

PJM Facilities Study Report
For
Network Upgrade N9139
Transition Cycle #1

June 2025

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff and PJM Manuals. The Transmission Owner (TO) is Virginia Electric and Power Company (VEPCO or Dominion).

A. Project Description

The System Impact Study for PJM Interconnection Transition Cycle #1 has identified the need for PJM Network Upgrade N9139. The scope of this Network Upgrade includes the following:

- Upgrade 37.41 Miles of 500kV transmission line 563 from Carson Substation to Midlothian Substation

B. Transmission Owner Facilities Study Results

1. Detailed Scope of work for Network Upgrade N9139:

The following is a detailed description of Transmission Owner Upgrades for Network Upgrade N9139. These facilities shall be designed according to the Transmission Owner's Applicable Technical Requirements and Standards. Once built the Transmission Owner will own, operate, and maintain these facilities.

See Preliminary Scoping Summaries located in the Appendices, Attachment #1, #2 and #3.

2. MILESTONE SCHEDULE FOR COMPLETION OF DOMINION WORK

Facilities outlined in this report are estimated to take 69 months to construct, from the time of full execution of the Generation Interconnection Agreement and completion of a construction kickoff call. This schedule may be impacted by the timeline for procurement and installation of long lead items and the ability to obtain outages to construct and test the proposed facilities.

Description	Start month	Finish month
Engineering	1	30
Permitting/Procurement	3	38
Construction	36	69

Due to outage congestion, Network Upgrades and/or internal Dominion projects have been identified as having possible outage conflicts with this network upgrade that may affect the estimated milestones listed above. Additional outage sequencing may be required that includes, but not limited to the following projects:

- AF1-125

3. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

- Coordinate with existing outages and line work for lines 563 and 511.
- The preliminary construction schedule is dependent on outage availability.
- See Attachment 1 and 2– Preliminary Scoping Summary – Substation for additional assumptions
- See Attachment 3 – Preliminary Scoping Summary – Transmission line for additional assumptions

4. LAND REQUIREMENTS

Dominion will be responsible for the following expectations in the area of Real Estate:

- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Any other Land/Permitting requirements required by the Network Upgrade

5. ENVIRONMENTAL AND PERMITTING

The Dominion will be responsible for the following expectations in the area of Environmental and Permitting:

- Assessment of environmental impacts related to the Network Upgrade including:
 - Environmental Impact Study requirements
 - Environmental Permitting
- A stormwater easement and/or specific stormwater design BMP's to allow access to and use of the facilities, including a maintenance agreement for said stormwater facilities.
- Conditional Use Permit for Substation
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation
- Any other Permitting requirements required by the Network Upgrade

C. APPENDICES

- Attachment #1: Preliminary Scoping Summary – Substation Midlothian
- Attachment #2: Preliminary Scoping Summary – Substation Carson
- Attachment #3: Preliminary Scoping Summary – Transmission



Project Number: N9139 – Midlothian Substation

Project Description: ***Substation Scope of Work*** Replace Line Lead for Line 563

Date: 07/01/2025

Revision Number: 0

Project Summary

Network upgrade N9139 provides for the upgrade of line 563 at Midlothian Substation in Chesterfield County, Virginia. Remove line 563 wave trap due to the power line carrier function now being performed over fiber optics. Transmission engineering will terminate the fiber at one of the backbone legs, and substation engineering will install 2" PVC conduits from the backbone leg to the control enclosure.

Assumptions & Clarifications:

- 1. The scope of work depicted on the drawings assumes that there is no overlap with other designs and construction activities, except if mentioned in this Project Summary.*
- 2. Relay Settings and P&C design will be revised as part of the SPE Scope of Work.*
- 3. 4-hole pad connections must be replaced with 6-hole and 8-hole pad connections to maintain 5000A ratings.*

Purchase & install substation material – Network Upgrade:

1. Three (3), 396kV, 318kV MCOV surge arrester
2. Two (2), runs of 2" conduits from the backbone leg to the cable trough
3. Conduit tracer wires, 1/C #10, green
4. Conductor, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards

Relocate substation material – Network Upgrade:

1. Three (3), 500kV, relay accuracy CCVT

Remove substation material – Network Upgrade:

1. One (1), 500kV, 4000A, wave trap
2. Conductor, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards

Purchase & install relay material – Network Upgrade:

1. One (1), 1340 – 24” dual SEL-411L CD/Fiber, DCB/Fiber line panel

Remove relay material – Network Upgrade:

1. Retire Panel No. 306



Project Number: N9139 – Carson Substation

Project Description: ***Substation Scope of Work*** Replace Line Lead for Line 563

Date: 07/01/2025

Revision Number: 0

Project Summary

Network upgrade N9139 provides for the upgrade of line 563 at Carson Substation in Dinwiddle County, Virginia. Remove line 563 wave trap due to the power line carrier function now being performed over fiber optics. Transmission engineering will terminate the fiber at one of the backbone legs, and substation engineering will install 2" PVC conduits from the backbone leg to the control enclosure.

