7 44.5 |
| -8.23 | 52.6 | 51.5 | 60.9 | 22.8 44.6 |
| -7.32 | 52.6 | 51.6 | 61.0 | 22.9 44.7 |
| -6.40 | 52.7 | 51.7 | 61.1 | 22.9 44.7 |
| -5.49 | 52.7 | 51.7 | 61.1 | 23.0 44.8 |
| -4.57 | 52.8 | 51.8 | 61.2 | 23.0 44.9 |
| -3.66 | 52.8 | 51.8 | 61.2 | 23.1 44.9 |
| -2.74 | 52.9 | 51.8 | 61.2 | 23.1 44.9 |
| -1.83 | 52.9 | 51.9 | 61.3 | 23.2 45.0 |
| -0.91 | 52.9 | 51.9 | 61.3 | 23.2 45.0 |
| 0.00 | 52.9 | 51.9 | 61.3 | 23.2 45.0 |
| 0.91 | 52.9 | 51.9 | 61.3 | 23.2 45.0 |
| 1.83 | 52.9 | 51.9 | 61.3 | 23.2 45.0 |
| 2.74 | 52.9 | 51.8 | 61.2 | 23.1 44.9 |
| 3.66 | 52.8 | 51.8 | 61.2 | 23.1 44.9 |
| 4.57 | 52.8 | 51.8 | 61.2 | 23.0 44.9 |
| 5.49 | 52.7 | 51.7 | 61.1 | 23.0 44.8 |
| 6.40 | 52.7 | 51.7 | 61.1 | 22.9 44.7 |
| 7.32 | 52.6 | 51.6 | 61.0 | 22.9 44.7 |
| 8.23 | 52.6 | 51.5 | 60.9 | 22.8 44.6 |
| 9.14 | 52.5 | 51.5 | 60.9 | 22.7 44.5 |
| 10.06 | 52.4 | 51.4 | 60.8 | 22.6 44.4 |
| 10.97 | 52.3 | 51.3 | 60.7 | 22.5 44.3 |
| 11.89 | 52.2 | 51.2 | 60.6 | 22.4 44.3 |
| 12.80 | 52.1 | 51.1 | 60.5 | 22.3 44.2 |
| 13.72 | 52.0 | 51.0 | 60.4 | 22.2 44.0 |
| 14.63 | 51.9 | 50.9 | 60.3 | 22.1 43.9 |
| 15.54 | 51.8 | 50.8 | 60.2 | 21.9 43.8 |
| 16.46 | 51.7 | 50.6 | 60.1 | 21.8 43.7 |
| 17.37 | 51.6 | 50.5 | 60.0 | 21.7 43.6 |
| 18.29 | 51.5 | 50.4 | 59.9 | 21.6 43.5 |
| 19.20 | 51.3 | 50.3 | 59.8 | 21.5 43.4 |
| 20.12 | 51.2 | 50.2 | 59.6 | 21.4 43.2 |
| 21.03 | 51.1 | 50.1 | 59.5 | 21.2 43.1 |
| 21.95 | 51.0 | 49.9 | 59.4 | 21.1 43.0 |
| 22.86 | 50.9 | 49.8 | 59.3 | 21.0 42.9 |



(*) According to the BPA method the L5 rain is obtained by adding 3.5 dB to the L50 rain and the L50 fair weather value is obtained by subtracting 25 dB from the L50 rain value



| | |
|--|----------------|
| PNM PUBLIC SERVICE COMPANY OF NEW MEXICO | |
| PAJARITO-RIO PUERCO 345kV T-LINE AUDIBLE NOISE CALCULATIONS | |
| DR: JLM | DATE: 01/14/26 |
| ACAD: PAJA-RIPU-ROW | APP: JR |
| PAJA-RIPU-ROW S6 | |

Transmission Line Design Standards

PNM Exhibit JLM-4

Is contained in the following 48 pages.



TSD-000-001 Transmission Line Design Standards Document



Public Service Company of New Mexico

**Revision 3.4
2/5/2026**



PURPOSE

This Design Standards Document (DSD) is intended to summarize design criteria for the design of 115kV & 345kV Projects for Public Service Company of New Mexico (PNM). The DSD was developed by PNM and is based on the National Electrical Safety Code 2017 (NESC), project scope documents, industry standards and codes, and existing PNM standards. This document is meant as a guide only and will be revised periodically by PNM and other relevant parties.

RECORD OF REVISIONS

| Revision No. | Date | By | Description | Reviewed By |
|--------------|----------|---------------|------------------------------|------------------|
| 0 | 10/18/21 | W. Alford | Issued for Approval | J. Flores-Olivas |
| 1 | 11/1/21 | W. Alford | Addressing Internal Comments | J. Flores-Olivas |
| 2 | 11/19/21 | E. Whitehouse | Addressing Internal Comments | J. Flores-Olivas |
| 3 | 5/25/22 | E. Whitehouse | Addressing Internal Comments | J. Flores-Olivas |
| 3.1 | 8/1/22 | E. Whitehouse | Addressing Internal Comments | J. Flores-Olivas |
| 3.2 | 2/8/23 | E. Whitehouse | Addressing Internal Comments | J. Flores-Olivas |
| 3.3 | 4/7/25 | J. Munoz | Addressing Internal Comments | J. Romero |
| 3.4 | 2/5/26 | J. Munoz | Addressing Internal Comments | J. Romero |

SUMMARY OF REVISIONS

- Revision 0 – Initial submission of the document for client review and approval
- Revision 1 – Addressing initial internal comments, 345kV and 500kV phase to phase same circuit clearances and avian protection guidelines
- Revision 2 –
 - Section 3: Addition of NESC 5mA check
 - Section 5: Addition of Phase to overhead shield wire sag ratio criteria
 - Section 6: Adjustment of phase to supporting structure weather criteria
 - Section 7: Update to typical cable tension limit and clarification to bi-metallic conductor settings
 - Section 9: Addition of uplift load case and load application table
 - Section 10: Addition of anti-cascading criteria, structure placement and orientation, and fiber splice point locations
 - Section 11: Adjustment of foundation design parameters for direct embed and drilled pier foundations
 - Appendix A: Adjustment of supporting structures horizontal clearances and bridge vertical clearances. Addition of horizontal clearances for railroad tracks
- Revision 3 –
 - Section 2: Addition of coordinate system footnote
 - Section 3: Updated lightning flashover rate
 - Section 5: Addition of working clearance for wire-to-wire clearances on different supporting structures, distribution crossing clearance, and distribution underbuild clearance
 - Section 7: Addition of two OPGW wires to the cable properties
 - Section 8: Addition of minimum insulation requirements
 - Section 9: Updated table 21, updated section 9.3 notes 5 and 7, addition of structure modifications, addition of cambering and raking structures, and addition of light duty poles
 - Section 10: Updated anti-cascading criteria
 - Appendix A: Addition of local authority clearances footnote to all tables
- Revision 3.1 –

- Section 5: Updated galloping clearance
- Revision 3.2 –
 - Section 1: Updated to include the minimum number of borings per structure type.
 - Section 5: Addition of horizontal clearance criteria
 - Section 7: Addition of two OPGW wires and two ACSR wires to the cable properties. Removal of two OPGW wires from the cable properties.
 - Section 10: Addition of 100-year flood spotting criteria
 - Appendix B: Addition of 12.5kV clearance criteria
- Revision 3.3 –
 - Section 1.1.9: Addition of HFA requirements.
 - Section 3.5: Addition of structure shielding angle
 - Section 4: Addition of 15deg weather case & updated maximum operating weather case's ambient temperature from 90 to 104 deg F.
 - Section 4.1: Addition of NESC special wind regions
 - Section 6: Updated Table 14 to include additional elevation clearance.
 - Section 7.1: Updated cable properties
 - Section 7.2: Updated cable tension limits
 - Section 9.7.2: Addition of switch structure loading
 - Section 10.7: Addition of collocate structures
 - Section 11.4: Addition of minimum foundation reveal for drilled shaft foundations.
- Revision 3.4 –
 - Section 6.1: Updated Table 14 to correct weather case numbers for Moderate Wind (Swing 2).
 - Section 6.1: Removed highlighting from Table 14.
 - Section 7.2: Updated Table 16 to correct weather case numbers for NESC Extreme Wind and NESC Ice/Wind.

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1.0 GENERAL

The Public Service Company of New Mexico (PNM) is the state's largest energy provider, powering residential and business customers across New Mexico every day.

PNM serves residential and business customers in greater Albuquerque, Rio Rancho, Los Lunas, Belen, Santa Fe, Las Vegas, Alamogordo, Ruidoso, Silver City, Deming, Bayard, Lordsburg, and Clayton. PNM also serves communities of the Tesuque, Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, Isleta, and Laguna Pueblos. The terrain in New Mexico varies from 2,842 feet above mean sea level (ft-MSL) at Red Bluff Reservoir to the highest point in Wheeler Park at 13,167 ft-MSL.

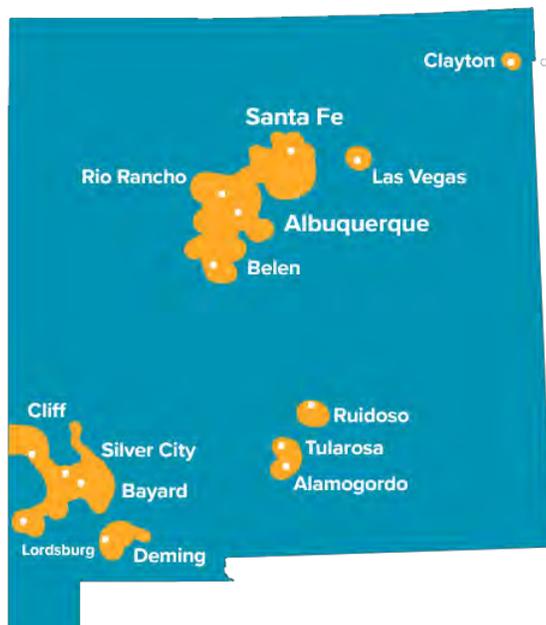


Figure 1 Map of New Mexico and PNM Service Areas

1.1 Design Considerations

1.1.1 Survey Information

LiDAR and survey data for Projects will be provided by PNM. Additional LiDAR or ground survey may be required and shall be ordered only with the approval of PNM.

1.1.2 Elevation

Due to the variation in elevation within the PNM service territory, some areas and Projects may require additional design considerations including but not limited to clearances, weather criteria and load factors. Any project extending higher than 7300 ft-MSL in elevation shall require custom clearances.

1.1.3 Right-of-Way

Existing Right-of-Way (ROW) exhibits will be provided by PNM. New ROW easements will be procured by PNM. The Project Engineer shall support PNM with project specific requirements and needs when acquiring new ROW easements. Preferred ROW widths are 75 ft for 115kV lines and 150 ft for 345kV.

1.1.4 Structures

Standard 115kV and 345kV lines will be constructed using monopole or H-frame weathered or galvanized steel structures, unless otherwise specified by PNM. Structures shall be designed to PNM standards. The use of custom structures on Projects shall require PNM approval.

1.1.5 Geotechnical Investigation

PNM will provide a list of pre-qualified geotechnical engineering consultants in preparation for requesting bids for the geotechnical field investigation. Contractors shall produce geotechnical specifications to assist in the bid process as well as provide the necessary geotechnical guideline parameters for subsurface exploration. The Project Engineer shall provide a plan drawing showing the location and coordinates of the proposed borings to the geotechnical contractor.

Tangent structures shall be required to meet a minimum of one (1) boring per mile. Angle and deadend structures shall have one (1) boring done at each location. Structures with non-standard conductors or located in poor soil conditions shall require additional borings and approval from PNM.

1.1.6 Aerial Markers for FAA

Aerial markers may be required on a per project basis as directed by PNM.

1.1.7 Removal of Existing Transmission Line Facilities

Removal, replacement, or relocation of any of existing facilities are to be detailed in the design package. This shall include location and inventory of equipment being removed.

1.1.8 Avian Protection

Transmission lines will be designed in accordance with the commitments in the PNM Avian Protection Plan to avoid electrocutions and collisions in compliance with the Migratory Bird Treaty Act.

1.1.9 High Fire Areas

All structures in high fire areas (HFAs) shall be steel installation only. New lines built in HFAs shall be vertical configuration to reduce the conductor corridor. Rebuilds or structure replacements on an existing line should use vertical configuration, where practicable, though the existing configuration may be used with PNM approval.

2.0 PROJECT DATA

2.1 Coordinate System

All geospatial information will be based on the State Plane NAD 83, New Mexico West, Central and East horizontal datum, and the State Plane NAVD 88 vertical datum with a unit of US survey foot, Grid, unless stated otherwise.