Assumptions & Clarifications:

4. *The scope of work depicted on the drawings assumes that there is no overlap with other designs and construction activities, except if mentioned in this Project Summary.*
5. *Relay Settings and P&C design will be revised as part of the SPE Scope of Work.*
6. *4-hole pad connections must be replaced with 6-hole and 8-hole pad connections to maintain 5000A ratings.*

Purchase & install substation material – Network Upgrade:

5. Three (3), 396kV, 318kV MCOV surge arrester
6. Two (2), runs of 2" conduits from the backbone leg to the cable trough
7. Conduit tracer wires, 1/C #10, green
8. Conductor, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards

Relocate substation material – Network Upgrade:

2. Three (3), 500kV, relay accuracy CCVT

Remove substation material – Network Upgrade:

3. One (1), 500kV, 4000A, wave trap
4. Conductor, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards

Purchase & install relay material – Network Upgrade:

2. One (1), 1340 – 24” dual SEL-411L CD/Fiber, DCB/Fiber line panel

Remove relay material – Network Upgrade:

2. Retire Panel No. 306

500kV LINE #563
CARSON - MIDLOTHIAN
PROJECT N9139

PRELIMINARY SCOPING SUMMARY

This project serves to rebuild 500kV line 563 from Carson Substation to Midlothian Substation for approximately 37.41 miles, which is located in Dinwiddie and Chesterfield Counties, VA. See **Figure 1** for the project location. The proposed work requires no additional land and will all be completed within existing right of way. The project will install a total of 210 new structures. A CPCN filing will be required for this project.

The existing line consists mainly of single circuit weathering steel towers built in 1981. The proposed structures to be installed are single circuit galvanized steel engineered monopole structures. The existing double bundled (2) 2500 ACAR (84/7) and triple bundled (3) 1351.5 ACSR (45/7) conductor will be replaced with 3-phase triple bundled (3) 1351 ACSS/TW/HS. The existing two (2) 7#7 Alumoweld shield wire will be replaced with two (2) DNO-10100.

Project N9249 plans to construct a new 500kV line, from Carson Substation to Midlothian Substation, within the same corridor as line 563. It is assumed that project N9139 is independent of project N9249.

Design Considerations:

EXISTING FACILITIES TO BE REMOVED:

1. Remove one hundred eighty-five (185) existing 500kV single circuit suspension weathering steel lattice towers as follows:
 - a. Structures 563/2, 563/4 – 563/11, 563/13 – 563/33, 563/35 – 563/42, 563/44, 563/45, 567/47 – 563/54, 563/56 – 563/62, 563/64 – 563/67, 563/68B, 563/70 – 563/101, 563/103 – 563/105, 563/107 – 563/112, 563/114 – 563/133, 563/135, 563/137 – 563/147, 563/149 – 563/159, 563/161 – 563/165, 563/167 – 563/169, 563/171 – 563/176, 563/178, 563/181 – 563/185 and 563/187 – 563/207.
2. Remove five (5) existing 500kV single circuit steel double deadend weathering steel lattice towers as follows:
 - a. Structures 563/69, 563/102, 563/136, 563/179 and 563/186.
3. Remove nineteen (19) existing 500kV single circuit steel running angle weathering steel lattice towers as follows:
 - a. Structures 563/3, 563/12, 563/34, 563/43, 563/46, 563/55, 563/63, 563/68, 563/106, 563/113, 563/134, 563/148, 563/160, 563/166, 563/170, 563/177, 563/180, 563/208 and 563/209.
4. Remove approximately 37.26 miles of double bundled (2) 2500 ACAR (84/7) conductor from existing structure 563/1 to existing backbone structure 563/209A.

5. Remove approximately 0.15 miles of triple bundled (3) 1351.5 ACSR (45/7) conductor from existing backbone structure 563/1C to existing structure 563/1.
6. Remove approximately 37.41 miles of two (2) 7#7 Alumoweld shield wire from existing backbone structure 563/1C to existing backbone structure 563/209A.

EXISTING FACILITIES TO BE MODIFIED:

1. Replace three (3) conductor strain assemblies [Reference Drawing 35.250] on the following one (1) structure:
 - a. Structure 563/209A.
2. Replace six (6) conductor strain assemblies [Reference Drawing 35.250], three (3) jumper loop assemblies [Reference Drawing 39.500] and four (4) OPGW strain assemblies [Reference Drawing 96.050] on the following one (1) structure:
 - a. Structure 563/1A.
3. Replace two (2) OPGW strain assemblies [Reference Drawing 96.051] on the following two (2) structures.
 - a. Structures 563/1C and 563/209A.