Figure 2 New Mexico County Map

Table 1 New Mexico State Plane NAD 83 Zones

| Eastern | | Central | | Western | |
|------------|------|------------|------|----------|------|
| County | Code | County | Code | County | Code |
| Chaves | 3001 | Bernalillo | 3002 | Catron | 3003 |
| Colfax | 3001 | Dona Ana | 3002 | Cibola | 3003 |
| Curry | 3001 | Lincoln | 3002 | Grant | 3003 |
| DeBaca | 3001 | Los Alamos | 3002 | Hidalgo | 3003 |
| Eddy | 3001 | Otero | 3002 | Luna | 3003 |
| Guadalupe | 3001 | Rio Arriba | 3002 | McKinley | 3003 |
| Harding | 3001 | Sandoval | 3002 | San Juan | 3003 |
| Lea | 3001 | Santa Fe | 3002 | Sierra | 3003 |
| Mora | 3001 | Socorro | 3002 | | |
| Quay | 3001 | Taos | 3002 | | |
| Roosevelt | 3001 | Torrance | 3002 | | |
| San Miguel | 3001 | Valencia | 3002 | | |
| Union | 3001 | | | | |

Note: If a project is across two NAD 83 zones, the zone with most of the project in it shall be selected.

3.0 ELECTRICAL PERFORMANCE

PNM's transmission standards shall be utilized for the design of each project, wherever practicable. Deviation from these standards in the design stage shall be communicated to PNM prior to final issuance of design drawings.

3.1 Lightning Performance

The structure geometry, insulation, and ground resistance shall be coordinated to achieve a lightning flashover rate of 4.0 flashovers per 100 miles per year for 115kV and 1.0 flashovers per 100 miles per year for 345kV transmission lines, unless specified otherwise by PNM.

3.2 Phase Transpositions

The need for line transpositions will be determined after the final conductor and configuration is decided through an electrical system study performed by the Project Engineer. The Project Engineer shall provide an electrical study for circuits longer than 40 miles to determine if a transposition is required.

3.3 Grounding Requirements

All structures shall be grounded to eliminate potentially hazardous stray currents and voltages prior to any conductor or shield wire installation. Grounding shall be detailed on design plans.

3.3.1 Structure Grounding

Grounding involves driving ground rods and electrically bonding them to the structure foundations. The desired maximum structure ground resistance is 25 ohms for 115kV and 15 ohms for 345kV. In areas where site studies indicate that it may be difficult to achieve structure grounding requirements with standard grounding designs, the Project Engineer/Contractor will present potential mitigation solutions for review and approval by PNM.

3.3.2 Grounding Structure Near Substation

Structures located inside the substation perimeter shall be treated as a metallic substation structure and a grounding analysis shall be performed by PNM substation engineering. Structures located less than 20 ft from the substation fence shall be analyzed as if it is located inside the substation, whereas structures located 20 ft or more outside substation fence shall be independently grounded.

3.3.3 Fence Grounding

At each point where the transmission line crosses a metal fence, ground rods shall be installed on the fences at the edge of the easement. If the angle of the crossing is such that the distance between grounds exceeds 300 ft, additional grounds shall be installed such that the distance between grounds within the easement does not exceed 300 ft. Whenever a fence gate crosses a transmission centerline, a ground shall be installed on each side of the gate opening. Any metal fence that parallels the transmission line within 200 ft of the centerline shall be grounded as indicated in Table 2.

Table 2 Parallel Fence Grounding Requirements

| Distance from Centerline (ft) | Grounding Interval Along Fence Line (ft) |
|-------------------------------|--|
| 0 - 100 | 300 |
| 100 - 200 | 450 |

*Ground at every deadend fence post.

3.4 NESC 5 mA Check

NESC Rule 232-D3.C states that “For voltages exceeding 98kV ac to ground, either the clearances shall be increased or the electrical field, or the effects thereof, shall be reduced by other means as required to limit the steady state current due to electrostatic effects to 5 mA, rms, if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground. The size of the anticipated truck, vehicle, or equipment used to determine these clearances may be less than but need not be greater than that limited by federal, state, or local regulations governing the area under the line. For this determination, the conductors shall be at a final sag at 50°C (120°F).” In accordance with the rule stated above, a NESC 5 mA study shall be performed for lines that exceed voltages of 98kV phase to ground or 170 kV phase to phase. Cumulative electric field effects from parallel or adjacent lines shall be included where engineering judgment deems it necessary. The following maximum electric field values shall be maintained within the transmission right-of-way:

- 5.0 kV/m over highway crossing
- 10.0 kV/m over all other surfaces

3.5 Structure Shielding Angle

All structures shall have a maximum shielding angle of 30 degrees. Shielding angles over 30 degrees shall be discussed with PNM.

4.0 WEATHER DATA

Table 3 shows PNM weather cases to be used on all projects that fall within NESC Medium Zones. The values in Table 3 were developed in conjunction with NESC, RUS and may change due to site specific conditions.

Table 3 Weather Data

| Weather Case No. | Description | Wind Velocity (mph) | Wind Pressure (psf) | Wire Ice Thickness (in) | Wire Temp. (deg F) | Ambient Temp. (deg F) |
|------------------|---------------------------------------|---------------------|---------------------|-------------------------|--------------------|-----------------------|
| 1 | NESC Medium (250B) ¹⁵ | 39.5 | 4.0 | 0.25 | 15.0 | 15.0 |
| 2 | NESC Extreme Wind (250C) | 90.0 | 20.7 | 0.0 | 60.0 | 60.0 |
| 3 | NESC Concurrent Ice and Wind (250D) | 30.0 | 2.3 | 0.0 | 15.0 | 15.0 |
| 4 | Extreme Ice ⁵ | 0.0 | 0.0 | 0.5 | 30.0 | 30.0 |
| 5 | Cold Uplift | 0.0 | 0.0 | 0.0 | -5.0 | -5.0 |
| 6 | Maximum Operating ² | 0.0 | 0.0 | 0.0 | *2 | 104.0 |
| 7 | NESC Tension Limit (261H1c) | 0.0 | 0.0 | 0.0 | 15.0 | 15.0 |
| 8 | NESC Blowout 6PSF | 48.4 | 6.0 | 0.0 | 60.0 | 60.0 |
| 9 | No Wind (Swing 1) | 0.0 | 0.0 | 0.0 | 60.0 | 60.0 |
| 10 | Moderate Wind (Swing 2) | 48.4 | 6.0 | 0.0 | 32.0 | 32.0 |
| 11 | Moderate Wind (Swing 3) | 48.4 | 6.0 | 0.0 | 60.0 | 60.0 |
| 12 | High Wind (Swing 4) | 90.0 | 20.7 | 0.0 | 60.0 | 60.0 |
| 13 | Galloping (Swing) ⁵ | 28.0 | 2.0 | 0.25 | 32.0 | 32.0 |
| 14 | Galloping (Sag) ⁵ | 0.0 | 0.0 | 0.25 | 32.0 | 32.0 |
| 15 | -20 Deg F | 0.0 | 0.0 | 0.0 | -20.0 | -20.0 |
| 16 | 0 Deg F | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | 15 Deg F | 0.0 | 0.0 | 0.0 | 15.0 | 15.0 |
| 18 | 30 Deg F | 0.0 | 0.0 | 0.0 | 30.0 | 30.0 |
| 19 | 32 Deg F | 0.0 | 0.0 | 0.0 | 32.0 | 32.0 |
| 20 | 32 Deg F ¼ Inch Ice ⁵ | 0.0 | 0.0 | 0.25 | 32.0 | 32.0 |
| 21 | 60 Deg F | 0.0 | 0.0 | 0.0 | 60.0 | 60.0 |
| 22 | 90 Deg F | 0.0 | 0.0 | 0.0 | 90.0 | 90.0 |
| 23 | 120 Deg F | 0.0 | 0.0 | 0.0 | 120.0 | 90.0 |
| 24 | 212 Deg F | 0.0 | 0.0 | 0.0 | 212.0 | 90.0 |
| 25 | PNM Extreme Wind (Wind on Wires) | 94.8 | 23.0 | 0.0 | 60.0 | 60.0 |
| 26 | PNM Extreme Wind (Wind on Structures) | 123.4 | 39.0 | 0.0 | 60.0 | 60.0 |
| 27 | Stringing (No Snub) | 28.0 | 2.0 | 0.0 | 60.0 | 60.0 |
| 28 | Construction (With Snub) | 34.2 | 3.0 | 0.0 | 30.0 | 30.0 |
| 29 | Everyday ³ | 0.0 | 0.0 | 0.0 | *3 | *3 |
| 30 | AAMT ⁴ | 0.0 | 0.0 | 0.0 | *4 | *4 |
| 31 | Deflection | 28.0 | 2.0 | 0.0 | 40.0 | 40.0 |
| 32 | PNM 3PSF Wind | 34.2 | 3.0 | 0.0 | 60.0 | 60.0 |

1. NESC Medium should be utilized for the whole state unless specified otherwise by PNM. K Factor of 0.2 to be included per NESC.
2. Maximum Operating weather case is the maximum operating temperature (MOT) of the conductor. For ACSR, the MOT will be 212°F.
3. Everyday weather case is annual average temperature (AAT) for the project site.
4. AAMT annual average minimum temperature (AAMT) for the project site.
5. Density of ice is 57 lbs/ft³.

4.1 NESC Special Wind Regions

Project sites with one or more structures identified in a NESC Special Wind Region, per National Electrical Safety Code 2017 (NESC) Section 25, are subject to a wind study investigation to determine the basic wind speed that should be utilized for NESC Extreme Wind (250C).

5.0 ELECTRICAL CLEARANCES

Structure configuration and spotting will be completed to maintain appropriate electrical clearances throughout the line. Clearance requirements shall adhere to those outlined in the following sections. All required clearance values are calculated using NESC, RUS, or other specified design documents. Required clearances are based on maximum phase-to-phase operating voltages (nominal phase-to-phase voltage with a 1.05 over-voltage factor for nominal voltages up to 500kV and 1.10 over-voltage factor for 500kV), unless otherwise noted. Elevations may exceed 3300 ft-MSL and therefore shall require elevation factors. Clearance values listed in this document include elevation factors for elevations above 3,300 ft-MSL and are adequate to an elevation of 7,300 ft-MSL. Project-specific clearances shall be increased if the elevation exceeds 7,300 ft-MSL. The Project Engineer shall coordinate with PNM to determine and agree if structures need to be designed for live line maintenance. The Project Engineer shall verify each project's elevation at the preliminary design stage.

For clearances to ground and obstacles not associated with the circuit to be installed, clearance buffers will be applied in addition to code requirements to account for construction and survey tolerances. For vertical and horizontal clearances, PNM requires minimum design buffers of 2.5 ft vertical and 2.5 ft horizontal for all ground and obstacle clearances in addition to those required by the NESC and avian protection guidelines.

5.1 Clearances to Ground and Obstacles

Permits such as Roadway, Railway, Pipeline, Canals, Rivers, Highways and FAA shall be considered on a per-project basis which may have clearance requirements that exceed PNM design standards.

5.1.1 Vertical Clearance to Ground and Obstacles

Vertical clearances to ground and obstacles under NESC Rules 232 and 234 shall meet or exceed the values summarized in Table 27, Table 28, and Table 29 in Appendix A.

5.1.2 Horizontal Clearances to Obstacles

Horizontal clearances to obstacles under NESC Rule 234 shall meet or exceed the values summarized in Table 28 and Table 29 in Appendix A.

5.1.3 Horizontal Clearance to Edge of Right-of-Way

Horizontal clearances to edge of right-of-way (ROW) shall consider a building constructed on the edge of the ROW. Horizontal clearances to buildings are stated in Appendix A, and corresponding weather conditions are listed in Table 6. When determining ROW clearances, structure deflection shall be considered, as noted in Section 9.4. Energized conductors and non-energized wires shall maintain 15' of clearance to the edge of the ROW at rest. Wires shall also maintain the horizontal clearances listed in Table 4 for NESC Extreme Wind (250C) to the edge of ROW.

Table 4 FAC-003 Minimum Vegetation Clearance Distances (MVCD)

| Voltage (kV) | MVCD Distance (ft) |
|--------------|--------------------|
| 69 | 1.3 |
| 115 | 2.2 |
| 230 | 4.7 |
| 345 | 5.0 |
| 500 | 8.1 |

*MVCD are for alternating current voltages for elevations up to 8,000ft.

Transmission lines located in high fire areas shall coordinate with the Vegetation Management Team to obtain Project-specific vegetation clearances.

Spans that cannot meet the clearance to the edge of ROW criteria will be reported to PNM and documented in the project-specific design criteria document.

5.1.4 Applicable Weather Cases for Vertical Clearances

Vertical clearance requirements will be applied under the weather conditions summarized in Table 5.

Table 5 Vertical Clearance Weather Cases

| Weather Case No. | Description | Sag (F/I) | Reference |
|------------------|---------------------|-----------|-----------------------|
| 20 | 32 Deg F ¼ Inch Ice | F | NESC 232-A3 & 234-A1c |
| 5 | Cold Uplift | I | NESC 234-A1d |
| 21 | 60 Deg F | I | NESC 232-A3 |
| 23 | 120 Deg F | F | NESC 232-A1 & 234-A1a |
| 24 | 212 Deg F | F | NESC 232-A2 & 234-A1b |
| 6 | *Maximum Operating | F | NESC 232-A2 & 234-A1b |

*Maximum Operating weather case is the maximum operating temperature (MOT) of the conductor. For ACSR, the MOT will be 212°F.

5.1.5 Applicable Weather Cases for Horizontal Clearances

Horizontal clearance requirements will be applied under the weather conditions in Table 6.

Table 6 Horizontal Clearance Weather Cases

| Weather Case No. | Description | Sag (F/I) | Reference |
|------------------|---------------------|-----------|--------------|
| 20 | 32 Deg F ¼ Inch Ice | F | NESC 234-A1c |
| 8 | NESC Blowout 6PSF | F | NESC 234-2 |
| 32 | PNM 3PSF Wind | F | PNM Standard |
| 5 | Cold Uplift | I | NESC 234-A1d |
| 23 | 120 Deg F | F | NESC 234-1a |
| 24 | 212 Deg F | F | NESC 234-A1b |
| 6 | *Maximum Operating | F | NESC 234-A1b |

*Maximum Operating weather case is the maximum operating temperature (MOT) of the conductor. For ACSR, the MOT will be 212°F.

5.2 Wire to Wire Clearances on Different Supporting Structures

Wire to wire vertical and horizontal clearances on different supporting structures under NESC Rule 233 shall meet or exceed the values summarized in Table 30 and Table 31 in Appendix B, respectively. PNM clearances include a 2.5 ft buffer to allow for modeling inaccuracies, survey inaccuracies, and construction tolerances.

5.2.1 Applicable Weather Cases for Wire to Wire Clearances on Different Supporting Structures

Wire to wire clearance on different supporting structures shall be applied under the weather conditions summarized in Table 7. Both circuits are assumed to have wind applied in the same direction simultaneously.

Table 7 Wire to Wire Clearances on Different Supporting Structures Weather Cases

| Subject Conductor / Upper Crossing | | | Adjacent Conductor / Lower Crossing | | | Reference |
|------------------------------------|---------------------|-----------|-------------------------------------|---------------|-----------|--------------|
| Weather Case No. | Description | Sag (F/I) | Weather Case No. | Description | Sag (F/I) | |
| 8 | NESC Blowout 6PSF | F | 32 | PNM 3PSF Wind | F | PNM Standard |
| 20 | 32 Deg F ¼ Inch Ice | F | 19 | 32 Deg F | I | NESC 233-A |
| 24 | 212 Deg F | F | 21 | 60 Deg F | I | NESC 233-A |
| 6 | Maximum Operating | F | 21 | 60 Deg F | I | NESC 233-A |

5.2.2 Working Clearance for Wire to Wire Clearances on Different Supporting Structures

Wire to wire clearance on different supporting structures shall meet the minimum 15' horizontal working clearance for 115kV circuits and the 20' horizontal working clearance for 345kV circuits as per OSHA 1926.1408.

5.3 Wire to Wire Clearances on the Same Supporting Structure (Different Circuit)

Vertical wire to wire clearances on the same supporting structure at the support and midspan for the same utility shall meet or exceed the values summarized in Table 32 and Table 33 in Appendix C, respectively.

Vertical wire to wire clearances on the same supporting structure at the support and midspan for different utilities shall meet or exceed the values summarized in Table 34 and Table 35 in Appendix D, respectively.

Horizontal wire to wire clearances on the same supporting structure at the support and midspan for different or the same utilities shall meet or exceed the values summarized in Table 36 in Appendix E.

Referenced vertical and horizontal clearances are based on NESC Rule 235. PNM clearances include a 2.5 ft buffer to allow for modeling inaccuracies, survey inaccuracies, and construction tolerances.

5.3.1 Applicable Weather Cases for Wire to Wire Clearances on the Same Supporting Structure (Different Circuit)

Wire to wire clearance requirements will be applied under the weather conditions summarized in Table 8.

Table 8 Wire to Wires Clearances on the Same Supporting Structure (Different Circuit) Weather Cases

| Clearance Type | Upper Conductor | | | Lower Conductor | | | Reference |
|----------------|------------------|---------------------|-----------|------------------|---------------|-----------|------------|
| | Weather Case No. | Description | Sag (F/I) | Weather Case No. | Description | Sag (F/I) | |
| Vertical | 20 | 32 Deg F ¼ Inch Ice | F | 19 | 32 Deg F | I | NESC 235-C |
| Vertical | 24 | 212 Deg F | F | 19 | 32 Deg F | I | NESC 235-C |
| Vertical | 6 | Maximum Operating | F | 19 | 32 Deg F | I | NESC 235-C |
| Horizontal | 21 | 60 Deg F | F | 21 | 60 Deg F | I | NESC 235-B |
| Horizontal | 8 | NESC Blowout 6PSF | F | 32 | PNM 3PSF Wind | I | NESC 235-B |

5.4 Phase to Phase Clearances of the Same Circuit

Phase to phase clearances of the same circuit at the supports and at midspan shall meet or exceed the values summarized in Table 9. Referenced clearances are based on NESC Rule 235. PNM clearances include a 1.0 ft buffer for voltages below 100kV and a 2.0 ft buffer for voltages above 100kV. These buffers allow for modeling inaccuracies, survey inaccuracies, and construction tolerances.

Table 9 Phase to Phase Clearances of the Same Circuit Requirements

| RADIAL CLEARANCES BETWEEN PHASES OF THE SAME CIRCUIT | | | | | | | | |
|--|------------------------|-----------------------|-----------------------|------|------|------|------|------|
| Rule 235-E NESC 2017 Pg. 158 and Base Clearance from Table 235-6 NESC 2017 Pg. 180 | | | | | | | | |
| Assumed elevation of 7,300 ft-MSL. | | | | | | | | |
| | Open Supply Conductors | | | | | | | |
| | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.00 |
| | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 |
| | CODE | kV | kV | kV | kV | kV | kV | kV |
| Radial Clearance between Phases of the Same Circuit at the Supports | PNM | 24.0 ³ | 17.0 ³ | 11.6 | 7.6 | 5.0 | 4.2 | 4.2 |
| | RUS Table 6-1 | No Value ² | No Value ² | 9.6 | 5.6 | 4.0 | 3.2 | 3.2 |
| Radial Clearance between Phases of the Same Circuit at Mid Span | PNM | 24.0 ³ | 17.0 ³ | 11.0 | 6.9 | 4.3 | 3.5 | 3.5 |
| | RUS Table 6-1 | No Value ² | No Value ² | 9.0 | 4.9 | 3.3 | 2.5 | 2.5 |

1. NESC does not provide a required clearance
2. RUS does not prove a required clearance
3. Based on values adopted by various utilities per industry standards (plus PNM buffer). These values should be used as a guideline, the actual required clearances are a function of several variables including type of structure adopted, span lengths, voltages, terrain and possibility of Aeolian vibration and galloping.

5.4.1 Applicable Weather Cases for Phase to Phase Clearances of the Same Circuit

Wire to wire clearance requirements will be applied under the weather conditions summarized in Table 10.

Table 10 Phase to Phase Clearances of the Same Circuit Requirements Weather Cases

| Upper Conductor | | | Lower Conductor | | | Reference |
|------------------|---------------------|-----------|------------------|-------------|-----------|------------|
| Weather Case No. | Description | Sag (F/I) | Weather Case No. | Description | Sag (F/I) | |
| 20 | 32 Deg F ¼ Inch Ice | F | 19 | 32 Deg F | I | NESC 235-C |
| 21 | 60 Deg F | F | 21 | 60 Deg F | I | NESC 235-B |

5.5 Phase to Overhead Shield Wire Clearances

The radial clearance between phases and shield wires on the same supporting structure at the support and midspan shall meet or exceed the values summarized in Table 11. The values in Table 11 are based on the RUS Bulletin 1724E-200 (2015) Section 6 and include a 2.0 ft buffer to account for ice jumping.

In addition to the clearance values stated in Table 11, an overhead shield wire to phase sag ratio of 80% shall be maintained at a 60°F final cable condition for all wires.

Table 11 Phase to Overhead Shield Wire Clearance Requirements

| RADIAL CLEARANCES BETWEEN PHASES TO OVERHEAD SHIELD WIRE OF THE SAME CIRCUIT | | | |
|--|---------------|-----------------------|-----|
| | Phase Voltage | 345 | 115 |
| | CODE | kV | kV |
| Radial Clearance between Phase and Overhead Shield Wire attached to the Same Structure at the Supports | PNM | 10.5 ³ | 5.9 |
| | RUS Table 6-1 | No Value ² | 3.9 |
| Radial Clearance between Phase and Overhead Shield Wire attached to the Same Structure at Mid Span | PNM | 9.5 ³ | 5.2 |
| | RUS Table 6-1 | No Value ² | 3.2 |

1. The two (2) foot buffer for ice jumping can be removed when shield wires have a horizontal offset greater than 12 inches from energized wires below.
2. RUS does not prove a required clearance
3. Based on values adopted by various utilities per industry standards (plus PNM buffer).

5.5.1 Applicable Weather Cases for Phase to Overhead Shield Wire Clearances

Phase to overhead shield wire clearance requirements will be applied under the weather conditions summarized in Table 12.

Table 12 Phase to Overhead Shield Wire Clearance Requirements Weather Cases

| Clearance Type | Upper Wire | | | Lower Conductor | | |
|----------------|------------------|---------------------|-----------|------------------|-------------|-----------|
| | Weather Case No. | Description | Sag (F/I) | Weather Case No. | Description | Sag (F/I) |
| Vertical | 20 | 32 Deg F ¼ Inch Ice | F | 19 | 32 Deg F | I |
| Vertical | 23 | 120 Deg F | F | 23 | 120 Deg F | I |

5.6 Galloping

Conductor and shield wire galloping ellipses will be modeled using the A.E. Davison method for single loop galloping and the L.W. Toye method for double loop galloping under the conditions specified in Table 13. Modeled ellipse dimensions will reflect the full calculated size. Galloping will be calculated as single loop for span lengths up

to 600 ft and double loop for span lengths greater than 600 ft. Zero inches of clearance will be maintained between ellipses, unless noted otherwise.

Table 13 Galloping Weather Cases

| Weather Case No. | Description | Ice (in) | Wind (psf) | Sag (F/I) |
|------------------|-------------------|----------|------------|-----------|
| 13 | Galloping (Swing) | 0.25 | 2.0 | F |
| 14 | Galloping (Sag) | 0.25 | 0.0 | F |

5.7 Distribution and Third Party Attachments

All crossings should be verified with the respective parties.

5.7.1 Distribution Crossing Clearance

Wire to structure clearance shall meet or exceed the values summarized in Table 28 in Appendix A with an additional 38.5' above ground clearance for all distribution crossings. All crossings to be verified with PNM distribution at each phase of the project.

5.7.2 Distribution Underbuild Clearance

No distribution underbuild shall be on 345kV lines. PNM prefers to have no distribution underbuild on 115kV lines. If distribution underbuild is required, wire to wire clearance on the same supporting structure with distribution underbuild shall be greater of the values summarized in Table 32 in Appendix C or the minimum 15' clearance from the lowest transmission conductor attachment to the highest distribution attachment. In addition to the wire to wire clearance, an additional 38.5' above ground clearance for all distribution crossings to account for a future 45' distribution pole rebuild. All areas with underbuild to be verified with PNM distribution at each phase of the project.

6.0 CLEARANCE TO SUPPORTING STRUCTURE

6.1 Phase to Supporting Structure Clearance

The minimum radial clearance requirements from a conductor to its supporting structure shall meet or exceed the PNM values summarized in Table 14. The PNM values in Table 14 are based on NESC Rule 235 or RUS 1724E-200 with a 6-inch buffer and assumed elevation of 7,300 ft-MSL.

Table 14 Phase to Supporting Structure Clearance Requirements

| Description | Cable Condition | Clearance | Weather Case No. | Description | Reference | Clearance (ft) | |
|---|-----------------|--|------------------|-------------------------|---------------|----------------|------------------|
| | | | | | | 115kV | 345kV |
| No Wind Clearance ¹ (Condition 1) | Final | Minimum Clearance to Structure or Guy | 9 | No Wind (Swing 1) | PNM | 4.2 | 9.5 |
| | | | | | RUS Section 7 | 3.7 | 9.0 ² |
| | | Minimum Clearance to Structure or Guy | 16 | 0 Deg F | PNM | 4.2 | 9.5 |
| | | | | | RUS Section 7 | 3.7 | 9.0 ² |
| Moderate Wind Clearance (Condition 2) | Final | Minimum Clearance to Structure | 10 | Moderate Wind (Swing 2) | PNM | 2.8 | 7.1 |
| | | | | | NESC 235-6 | 2.3 | 6.6 |
| | | Minimum Clearance to Jointly Used Structures | 10 | Moderate Wind (Swing 2) | PNM | 3.0 | 7.3 |
| | | | | | NESC 235-6 | 2.5 | 6.8 |
| | | Minimum Clearance to Anchor Guys | 10 | Moderate Wind (Swing 2) | PNM | 3.5 | 8.9 |
| | | | | | NESC 235-6 | 3.0 | 8.4 |
| Moderate Wind Clearance (Condition 3) | Final | Minimum Clearance to Structure | 11 | Moderate Wind (Swing 3) | PNM | 2.8 | 7.1 |
| | | | | | NESC 235-6 | 2.3 | 6.6 |
| | | Minimum Clearance to Jointly Used Structures | 11 | Moderate Wind (Swing 3) | PNM | 3.0 | 7.3 |
| | | | | | NESC 235-6 | 2.5 | 6.8 |
| | | Minimum Clearance to Anchor Guys | 11 | Moderate Wind (Swing 3) | PNM | 3.5 | 8.9 |
| | | | | | NESC 235-6 | 3.0 | 8.4 |
| High Wind Clearance (Condition 4) | Final | Minimum Clearance to Structure or Guy | 12 | High Wind (Swing 4) | PNM | 1.6 | 3.0 |
| | | | | | RUS Section 7 | 1.1 | 2.5 ² |

1. Clearance to structure at no wind case shall not be less than the dry arc distance of the insulator.
2. Based on values adopted by various utilities per industry standards.

7.0 CONDUCTOR AND SHIELD WIRE

7.1 Cable Properties

Unless otherwise approved by PNM, all new 115kV transmission structures shall be designed to support (2) DNO-6318 OPGW cables. Table 15 summarizes the properties for typical PNM wire types.

Table 15 Cable Properties

| Voltage | Cable Type | Cable Name | Cable Description | Diameter (in) | Unit Weight (lbs/ft) | RBS (lbs) |
|---------|------------|---------------|--|---------------|----------------------|-----------|
| N/A | OHGW | Shield Wire | 3/8" EHS Steel | 0.360 | 0.273 | 15,400 |
| N/A | OPGW | AFL DNO-11282 | 72 Count Fiber | 0.512 | 0.304 | 15,190 |
| N/A | OPGW | AFL DNO-6318 | 144 Singlemode Fiber | 0.630 | 0.417 | 19,791 |
| N/A | OPGW | AFL DNO-12663 | 24 Corning LEAF & 120 Singlemode Fiber | 0.630 | 0.417 | 19,791 |
| 115kV | ACSR | Drake | 795 kcmil 26/7 ACSR | 1.108 | 1.093 | 31,500 |
| 115kV | ACSR | Cardinal | 954 kcmil 54/7 ACSR | 1.196 | 1.227 | 33,800 |
| 115kV | ACSR | Chukar | 1780 kcmil 84/19 ACSR | 1.602 | 2.072 | 51,000 |
| 345kV | ACSR | Drake | 2-795 kcmil 26/7 ACSR | 1.108 | 1.093 | 31,500 |
| 345kV | ACSR | Pheasant | 2-1272 kcmil 54/19 ACSR | 1.382 | 1.634 | 43,600 |

* Non-standard conductors shall require PNM approval at project kick-off.

7.2 Cable Tensions

Typical cable tensions will be limited to the values outlined in Table 16 based on NESC Rule 261 or specified by the client. Additional OPGW cable tensions to be applied per manufacturer recommendations.

Table 16 Typical Cable Tension Limits

| Cable Name | Weather Case | Description | Sag (F/I) | Tension Limit | Reference |
|------------|--------------|-----------------------|-----------|-----------------|---------------|
| All | 1 | NESC Medium | I | 60% RBS | NESC Rule 261 |
| All | 2 | NESC Extreme Wind | I | 80% RBS | NESC Rule 261 |
| All | 3 | NESC Ice/Wind | I | 80% RBS | NESC Rule 261 |
| All | 7 | NESC Initial Unloaded | I | 35% RBS | NESC Rule 261 |
| All | 17 | 15 Deg | F | 25% RBS | NESC Rule 261 |
| All | 21 | 60 Deg | F | 17% RBS | PNM Standard |
| All | 5 | Cold Uplift | F | 25% RBS | PNM Standard |
| Drake | 1 | NESC Medium | I | TBD per Project | PNM Standard |
| Cardinal | 1 | NESC Medium | I | TBD per Project | PNM Standard |
| Chukar | 1 | NESC Medium | I | TBD per Project | PNM Standard |
| Pheasant | 1 | NESC Medium | I | TBD per Project | PNM Standard |

7.3 Aeolian Vibration

Aeolian vibration mitigation shall be based on a qualified engineering study, manufacturer’s recommendations, or experience from comparable installations. Consideration shall include, but is not limited to conductor material, stranding, type, size, tension, conductor attachment hardware, span length, wind exposure, and expected atmospheric loadings. If vibration control devices are required, dampers will be installed on phase conductors and shield wire in accordance with manufacturer’s placement recommendations. Dampers shall be installed on the ahead and back side every other structure and shall be included in design submittals. Table 17 summarizes the variables that will be used for Aeolian vibration analyses per Project.

Table 17 Aeolian Vibration Analysis Criteria

| Parameter | Value |
|---|-------|
| Maximum Steady Wind Speed (mph) | 15 |
| Average Annual Temperature (°F) | * |
| Average Annual Minimum Temperature (°F) | * |

* Temperatures are dependent on Project location.

7.4 Bi-metallic Conductor Modeling

Aluminum has a thermal expansion coefficient larger than steel. Consequently, at some high temperature transition point, the aluminum strands used as the outer material of a bi-metallic conductor are no longer under tension. At temperatures higher than this transition point, it is assumed that the aluminum goes into compression. For calculation of maximum sag at high temperatures, the maximum virtual compressive strength of aluminum is assumed to be 1.5 ksi for ACSR only.

7.5 Creep & Load

Creep is permanent stretching of wire in response to application of tension over time. This permanent stretch results in lower tensions for wires in the “after creep” condition compared to the initial condition. For calculation of permanent stretch due to creep, a 60 Deg F weather case will be used.

Wires can also be permanently stretched due to short exposures to extreme load. Calculations done in the “after load” condition will include an adjustment for the permanent stretch caused by a short-term exposure to the following weather cases: NESC Medium (250B), NESC Extreme Wind (250C), NESC Ice & Wind (250D), and Extreme Ice.

7.6 Set and Phase Coordination for PLS-CADD Insulator Links

The PLSCADD insulator links noted in Table 18 shall be used for PNM Projects.

Table 18 PLS-CADD Insulator Links

| VOLTAGE | CKT | SET | | |
|---------|--------------|---------|---------|------|
| | | TANGENT | DEADEND | |
| | | | AHEAD | BACK |
| OHSW | Left | 1 | 1 | 31 |
| | Right | 2 | 2 | 32 |
| | Tap | 3 | 3 | 33 |
| 345 | Left/Top | 4 | 4 | 34 |
| | Right/Bottom | 5 | 5 | 35 |
| | Tap | 6 | 6 | 36 |
| 230 | Left/Top | 7 | 7 | 37 |
| | Right/Bottom | 8 | 8 | 38 |
| | Tap | 9 | 9 | 39 |
| 115 | Left/Top | 10 | 10 | 40 |
| | Right/Bottom | 11 | 11 | 41 |
| | Tap | 12 | 12 | 42 |
| 69 | Left/Top | 13 | 13 | 43 |
| | Right/Bottom | 14 | 14 | 44 |
| | Tap | 15 | 15 | 45 |
| 46 | Left/Top | 16 | 16 | 46 |
| | Right/Bottom | 17 | 17 | 47 |
| | Tap | 18 | 18 | 48 |
| 12.47 | Left/Top | 19 | 19 | 49 |
| | Right/Bottom | 20 | 20 | 50 |
| | Tap | 21 | 21 | 51 |
| NEUTRAL | Top | 22 | 22 | 52 |
| | Mid | 23 | 23 | 53 |
| | Bottom | 24 | 24 | 54 |
| MISC | Top | 25 | 25 | 55 |
| | Mid | 26 | 26 | 56 |
| | Bottom | 27 | 27 | 57 |

8.0 INSULATORS & HARDWARE

8.1 Insulator Assemblies

Insulator assemblies will be selected from PNM’s library of assemblies, wherever practicable. Deadend and strain structures will use strain assemblies. PNM preference is to use polymer insulators.

8.2 Insulator Strength

Insulator strengths will be determined during detailed design using the strength reduction factors outlined in Table 19 based on NESC Rule 277. All insulator strength factors shall be applied without load factors.

Table 19 Insulator Strength Reduction Factors

| Load Case No. | Weather Case No. | Load Case | Ceramic | | | Non-ceramic | | |
|---------------|------------------|---------------------------------------|------------|------------|-----------------------|-------------|------------|-----------------------|
| | | | Suspension | Post | | Suspension | Post | |
| | | | | Cantilever | Tension / Compression | | Cantilever | Tension / Compression |
| 1 | 1 | NESC 250B Medium | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 |
| 2 | 2 | NESC 250C Extreme Wind | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 3 | 3 | NESC 250D Extreme Ice/Wind | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 4 | 4 | Extreme Ice | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 5 | 20 | Differential Ice | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 6 | 25 | PNM Extreme Wind (Wind on Wires) | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| | 26 | PNM Extreme Wind (Wind on Structures) | | | | | | |
| 7 | 27 | Stringing (No Snub) | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 8 | 28 | Construction (With Snub) | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 9 | 31 | Deflection | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |
| 10 | 5 | Uplift | 0.5 | 0.4 | 0.5 | 0.65 | 0.5 | 0.5 |

* Project Engineer shall verify that the custom insulator strength values from the vendors are unfactored, so strength reductions are not taken twice.

8.3 Hardware Strength

Per NESC Rule 261, attachment hardware shall be capable of supporting NESC 250B (Load Case No. 1) design loads inclusive of all load factors without exceeding 100% of its ultimate strength. For NESC 250C (Load Case No. 2) and 250D (Load Case No. 3), wire tension loads shall not exceed 80% of the hardware ultimate strength with no load factors.

8.4 Minimum Insulation Requirements

For elevations under 7,300ft, refer to current insulation standards for 115kV and 345kV. For elevations over 7,300ft, insulation requirements shall be discussed with PNM.

9.0 LOADINGS AND LOAD FACTORS

9.1 Assumptions

The following assumptions are used for structure load calculation on the Project:

- The 2017 NESC wind model will be used for NESC 250C Extreme Wind loading only
- Density of ice = 57 lbs/ft³
- Structure icing is negligible
- Misc. conductor load (dampers, spacers, etc.) = 150 lbs
- Misc. OHGW load = 75 lbs

9.2 Loadings

Structures will be designed for the load cases summarized in Table 20.

Table 20 Structure Loadings

| Load Case No. | Weather Case No. | Description | Sag (F/l) | Load Factor | | | | |
|---------------|------------------|---------------------------------------|-----------|-------------|------|---------|-----------|------|
| | | | | Wire | | | Structure | |
| | | | | Vert. | Wind | Tension | Weight | Wind |
| 1 | 1 | NESC 250B Medium ¹ | I | 1.5 | 2.5 | 1.65 | 1.5 | 1.0 |
| 2 | 2 | NESC 250C Extreme Wind ^{2,3} | I | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 3 | 3 | NESC 250D Extreme Ice/Wind | I | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 4 | 4 | Extreme Ice | I | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 5 | 20 | Differential Ice | I | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 |
| 6 | 25 | PNM Extreme Wind (Wind on Wires) | I | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | 26 | PNM Extreme Wind (Wind on Structures) | | | | | | |
| 7 | 27 | Stringing (No Snub) | I | 2.0 | 2.0 | 2.0 | 2.0 | 1.0 |
| 8 | 28 | Construction (With Snub) | I | 1.5 | 1.5 | 1.5 | 1.5 | 1.0 |
| 9 | 31 | Deflection | F | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 10 | 5 | Uplift | I | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

1. A k value of 0.2 will be used with the NESC Medium load case.

2. Wind speed/pressure is the base wind speed/pressure. Wind speed/pressure will be adjusted per NESC Rule 250C.

3. A NESC 250C Extreme Wind loading case without any wires shall also be checked.

9.3 Application of Loads

Table 21 indicates what loadings specified in Table 20 shall be applied to each structure group.

Table 21 Load Application

| Load Case No. | Weather Case No. | Description | Deadend | | Strain | | | Suspension | |
|---------------|------------------|---------------------------------------|---------|---------------|--------|---------------|-------------|------------|-------------|
| | | | Intact | One Side Only | Intact | One Side Only | Broken Wire | Intact | Broken Wire |
| 1 | 1 | NESC 250B Medium | X | X | X | | X | X | |
| 2 | 2 | NESC 250C Extreme Wind | X | X | X | | | X | |
| 3 | 3 | NESC 250D Extreme Ice/Wind | X | X | X | | | X | |
| 4 | 4 | Extreme Ice | X | X | X | | | X | |
| 5 | 20 | Differential Ice | | | X | | | X | |
| 6 | 25 | PNM Extreme Wind (Wind on Wires) | X | X | X | | | X | |
| | 26 | PNM Extreme Wind (Wind on Structures) | | | | | | | |
| 7 | 27 | Stringing (No Snub) | X | | X | | | X | |
| 8 | 28 | Construction (With Snub) | X | | X | | | X | |
| 9 | 31 | Deflection | X | X | X | X | | X | |
| 10 | 5 | Uplift | X | X | X | | | | |

1. Load cases 5 and 8 shall be excluded for structures utilizing braced post insulators.

The following load application details shall be used in conjunction with the information above:

- Multi-circuit structures will be designed to allow for the installation of any one single circuit at a time in addition to the installation of all circuits.
- Where multiple OHGW types are required, structures will be designed to carry the OHGW that produces the largest loads at all OHGW locations.
- Deadend structures will be designed to support ahead wires only installed, back wires only installed, and both ahead and back wires installed for all applicable load cases.
- Strain structures will be designed to support differential tension resulting from different ahead and back ruling spans.
- A broken wire load case at the NESC 250B Medium case shall include a single broken shield wire or conductor. For construction using bundled conductor, one subconductor of any one phase bundle is assumed broken with the other subconductor(s) intact. Tensions will not be reduced by assumed insulator swing. NESC Medium load factors are applied to the intact wires. A load factor reduction of 1.1 will be applied to all load factors resulting from the broken wire.
- Differential Ice load case is applied with conductor and shield wires on one side of the structure subjected to the iced condition with conductor and shield wires on the other side bare. The longitudinal loading at the attachment points considers the resulting loads from the iced wire tension on one side of the structure and the non-iced wire on the opposite side. A reduction in tension may be assumed for suspension insulator swing. The Differential Ice load case is not applied to deadend structures.
- Stringing load case assumes any one phase or shield wire binds in the block during installation. The block is assumed to swing 45 deg resulting in a longitudinal load equal to sum of the vertical load and longitudinal load of the phase or shield wire for suspension structures. For deadend and strain structures, the Stringing load case will only be designed to support ahead wires only installed and back wires only installed.
- Construction load case will be applied for wire snubbing to the ground or construction equipment at a pulling line slope of 3/1 (horizontal/vertical). For deadend and strain structures, the Construction load case will only be designed to support ahead wires only installed and back wires only installed.
- Weight of lineman and tools shall be 300 lbs and added to load cases 7, 8, and 9.
- Uplift load case will be applied to deadend and strain structures only.

9.4 Structure Modifications

Modified structures are structures that are select location replacements that are needed to be replaced due to a maintenance issue. Modified structures shall be evaluated using section 9.2 and 9.3 normally. If the structure design doesn't meet the loads in section 9.2 and 9.3, PNM should be notified.

9.5 Deflection

Structure deflection shall be calculated independently from an assumed rotation at the base of the structure or groundline due to foundation movement. Table 22 summarizes structure deflection limits.

Table 22 Structure Deflection Limits

| Load Case | Weather Case No. | Description | Deflection Limits (% of Above Ground Height) | | | |
|-------------------|------------------|----------------------------|--|--------|---------|---------------|
| | | | Tangent | Strain | Deadend | |
| | | | | | Intact | One Side Only |
| Deflection | 30 | Deflection | 2 | 2 | 1 | 1 |
| NESC Extreme Wind | 2 | NESC 250C Extreme Wind | 7 | 7 | 7 | 7 |
| NESC Ice/Wind | 3 | NESC 250D Extreme Ice/Wind | 7 | 7 | 7 | 7 |

9.5.1 Cambering and Raking

Cambered and raked poles shall not be used.

9.6 Secondary Moments

Structures will be designed to withstand the secondary moments induced by structure deflection. These secondary moments will be based on the deflection of the structure itself and an assumed foundation rotation as specified in Table 25 or Table 26 for direct embed foundations and drilled shaft foundations, respectively.

9.7 Strength Reduction Factors

The following strength factors in Table 23 are applied to the loadings in Table 20. Strength factors for NESC load cases are based on NESC Rule 261. Guy strength reduction factors are based on the recommendations of Section 6.3.2 of the ASCE Manual of Practice 91.

Table 23 Strength Factors

| Load Case No. | Weather Case No. | Description | Steel Poles, Arms, & Braces | Wood Poles, Cross Arms, & Braces | Guys | Guy |
|---------------|------------------|-------------|-----------------------------|----------------------------------|------|-----|
|---------------|------------------|-------------|-----------------------------|----------------------------------|------|-----|

10.0 STRUCTURES

Unless otherwise noted or pre-approved by PNM, tubular galvanized or weathering steel structures shall be used on all designs.

10.1 Types

For purposes of applying the design criteria, the following defines the structure types on the project:

- Suspension Structure: A structure where the phase conductors and OHSWs are attached using suspension insulators and hardware or, in the case of the overhead ground wire, with a clamp not capable of resisting the full design tension of the wire.
- Strain Structure: A structure where the phase conductors and OHSWs are attached using deadend insulators and hardware but where the ability of the structure to resist a condition where all wires are broken on one side under full loading is not required or desired.
- Deadend Structures: A structure where the phase conductors and OHGWs are attached using deadend insulators and hardware and where the ability of the structure to resist a condition where all wires are broken on one side under full loading is required or desired.

10.2 Groups

Groups are based on actual structure line angles determined during the structure spotting process, groups may be further divided to improve structure utilization. Structure groups are to be determined by the Project Engineer and are anticipated to be broken up into, but not limited to, the following groups:

- 0 – 2 Degree Suspension Tangent
- 2 – 10 Degree Suspension Angle
- 0 – 60 Degree Strain
- 0 – 90 Degree Deadend

10.3 Uplift

Table 24 summarizes the uplift load criteria for conductor and shield wire suspension attachment points. Uplift will be allowed on strain and deadend structures.

Table 24 Uplift Design Parameters

| Weather Case | Description | Sag (F/I) | Conductor Minimum Load (lbs) | OHSW Minimum Load (lbs) |
|--------------|-------------|-----------|------------------------------|-------------------------|
| 5 | Cold Uplift | 1 | 0 | 0 |

10.4 Anti-Cascading Criteria

For failure containment, a deadend structure shall be spotted every 5 miles at a minimum. A strain structure shall be spotted every 2.5 miles. Deadend and strain structure locations shall be coordinated with PNM.

10.5 Structure Placement and Orientation

No structures shall be placed in 100-year flood zones. If a 100-year flood zone is unavoidable, PNM should be notified.

10.5.1 Switch Structures

Where line sectionalizing switches are mounted on transmission structures, the following criteria shall be met wherever feasible:

- The switch structure shall be spotted in an accessible location (preferably near a public road) for future maintenance and use.
- Switches shall be oriented to face away from roads, where applicable.

All switch structure locations shall be coordinated with PNM.

10.5.2 Deadend and Strain Structures

The first structure outside of a substation shall be a deadend. Deadend or strain structures shall also be spotted on both sides of a highway crossing.

10.6 Fiber Splice Point Locations

The project engineer shall reach out to PNM for splice location preferences. Consideration shall be given to the following:

- Minimize cumulative line angles over a continuous run of OPGW to reduce bends in the fiber tubes.
- Splice points shall be placed near public roads wherever practicable for increased accessibility and future maintenance.

The following are preferences that should be considered, wherever feasible:

- Splice points should be placed near transmission crossings.
- Splice points should be placed near a parallel line or parallel line splice location.

All splice locations shall be coordinated with PNM.

10.7 Colocate and Distribution Underbuild Structures

All collocate structure locations shall be coordinated with PNM. Colocate structures shall meet the following requirements:

- All cell antenna or joint use installations shall be reviewed and approved on a case-by-case basis.
- No cell antennas shall be installed on double circuit poles above conductors.
- Cell antenna installations shall not be allowed where installation or maintenance would require a substation or transmission line outage. Only locations that could be installed or maintained through hot-line-holds will be allowed.
- Underbuilt ADSS or any other communication wire shall not be allowed on any transmission line without distribution underbuild.

- Colocate structures and any component shall not exceed 95% usage.
- Distribution risers (PNM or customer owned) and transformers shall not be allowed on transmission structures.
- Three-phase and single-phase distribution takeoffs shall be limited as much as possible.
- A transmission pole shall never be used as part of another, unrelated structure.

11.0 FOUNDATIONS

11.1 Foundation Selection

All tangent structures will be supported by direct embed foundations and all other structures will be supported by drilled shaft foundations, wherever practicable. Areas inaccessible for concrete trucks shall use guyed structures.

11.2 Loadings

Foundations will be designed to withstand groundline reactions based on the results of the structure manufacturer's calculations. The maximum shear, moment, and axial loads from the structure manufacturer's calculations will be enveloped for the purposes of foundation design.

11.3 Direct Embed Foundation Design

Direct embed foundation design shall assume all embedded structures are subject to a geotechnical investigation to determine the embedment length. All direct embedded structures are based on the parameters outlined in Table 25.

Table 25 Direct Embed Foundation Design Parameters

| Attribute | Design Value |
|--------------------------------------|--------------------|
| Analysis Tool | MFAD |
| Total Deflection (in) | 4.0 |
| Non-Recoverable Deflection (in) | 2.0 |
| Total Rotation Limit (deg) | 2.0 |
| Non-Recoverable Rotation Limit (deg) | 1.0 |
| Backfill Material | Crushed Rock |
| Backfill Material (Optional) | 1,500 psi Concrete |
| Load Factor ¹ | 1.1 |

1. Load factor applied to groundline reactions for use in geotechnical design.

11.4 Drilled Shaft Foundation Design

Drilled shaft foundation design shall be based on the parameters outlined in Table 26. Structural design will follow the guidelines established in ACI 336.3R and the applicable requirements of ACI 318. The first 2 ft of the soil profile shall be ignored.

Drilled shaft foundations shall use #4 to #11 steel bars, where feasible, with a minimum difference of two bar sizes between the longitudinal steel and shear ties.

Drilled shaft foundations shall have a minimum reveal of 2 ft.

Table 26 Drilled Pier Foundation Design Criteria

| Attribute | Design Value |
|--|--------------|
| Analysis Tool | MFAD |
| Total Deflection (in) | 4.0 |
| Non-Recoverable Deflection (in) | 2.0 |
| Total Rotation Limit (deg) | 2.0 |
| Non-Recoverable Rotation Limit (deg) | 1.0 |
| Design Concrete Compressive Strength (psi) | 3,000 |
| Construction Concrete Compressive Strength (psi) | 4,000 |
| Maximum Shaft Diameter (ft) | 12 |
| Minimum Longitudinal Reinforcement (% steel) | 0.75% |
| Design Reinforcement Yield Strength (ksi) | 60 |
| Structural Load Factor ¹ | 1.0 |
| Geotechnical Load Factor ² | 1.0 |

1. Load factor applied to groundline reactions for use in geotechnical design.
2. Load factor applied to internal reactions developed during geotechnical analysis for use in structural reinforcement design.

12.0 REFERENCES

12.1 Codes

- IEEE National Electrical Safety Code, C2-2017.

12.2 Design References

- U.S. Department of Agriculture Rural Utilities Service Bulletin 1724E-200: Design Manual for High Voltage Transmission Lines, December 2015.
- ASCE Manuals and Reports on Engineering Practice No. 48: Design of Steel Transmission Pole Structures, 2019
- ASCE Manual and Reports on Engineering Practice 74: Guidelines for Electrical Transmission Line Structural Loading, 4th Edition, 2020.
- ASCE Manuals and Reports on Engineering Practice No. 91: Design of Guyed Electrical Transmission Structures.
- ACI 318 Building Code Requirements for Structural Concrete and Commentary, 2008
- ACI 336.3R Design and Construction of Drilled Piers, 2014

APPENDIX A – VERTICAL AND HORIZONTAL CLEARANCES TO GROUND AND OBSTACLES

Table 27 Vertical Clearances to Ground Under NESC Rule 232

| VERTICAL CLEARANCE ABOVE GROUND, ROADWAY, RAIL, OR WATER SURFACES | | | | | | | | | | |
|---|---------------|---------------------|------|------|------|------|------|-------------------|---------|-------------|
| NESC only requires a 1.05 multiplier for voltages exceeding 50kV and 1.10 multiplier for 500kV. Rule 232-1 Base Clearance from Table 232-1 NESC 2017 Pg. 103 Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | |
| | Code | Phase to Phase (kV) | | | | | | | Neutral | Shield Wire |
| | | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 ³ | | |
| Tracks, Rails of Railroads (except electrified railroads using overhead trolley conductors) ¹ | PNM | 40.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 26.5 | 26.0 |
| | NESC RULE 232 | 37.5 | 33.5 | 30.9 | 28.3 | 27.2 | 26.7 | 26.5 | 24.0 | 23.5 |
| Roads, Streets, and other areas subject to truck traffic | PNM | 32.0 | 28.0 | 25.4 | 22.8 | 21.7 | 21.2 | 21.0 | 18.5 | 18.0 |
| | NESC RULE 232 | 29.5 | 25.5 | 22.9 | 20.3 | 19.2 | 18.7 | 18.5 | 16.0 | 15.5 |
| Driveways, Parking Lots, and Alleys | PNM | 32.0 | 28.0 | 25.4 | 22.8 | 21.7 | 21.2 | 21.0 | 18.5 | 18.0 |
| | NESC RULE 232 | 29.5 | 25.5 | 22.9 | 20.3 | 19.2 | 18.7 | 18.5 | 16.0 | 15.5 |
| Other land traversed by vehicles, such as cultivated, grazing, forest, orchards, etc. | PNM | 32.0 | 28.0 | 25.4 | 22.8 | 21.7 | 21.2 | 21.0 | 18.5 | 18.0 |
| | NESC RULE 232 | 29.5 | 25.5 | 22.9 | 20.3 | 19.2 | 18.7 | 18.5 | 16.0 | 15.5 |
| Spaces and ways subject to pedestrian or restricted traffic only | PNM | 28.0 | 24.0 | 21.4 | 18.8 | 17.7 | 17.2 | 17.0 | 14.5 | 12.0 |
| | NESC RULE 232 | 25.5 | 21.5 | 18.9 | 16.3 | 15.2 | 14.7 | 14.5 | 12.0 | 9.5 |
| Water areas not suitable for sail boating or where sail boating is prohibited | PNM | 30.5 | 26.5 | 23.9 | 21.3 | 20.2 | 19.7 | 19.5 | 17.0 | 16.5 |
| | NESC RULE 232 | 28.0 | 24.0 | 21.4 | 18.8 | 17.7 | 17.2 | 17.0 | 14.5 | 14.0 |
| Water Areas suitable of sail boating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with unobstructed surface area of: | | | | | | | | | | |
| a. Less than 20 acres | PNM | 34.0 | 30.0 | 27.4 | 24.8 | 23.7 | 23.2 | 23.0 | 20.5 | 20.0 |
| | NESC RULE 232 | 31.5 | 27.5 | 24.9 | 22.3 | 21.2 | 20.7 | 20.5 | 18.0 | 17.5 |
| b. Over 20 to 200 acres | PNM | 42.0 | 38.0 | 35.4 | 32.8 | 31.7 | 31.2 | 31.0 | 28.5 | 28.0 |
| | NESC RULE 232 | 39.5 | 35.5 | 32.9 | 30.3 | 29.2 | 28.7 | 28.5 | 26.0 | 25.5 |
| c. Over 200 to 2000 acres | PNM | 48.0 | 44.0 | 41.4 | 38.8 | 37.7 | 37.2 | 37.0 | 34.5 | 34.0 |
| | NESC RULE 232 | 45.5 | 41.5 | 38.9 | 36.3 | 35.2 | 34.7 | 34.5 | 32.0 | 31.5 |
| d. Over 2000 acres | PNM | 54.0 | 50.0 | 47.4 | 44.8 | 43.7 | 43.2 | 43.0 | 40.5 | 40.0 |
| | NESC RULE 232 | 51.5 | 47.5 | 44.9 | 42.3 | 41.2 | 40.7 | 40.5 | 38.0 | 37.5 |

Note:

1. PNM Standard 36' of vertical clearance for tracks, rails of railroads (except electrified railroads using overhead trolley conductors) for energized wire.
2. Local authorities may require additional clearance on a per-project basis. Refer to Section 5.0 for additional information.
3. For energized conductor less than 34.5kV, use the 34.5kV clearance values.

Table 28 Vertical and Horizontal Clearances to Obstacles under NESC Rule 234

| CLEARANCE OF CONDUCTORS FROM BUILDINGS, BRIDGES, RAIL CARS, SWIMMING POOLS, AND OTHER INSTALLATIONS | | | | | | | | | | | |
|---|----------------------|--------------------|---------------------|------|------|------|------|------|-------------------|---------|-------------|
| NESC only requires a 1.05 multiplier for voltages exceeding 50kV and 1.10 multiplier for 500kV. Rule 234 Base Clearance from Table 234-1 & 2 & 3 NESC 2017 Pg. 145-154 Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| | Clearance Direction | Code | Phase to Phase (kV) | | | | | | | | |
| | | | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 ² | Neutral | Shield Wire |
| Supporting structures (lighting support, traffic signal support, intermediate poles, etc.) | Horizontal (No Wind) | PNM | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | | NESC RULE 234 -B1a | 16.1 | 12.0 | 9.4 | 6.8 | 5.8 | 5.3 | 5.0 | 5.0 | 5.0 |
| | Vertical | PNM | 18.1 | 14.0 | 11.4 | 8.8 | 7.8 | 7.3 | 7.0 | 7.0 | 7.0 |
| | | NESC RULE 234 -B2 | 15.6 | 11.5 | 8.9 | 6.3 | 5.3 | 4.8 | 4.5 | 4.5 | 4.5 |
| Buildings with balconies, decks, areas, etc. readily accessible to pedestrians | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 27.1 | 23.0 | 20.4 | 17.8 | 16.8 | 16.3 | 16.0 | 16.0 | 16.0 |
| | | NESC Table 234-1 | 24.6 | 20.5 | 17.9 | 15.3 | 14.3 | 13.8 | 13.5 | 13.5 | 13.5 |
| Buildings with balconies, decks, areas, etc. not readily accessible to pedestrians | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 26.1 | 22.0 | 19.4 | 16.8 | 15.8 | 15.3 | 15.0 | 15.0 | 15.0 |
| | | NESC Table 234-1 | 23.6 | 19.5 | 16.9 | 14.3 | 13.3 | 12.8 | 12.5 | 12.5 | 12.5 |
| Buildings; over roofs, ramps, decks, and loading docks accessible to vehicles but not subject to truck traffic | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 27.1 | 23.0 | 20.4 | 17.8 | 16.8 | 16.3 | 16.0 | 16.0 | 16.0 |
| | | NESC Table 234-1 | 24.6 | 20.5 | 17.9 | 15.3 | 14.3 | 13.8 | 13.5 | 13.5 | 13.5 |
| Buildings; over roofs, ramps, decks, and loading docks accessible to truck traffic | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 32.1 | 28.0 | 25.4 | 22.8 | 21.8 | 21.3 | 21.0 | 21.0 | 21.0 |
| | | NESC Table 234-1 | 29.6 | 25.5 | 22.9 | 20.3 | 19.3 | 18.8 | 18.5 | 18.5 | 18.5 |
| Signs, chimneys, billboards, antennas, flagpoles, banners, tanks, and other installations not classified as buildings or bridges readily accessible to pedestrians | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 27.1 | 23.0 | 20.4 | 17.8 | 16.8 | 16.3 | 16.0 | 16.0 | 16.0 |
| | | NESC Table 234-1 | 24.6 | 20.5 | 17.9 | 15.3 | 14.3 | 13.8 | 13.5 | 13.5 | 13.5 |
| Tracks, Rails of Railroads (except electrified railroads using overhead trolley conductors) | Horizontal (No Wind) | PNM | 25.1 | 21.0 | 18.4 | 15.8 | 14.8 | 14.3 | 14.0 | 14.0 | 14.0 |
| | | NESC Table 234-1 | 22.6 | 18.5 | 15.9 | 13.3 | 12.2 | 11.7 | 11.5 | 11.5 | 11.5 |

Note:

1. Local authorities may require additional clearance on a per-project basis. Refer to Section 5.0 for additional information.
2. For energized conductor less than 34.5kV, use the 34.5kV clearance values.

Table 29 Vertical and Horizontal Clearances to Obstacles under NESC Rule 234 (Continued)

| CLEARANCE OF CONDUCTORS FROM BUILDINGS, BRIDGES, RAIL CARS, SWIMMING POOLS, AND OTHER INSTALLATIONS | | | | | | | | | | | |
|---|----------------------------|------------------------|---------------------|-------------|-------------|-------------|-------------|-------------|-------------------|-------------|-------------|
| NESC only requires a 1.05 multiplier for voltages exceeding 50kV and 1.10 multiplier for 500kV. Rule 234 Base Clearance from Table 234-1 & 2 & 3 NESC 2017 Pg. 145-154 Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| | Clearance Direction | Code | Phase to Phase (kV) | | | | | | | | |
| | | | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 ² | Neutral | Shield Wire |
| Signs, chimneys, billboards, antennas, flagpoles, banners, tanks, and other installations not classified as buildings or bridges not readily accessible to pedestrians | Horizontal (No Wind) | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 10.0 |
| | | NESC Table 234-1 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 7.5 |
| | Vertical | PNM | 21.6 | 17.5 | 14.9 | 12.3 | 11.3 | 10.8 | 10.5 | 10.5 | 10.5 |
| | | NESC Table 234-1 | 19.1 | 15.0 | 12.4 | 9.8 | 8.8 | 8.3 | 8.0 | 8.0 | 8.0 |
| Over bridge structure; horizontal (no wind) and vertical clearances | Attached | PNM | 19.1 | 15.0 | 12.4 | 9.8 | 8.8 | 8.3 | 8.0 | 8.0 | 6.0 |
| | | NESC Table 234-2 | 16.6 | 12.5 | 9.9 | 7.3 | 6.3 | 5.8 | 5.5 | 5.5 | 3.5 |
| | Not Attached | PNM | 26.1 | 22.0 | 19.4 | 16.8 | 15.8 | 15.3 | 15.0 | 15.0 | 13.0 |
| | | NESC Table 234-2 | 23.6 | 19.5 | 16.9 | 14.3 | 13.3 | 12.8 | 12.5 | 12.5 | 10.5 |
| Beside, under, or within bridge structure with readily accessible portions; horizontal (no wind) and vertical clearances | Attached | PNM | 19.1 | 15.0 | 12.4 | 9.8 | 8.8 | 8.3 | 8.0 | 8.0 | 6.0 |
| | | NESC Table 234-2 | 16.6 | 12.5 | 9.9 | 7.3 | 6.3 | 5.8 | 5.5 | 5.5 | 3.5 |
| | Not Attached | PNM | 21.1 | 17.0 | 14.4 | 11.8 | 10.8 | 10.3 | 10.0 | 10.0 | 8.0 |
| | | NESC Table 234-2 | 18.6 | 14.5 | 11.9 | 9.3 | 8.3 | 7.8 | 7.5 | 7.5 | 5.5 |
| Beside, under, or within bridge structure with ordinarily inaccessible portions; horizontal (no wind) and vertical clearances | Attached | PNM | 19.1 | 15.0 | 12.4 | 9.8 | 8.8 | 8.3 | 8.0 | 8.0 | 6.0 |
| | | NESC Table 234-2 | 16.6 | 12.5 | 9.9 | 7.3 | 6.3 | 5.8 | 5.5 | 5.5 | 3.5 |
| | Not Attached | PNM | 20.1 | 16.0 | 13.4 | 10.8 | 9.8 | 9.3 | 9.0 | 9.0 | 7.0 |
| | | NESC Table 234-2 | 17.6 | 13.5 | 10.9 | 8.3 | 7.3 | 6.8 | 6.5 | 6.5 | 4.5 |
| Any installation listed above | Horizontal (Wind) | PNM | 18.1 | 14.0 | 11.4 | 8.8 | 7.8 | 7.3 | 7.0 | 7.0 | 7.0 |
| | | 234B1b, 234C1b, 234D1b | 15.6 | 11.5 | 8.9 | 6.3 | 5.3 | 4.8 | 4.5 | 4.5 | 4.5 |
| Water level, pool edges, base of diving platform, or anchored raft | Clearance in any Direction | PNM | 38.6 | 34.5 | 31.9 | 29.3 | 28.3 | 27.8 | 27.5 | 27.5 | 27.5 |
| | | NESC Table 234-3 | 36.1 | 32.0 | 29.4 | 26.8 | 25.8 | 25.3 | 25.0 | 25.0 | 25.0 |
| Diving board platform, tower, water slide, or other fixed pool-related structures | Clearance in any Direction | PNM | 30.6 | 26.5 | 23.9 | 21.3 | 20.3 | 19.8 | 19.5 | 19.5 | 19.5 |
| | | NESC Table 234-3 | 28.1 | 24.0 | 21.4 | 18.8 | 17.8 | 17.3 | 17.0 | 17.0 | 17.0 |

Note:

1. Local authorities may require additional clearance on a per-project basis. Refer to Section 5.0 for additional information.
2. For energized conductor less than 34.5kV, use the 34.5kV clearance values.

APPENDIX B – VERTICAL AND HORIZONTAL CLEARANCES BETWEEN WIRES ON DIFFERENT STRUCTURES

Table 30 Vertical Clearances between Wires on Different Structures

| VERTICAL CLEARANCES BETWEEN WIRES, CONDUCTORS AND CABLES CARRIED ON DIFFERENT STRUCTURES | | | | | | | | | | | |
|--|---------------------|---------------------------|------------------------|------|------|------|------|------|------|------|------|
| Rule 233 Base Clearance from 233-C NESC 2017 Pg. 115-116 and Table 233 NESC 2017 Pg. 122-126 | | | | | | | | | | | |
| Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| Nominal Voltage Factor | Base Clearance (ft) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | | Code | kV |
| 1.10 | 2 | 500 | PNM | 27.4 | -- | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-C | 24.9 | -- | -- | -- | -- | -- | -- | -- |
| 1.05 | 2 | 345 | PNM | 23.3 | 19.3 | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-C | 20.8 | 16.8 | -- | -- | -- | -- | -- | -- |
| 1.05 | 2 | 230 | PNM | 20.7 | 16.7 | 14.1 | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-C | 18.2 | 14.2 | 11.6 | -- | -- | -- | -- | -- |
| 1.05 | 2 | 115 | PNM | 18.1 | 14.1 | 11.5 | 8.9 | -- | -- | -- | -- |
| | | | NESC RULE 233-C | 15.6 | 11.6 | 9.0 | 6.4 | -- | -- | -- | -- |
| 1.05 | 2 | 69 | PNM | 17.1 | 13.0 | 10.4 | 7.8 | 6.8 | -- | -- | -- |
| | | | NESC RULE 233-C | 14.6 | 10.5 | 7.9 | 5.3 | 4.3 | -- | -- | -- |
| 1.00 | 2 | 46 | PNM | 16.5 | 12.5 | 9.9 | 7.3 | 6.2 | 5.7 | -- | -- |
| | | | NESC RULE 233-C | 14.0 | 10.0 | 7.4 | 4.8 | 3.7 | 3.2 | -- | -- |
| 1.00 | 2 | 34.5 | PNM | 16.4 | 12.3 | 9.7 | 7.1 | 6.1 | 5.5 | 5.3 | -- |
| | | | NESC RULE 233-C | 13.9 | 9.8 | 7.2 | 4.6 | 3.6 | 3.0 | 2.8 | -- |
| 1.00 | 2 | 12.5 | PNM | 15.5 | 12.0 | 9.4 | 6.8 | 5.8 | 4.9 | 4.7 | 4.5 |
| | | | NESC RULE 233-C | 13.0 | 9.5 | 6.9 | 4.3 | 3.3 | 2.4 | 2.2 | 2.0 |
| 1.00 | 2 | Neutral/ Shield Wire | PNM | 15.5 | 11.5 | 8.9 | 6.3 | 5.2 | 4.7 | 4.5 | 4.5 |
| | | | NESC RULE 233-C | 13.0 | 9.0 | 6.4 | 3.8 | 2.7 | 2.2 | 2.0 | 2.0 |
| 1.00 | 5 | Comm | PNM | 18.5 | 14.5 | 11.9 | 9.3 | 8.2 | 7.7 | 7.5 | 7.5 |
| | | | NESC RULE 233-C | 16.0 | 12.0 | 9.4 | 6.8 | 5.7 | 5.2 | 5.0 | 5.0 |

Note:

1. NESC Rule 233-B states that the base clearance is designed to have a minimum of 5 ft clearance for anything below 38kV phase to phase (22kV phase to ground).
2. Comm includes all communication conductors that do not serve as an overhead shield wire.

Table 31 Horizontal Clearances between Wires on Different Structures

| HORIZONTAL CLEARANCES BETWEEN WIRES, CONDUCTORS AND CABLES CARRIED ON DIFFERENT STRUCTURES | | | | | | | | | | | |
|--|---------------------|---------------------------|------------------------|-------------|-------------|-------------|-------------|------------|------------|------------|------------|
| Rule 233 Base Clearance from 233-B NESC 2015 Pg. 116 and Table 233 NESC 2017 Pg. 122-126 Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| Nominal Voltage Factor | Base Clearance (ft) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| Code | | | kV | kV | kV | kV | kV | kV | kV | kV | |
| 1.10 | 5 | 500 | PNM | 30.4 | -- | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-B | 27.9 | -- | -- | -- | -- | -- | -- | -- |
| 1.05 | 5 | 345 | PNM | 26.3 | 22.3 | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-B | 23.8 | 19.8 | -- | -- | -- | -- | -- | -- |
| 1.05 | 5 | 230 | PNM | 23.7 | 19.7 | 17.1 | -- | -- | -- | -- | -- |
| | | | NESC RULE 233-B | 21.2 | 17.2 | 14.6 | -- | -- | -- | -- | -- |
| 1.05 | 5 | 115 | PNM | 21.1 | 17.1 | 14.5 | 11.9 | -- | -- | -- | -- |
| | | | NESC RULE 233-B | 18.6 | 14.6 | 12.0 | 9.4 | -- | -- | -- | -- |
| 1.05 | 5 | 69 | PNM | 20.1 | 16.0 | 13.4 | 10.8 | 9.8 | -- | -- | -- |
| | | | NESC RULE 233-B | 17.6 | 13.5 | 10.9 | 8.3 | 7.3 | -- | -- | -- |
| 1.00 | 5 | 46 | PNM | 19.5 | 15.5 | 12.9 | 10.3 | 9.2 | 8.7 | -- | -- |
| | | | NESC RULE 233-B | 17.0 | 13.0 | 10.4 | 7.8 | 6.7 | 6.2 | -- | -- |
| 1.00 | 5 | 34.5 | PNM | 19.4 | 15.3 | 12.7 | 10.1 | 9.1 | 8.5 | 8.3 | -- |
| | | | NESC RULE 233-B | 16.9 | 12.8 | 10.2 | 7.6 | 6.6 | 6.0 | 5.8 | -- |
| 1.00 | 5 | 12.5 | PNM | 18.5 | 15.0 | 12.4 | 9.8 | 8.8 | 7.9 | 7.7 | 7.5 |
| | | | NESC RULE 233-B | 16.0 | 12.5 | 9.9 | 7.3 | 6.3 | 5.4 | 5.2 | 5.0 |
| 1.00 | 5 | Neutral/ Shield Wire | PNM | 18.5 | 14.5 | 11.9 | 9.3 | 8.2 | 7.7 | 7.5 | 7.5 |
| | | | NESC RULE 233-B | 16.0 | 12.0 | 9.4 | 6.8 | 5.7 | 5.2 | 5.0 | 5.0 |
| 1.00 | 5 | Comm | PNM | 18.5 | 14.5 | 11.9 | 9.3 | 8.2 | 7.7 | 7.5 | 7.5 |
| | | | NESC RULE 233-B | 16.0 | 12.0 | 9.4 | 6.8 | 5.7 | 5.2 | 5.0 | 5.0 |

Note:

1. NESC Rule 233-B states that the base clearance is designed to have a minimum of 5 ft clearance for anything below 38kV phase to phase (22kV phase to ground).
2. Comm includes all communication conductors that do not serve as an overhead shield wire.

APPENDIX C – VERTICAL CLEARANCES BETWEEN WIRES OF THE SAME STRUCTURE – DIFFERENT CIRCUIT (SAME UTILITY)

Table 32 Vertical Clearances between Wires of the Same Structure – Different Circuit (Same Utility)

| VERTICAL CLEARANCES BETWEEN WIRES, CONDUCTORS AND CABLES CARRIED ON THE SAME STRUCTURES (SAME UTILITY) | | | | | | | | | | | |
|---|---------------------|---------------------------|------------------------|------|------|------|------|------|------|------|------|
| Rule 235-C1 NESC 2017 Pg. 160 and Base Clearance from Table 235-5 NESC 2017 Pg. 175-176 Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| AT THE STRUCTURE | | | | | | | | | | | |
| Nominal Voltage Factor | Base Clearance (in) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | | Code | kV | |
| 1.10 | 16 | 500 | PNM | 27.1 | -- | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 235-C | 24.6 | -- | -- | -- | -- | -- | -- | -- |
| 1.05 | 16 | 345 | PNM | 23.0 | 19.0 | -- | -- | -- | -- | -- | -- |
| | | | NESC RULE 235-C | 20.5 | 16.5 | -- | -- | -- | -- | -- | -- |
| 1.05 | 16 | 230 | PNM | 20.4 | 16.4 | 13.8 | -- | -- | -- | -- | -- |
| | | | NESC RULE 235-C | 17.9 | 13.9 | 11.3 | -- | -- | -- | -- | -- |
| 1.05 | 16 | 115 | PNM | 17.8 | 13.8 | 11.2 | 8.5 | -- | -- | -- | -- |
| | | | NESC RULE 235-C | 15.3 | 11.3 | 8.7 | 6.0 | -- | -- | -- | -- |
| 1.00 | 16 | 69 | PNM | 16.8 | 12.7 | 10.1 | 7.5 | 6.5 | -- | -- | -- |
| | | | NESC RULE 235-C | 14.3 | 10.2 | 7.6 | 5.0 | 4.0 | -- | -- | -- |
| 1.00 | 16 | 46 | PNM | 16.2 | 12.1 | 9.5 | 6.9 | 5.9 | 5.3 | -- | -- |
| | | | NESC RULE 235-C | 13.7 | 9.6 | 7.0 | 4.4 | 3.4 | 2.8 | -- | -- |
| 1.00 | 16 | 34.5 | PNM | 15.9 | 11.9 | 9.3 | 6.7 | 5.6 | 5.1 | 4.9 | -- |
| | | | NESC RULE 235-C | 13.4 | 9.4 | 6.8 | 4.2 | 3.1 | 2.6 | 2.4 | -- |
| 1.00 | 16 | 12.5 | PNM | 15.5 | 11.4 | 8.8 | 6.2 | 5.2 | 4.7 | 4.4 | 4.0 |
| | | | NESC RULE 235-C | 13.0 | 8.9 | 6.3 | 3.7 | 2.7 | 2.2 | 1.9 | 1.5 |
| 1.00 | 16 | Neutral/ Shield Wire | PNM | 15.2 | 11.2 | 8.5 | 5.9 | 4.9 | 4.4 | 4.2 | 3.8 |
| | | | NESC RULE 235-C | 12.7 | 8.7 | 6.0 | 3.4 | 2.4 | 1.9 | 1.7 | 1.3 |
| 1.00 | 16 | Comm | PNM | 15.2 | 11.2 | 8.5 | 5.9 | 4.9 | 4.4 | 4.2 | 3.8 |
| | | | NESC RULE 235-C | 12.7 | 8.7 | 6.0 | 3.4 | 2.4 | 1.9 | 1.7 | 1.3 |

Note: Comm includes all communication conductors that do not serve as an overhead shield wire.

Table 33 Vertical Clearances between Wires of the Same Structure – Different Circuit at Midspan (Same Utility)

| MIDSPAN | | | | | | | | | | | |
|------------------------|---------------------|---------------------------|------------------------|------|------|------|------|------|------|------|------|
| Nominal Voltage Factor | Base Clearance (in) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | | Code | kV |
| 1.10 | 16 | 500 | PNM | 26.4 | -- | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 23.9 | -- | -- | -- | -- | -- | -- | |
| 1.05 | 16 | 345 | PNM | 22.3 | 18.3 | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 19.8 | 15.8 | -- | -- | -- | -- | -- | |
| 1.05 | 16 | 230 | PNM | 19.7 | 15.7 | 13.1 | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 17.2 | 13.2 | 10.6 | -- | -- | -- | -- | |
| 1.05 | 16 | 115 | PNM | 17.1 | 13.1 | 10.5 | 7.9 | -- | -- | -- | |
| | | | NESC RULE 235-C | 14.6 | 10.6 | 8.0 | 5.4 | -- | -- | -- | |
| 1.00 | 16 | 69 | PNM | 16.1 | 12.0 | 9.4 | 6.8 | 5.8 | -- | -- | |
| | | | NESC RULE 235-C | 13.6 | 9.5 | 6.9 | 4.3 | 3.3 | -- | -- | |
| 1.00 | 16 | 46 | PNM | 15.5 | 11.5 | 8.9 | 6.3 | 5.2 | 4.6 | -- | |
| | | | NESC RULE 235-C | 13.0 | 9.0 | 6.4 | 3.8 | 2.7 | 2.1 | -- | |
| 1.00 | 16 | 34.5 | PNM | 15.3 | 11.2 | 8.6 | 6.0 | 5.0 | 4.4 | 4.3 | |
| | | | NESC RULE 235-C | 12.8 | 8.7 | 6.1 | 3.5 | 2.5 | 1.9 | 1.8 | |
| 1.00 | 16 | 12.5 | PNM | 14.8 | 10.7 | 8.1 | 5.5 | 4.5 | 4.1 | 4.0 | |
| | | | NESC RULE 235-C | 12.3 | 8.2 | 5.6 | 3.0 | 2.0 | 1.6 | 1.5 | |
| 1.00 | 16 | Neutral/ Shield Wire | PNM | 14.5 | 10.5 | 7.9 | 5.3 | 4.3 | 3.9 | 3.8 | |
| | | | NESC RULE 235-C | 12.0 | 8.0 | 5.4 | 2.8 | 1.8 | 1.4 | 1.3 | |
| 1.00 | 16 | Comm | PNM | 14.5 | 10.5 | 7.9 | 5.3 | 4.3 | 3.9 | 3.8 | |
| | | | NESC RULE 235-C | 12.0 | 8.0 | 5.4 | 2.8 | 1.8 | 1.4 | 1.3 | |

Note: Comm includes all communication conductors that do not serve as an overhead shield wire.

APPENDIX D – VERTICAL CLEARANCES BETWEEN WIRES OF THE SAME STRUCTURE – DIFFERENT CIRCUIT (DIFFERENT UTILITIES)

Table 34 Vertical Clearances between Wires of the Same Structure – Different Circuit (Different Utilities)

| VERTICAL CLEARANCES BETWEEN WIRES, CONDUCTORS AND CABLES CARRIED ON THE SAME STRUCTURES (DIFFERENT UTILITIES) | | | | | | | | | | | |
|---|---------------------|---------------------------|------------------------|------|------|------|------|------|------|------|------|
| Rule 235-C1 NESC 2017 Pg. 160 and Base Clearance from Table 235-5 NESC 2017 Pg. 175-176 | | | | | | | | | | | |
| Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | | |
| AT THE STRUCTURE | | | | | | | | | | | |
| Nominal Voltage Factor | Base Clearance (in) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | | Code | kV |
| 1.10 | 40 | 500 | PNM | 29.1 | -- | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 26.6 | -- | -- | -- | -- | -- | -- | |
| 1.05 | 40 | 345 | PNM | 25.0 | 21.0 | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 22.5 | 18.5 | -- | -- | -- | -- | -- | |
| 1.05 | 40 | 230 | PNM | 22.4 | 18.4 | 15.8 | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 19.9 | 15.9 | 13.3 | -- | -- | -- | -- | |
| 1.05 | 40 | 115 | PNM | 19.8 | 15.8 | 13.2 | 10.5 | -- | -- | -- | |
| | | | NESC RULE 235-C | 17.3 | 13.3 | 10.7 | 8.0 | -- | -- | -- | |
| 1.00 | 40 | 69 | PNM | 18.8 | 14.7 | 12.1 | 9.5 | 8.5 | -- | -- | |
| | | | NESC RULE 235-C | 16.3 | 12.2 | 9.6 | 7.0 | 6.0 | -- | -- | |
| 1.00 | 40 | 46 | PNM | 18.2 | 14.1 | 11.5 | 8.9 | 7.9 | 7.3 | -- | |
| | | | NESC RULE 235-C | 15.7 | 11.6 | 9.0 | 6.4 | 5.4 | 4.8 | -- | |
| 1.00 | 40 | 34.5 | PNM | 17.9 | 13.9 | 11.3 | 8.7 | 7.6 | 7.1 | 6.9 | |
| | | | NESC RULE 235-C | 15.4 | 11.4 | 8.8 | 6.2 | 5.1 | 4.6 | 4.4 | |
| 1.00 | 40 | 12.5 | PNM | 17.5 | 13.4 | 10.8 | 8.2 | 7.2 | 6.7 | 6.4 | |
| | | | NESC RULE 235-C | 15.0 | 10.9 | 8.3 | 5.7 | 4.7 | 4.2 | 3.9 | |
| 1.00 | 40 | Neutral/ Shield Wire | PNM | 17.2 | 13.2 | 10.5 | 7.9 | 6.9 | 6.4 | 6.2 | |
| | | | NESC RULE 235-C | 14.7 | 10.7 | 8.0 | 5.4 | 4.4 | 3.9 | 3.7 | |
| 1.00 | 40 | Comm | PNM | 17.2 | 13.2 | 10.5 | 7.9 | 6.9 | 6.4 | 6.2 | |
| | | | NESC RULE 235-C | 14.7 | 10.7 | 8.0 | 5.4 | 4.4 | 3.9 | 3.7 | |

Note: Comm includes all communication conductors that do not serve as an overhead shield wire.

Table 35 Vertical Clearances between Wires of the Same Structure – Different Circuit at Midspan (Different Utilities)

| MIDSPAN | | | | | | | | | | | |
|------------------------|---------------------|---------------------------|------------------------|-------------|-------------|-------------|------------|------------|------------|------------|------|
| Nominal Voltage Factor | Base Clearance (in) | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | Line to Line Voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | | Code | kV | kV | kV | kV | kV | kV | kV | kV |
| 1.10 | 40 | 500 | PNM | 27.9 | -- | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 25.4 | -- | -- | -- | -- | -- | -- | |
| 1.05 | 40 | 345 | PNM | 23.8 | 19.8 | -- | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 21.3 | 17.3 | -- | -- | -- | -- | -- | |
| 1.05 | 40 | 230 | PNM | 21.2 | 17.2 | 14.6 | -- | -- | -- | -- | |
| | | | NESC RULE 235-C | 18.7 | 14.7 | 12.1 | -- | -- | -- | -- | |
| 1.05 | 40 | 115 | PNM | 18.6 | 14.6 | 12.0 | 9.4 | -- | -- | -- | |
| | | | NESC RULE 235-C | 16.1 | 12.1 | 9.5 | 6.9 | -- | -- | -- | |
| 1.00 | 40 | 69 | PNM | 17.6 | 13.5 | 10.9 | 8.3 | 7.3 | -- | -- | |
| | | | NESC RULE 235-C | 15.1 | 11.0 | 8.4 | 5.8 | 4.8 | -- | -- | |
| 1.00 | 40 | 46 | PNM | 17.0 | 13.0 | 10.4 | 7.8 | 6.7 | 6.1 | -- | |
| | | | NESC RULE 235-C | 14.5 | 10.5 | 7.9 | 5.3 | 4.2 | 3.6 | -- | |
| 1.00 | 40 | 34.5 | PNM | 16.8 | 12.7 | 10.1 | 7.5 | 6.5 | 5.9 | 5.8 | |
| | | | NESC RULE 235-C | 14.3 | 10.2 | 7.6 | 5.0 | 4.0 | 3.4 | 3.3 | |
| 1.00 | 40 | 12.5 | PNM | 16.3 | 12.2 | 9.6 | 7.0 | 6.0 | 5.6 | 5.5 | |
| | | | NESC RULE 235-C | 13.8 | 9.7 | 7.1 | 4.5 | 3.5 | 3.1 | 3.0 | |
| 1.00 | 40 | Neutral/ Shield Wire | PNM | 16.0 | 12.0 | 9.4 | 6.8 | 5.8 | 5.4 | 5.3 | |
| | | | NESC RULE 235-C | 13.5 | 9.5 | 6.9 | 4.3 | 3.3 | 2.9 | 2.8 | |
| 1.00 | 40 | Comm | PNM | 16.0 | 12.0 | 9.4 | 6.8 | 5.8 | 5.4 | 5.3 | |
| | | | NESC RULE 235-C | 13.5 | 9.5 | 6.9 | 4.3 | 3.3 | 2.9 | 2.8 | |

Note: Comm includes all communication conductors that do not serve as an overhead shield wire.

APPENDIX E – HORIZONTAL CLEARANCES BETWEEN WIRES OF THE SAME STRUCTURE – DIFFERENT CIRCUIT

Table 36 Horizontal Clearances between Wires of the Same Structure – Different Circuit

| HORIZONTAL CLEARANCES BETWEEN WIRES, CONDUCTORS AND CABLES CARRIED ON THE SAME STRUCTURES (DIFFERENT CIRCUIT) | | | | | | | | | | |
|---|---------------------------|------------------------|------|------|------|------|------|------|------|------|
| Rule 235-B1 NESC 2017 Pg. 158 and Base Clearance from Table 235-1 NESC 2017 Pg. 167 | | | | | | | | | | |
| Assumed elevation of 7,300 ft-MSL. | | | | | | | | | | |
| AT THE STRUCTURE | | | | | | | | | | |
| Nominal Voltage Factor | Line to Line Voltage (kV) | Open Supply Conductors | | | | | | | | |
| | | Nominal Voltage Factor | 1.10 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.00 | 1.00 |
| | | Line to Line voltage | 500 | 345 | 230 | 115 | 69 | 46 | 34.5 | 12.5 |
| | | CODE | kV |
| 1.10 | 500 | PNM | 26.8 | -- | -- | -- | -- | -- | -- | -- |
| | | NESC RULE 235-C | 24.3 | -- | -- | -- | -- | -- | -- | -- |
| 1.05 | 345 | PNM | 22.7 | 18.7 | -- | -- | -- | -- | -- | -- |
| | | NESC RULE 235-C | 20.2 | 16.2 | -- | -- | -- | -- | -- | -- |
| 1.05 | 230 | PNM | 20.1 | 16.1 | 13.5 | -- | -- | -- | -- | -- |
| | | NESC RULE 235-C | 17.6 | 13.6 | 11.0 | -- | -- | -- | -- | -- |
| 1.05 | 115 | PNM | 17.5 | 13.5 | 10.9 | 8.3 | -- | -- | -- | -- |
| | | NESC RULE 235-C | 15.0 | 11.0 | 8.4 | 5.8 | -- | -- | -- | -- |
| 1.05 | 69 | PNM | 16.5 | 12.4 | 9.8 | 7.2 | 6.2 | -- | -- | -- |
| | | NESC RULE 235-C | 14.0 | 9.9 | 7.3 | 4.7 | 3.7 | -- | -- | -- |
| 1.05 | 46 | PNM | 15.9 | 11.9 | 9.3 | 6.7 | 5.7 | 5.1 | -- | -- |
| | | NESC RULE 235-C | 13.4 | 9.4 | 6.8 | 4.2 | 3.2 | 2.6 | -- | -- |
| 1.00 | 34.5 | PNM | 15.6 | 11.6 | 9.0 | 6.4 | 5.4 | 4.8 | 4.5 | -- |
| | | NESC RULE 235-C | 13.1 | 9.1 | 6.5 | 3.9 | 2.9 | 2.3 | 2.0 | -- |
| 1.00 | 12.5 | PNM | 15.2 | 11.1 | 8.5 | 5.9 | 4.8 | 4.4 | 4.1 | 3.7 |
| | | NESC RULE 235-C | 12.7 | 8.6 | 6.0 | 3.4 | 2.3 | 1.9 | 1.6 | 1.2 |
| 1.00 | Neutral/ Shield Wire | PNM | 14.9 | 10.9 | 8.3 | 5.7 | 4.6 | 4.1 | 3.9 | 3.5 |
| | | NESC RULE 235-C | 12.4 | 8.4 | 5.8 | 3.2 | 2.1 | 1.6 | 1.4 | 1.0 |
| 1.00 | Comm | PNM | 14.9 | 10.9 | 8.3 | 5.7 | 4.6 | 4.1 | 3.9 | 3.5 |
| | | NESC RULE 235-C | 12.4 | 8.4 | 5.8 | 3.2 | 2.1 | 1.6 | 1.4 | 1.0 |

Note: Comm includes all communication conductors that do not serve as an overhead shield wire.