PERMANENT FACILITIES TO BE INSTALLED:

1. Install one hundred sixty-seven (167) 500kV engineered steel single circuit suspension monopole structures [Reference Drawing 15.200] on foundations as follows:
 - a. Structures 563/2, 563/4 – 563/11, 563/13 – 563/21, 563/23 – 563/32, 563/36 – 563/42, 563/44, 563/45, 563/47 – 563/54, 563/56 – 563/62, 563/64 – 563/67, 563/71 – 563/81, 563/83 – 563/97, 563/99, 563/100, 563/104, 563/105, 563/107 – 563/112, 563/114 – 563/119, 563/121 – 563/133, 563/138 – 563/147, 563/149 – 563/159, 563/161 – 563/165, 563/167 – 563/169, 563/171 – 563/176, 563/182 – 563/184, 563/188 – 563/194 and 563/196 – 563/206.
 - b. See **Figure 2** for a visual of the proposed structure design.
2. Install five (5) 500kV engineered steel single circuit suspension monopole structures [Reference Drawing 15.200] with shield wire deadend assemblies on foundations as follows:
 - a. Structures 563/22, 563/82, 563/98, 563/120 and 563/195.
 - b. See **Figure 2** for a visual of the proposed structure design.
3. Install sixteen (16) 500kV engineered steel single circuit small angle (0°-25°) DDE monopole structures [Reference Drawing 15.210] on foundations as follows:
 - a. Structures 563/1, 563/3, 563/12, 563/43, 563/46, 563/55, 563/63, 563/68, 563/106, 563/113, 563/134, 563/148, 563/160, 563/166, 563/170 and 563/177.
 - b. See **Figure 3** for a visual of the proposed structure design.

4. Install fourteen (14) 500kV engineered steel single circuit tension imbalance DDE monopole structures [Reference Drawing 15.210] on foundations as follows:
 - a. Structures 563/33, 563/35, 563/68B, 563/70, 563/101, 563/103, 563/135, 563/137, 563/178, 563/181, 563/185, 563/187, 563/207 and 563/209.
 - b. See **Figure 3** for a visual of the proposed structure design.
5. Install eight (8) 500kV engineered steel single large angle (0°-60°) DDE monopole structures [Reference Drawing 15.212] on foundations as follows:
 - a. Structures 563/34, 563/69, 563/102, 563/136, 563/179, 563/180, 563/186 and 563/208.
 - b. See **Figure 4** for a visual of the proposed structure design.
6. Install approximately 37.41 miles of 3-phase triple bundled (3) 1351 ACSS/TW/HS from existing backbone structure 563/1C to existing backbone structure 563/209A.
7. Install approximately 37.41 miles of two (2) DNO-10100 OPGW from existing backbone structure 563/1C to existing backbone structure 563/209A.
 - a. This includes the installation of thirty-six (36) splices as follows:
 - i. Two (2) on structures 563/1C, 563/12, 563/22, 563/34, 563/43, 563/55, 563/68, 563/82, 563/98, 563/106, 563/120, 563/134, 563/148, 563/160, 563/170, 563/181, 563/195 and 563/209A.

CONCEPTUAL SCOPE NOTES:

1. The existing line consists primarily of single circuit weathering steel towers built in 1981. These structures are considered insufficient for the proposed conductor, resulting in the need for the line to be rebuilt. No PLS-CADD modeling was done for this project. Structures were replaced like for like and estimated using typical transmission right of way characteristics.
2. Structures are designed based off the following NESC 2017 code parameters: NESC Heavy, 90 mph wind, $\frac{3}{4}$ " Ice & 30 mph wind regardless of project location.
3. It is assumed for detailed engineering that a LiDAR survey will be required.
4. Existing structures 563/151 and 563/164 support a cellular antenna. Assume antenna will be transferred to new engineered steel structure.
5. Line 563 is within 2 miles of Dinwiddie Airport. Any potential height restrictions were not accounted for in this design.
6. Alternative design options for the proposed structures are lattice towers and H-frames.

Monopole structure designs were utilized to create additional space in the corridor to allow for future lines without acquiring right of way.

7. An existing right of way width varies based on existing plan and profiles and map viewer as shown below:
 - a. 450' between Carson Substation and structure 563/5
 - b. 350' between structure 563/5 and structure 563/6
 - c. 235' between structure 563/6 and structure 563/9
 - d. 285' between structure 563/9 and structure 563/11
 - e. 235' between structure 563/11 and structure 563/12
 - f. 220' between structure 563/12 and structure 563/14
 - g. 335' between structure 563/14 and structure 563/17
 - h. 235' between structure 563/17 and structure 563/133
 - i. 335' between structure 563/133 and structure 563/135
 - j. 235' between structure 563/135 and structure 563/138
 - k. 335' between structure 563/138 and structure 563/141
 - l. 235' between structure 563/141 and structure 563/181
 - m. 240' between structure 563/181 and structure 563/186
 - n. 325' between structure 563/186 and structure 563/193
 - o. 300' between structure 563/193 and Midlothian Substation
8. A wetland delineation has not been completed as part of this conceptual package.
9. Critical crossings were found here:
 - a. Between structures 563/5 and 563/6 – Transmission Lines 69 and 238
 - b. Between structures 563/41 and 563/42 – Interstate 85
 - c. Between structures 563/61 and 563/62 – Clarkes Lake
 - d. Between structures 563/68 and 563/68B – Highway 460
 - e. Between structures 563/68B and 563/69 – Railroad
 - f. Between structures 563/94 and 563/95 – Miry Run
 - g. Between structures 563/106 and 563/107 – Miry Run
 - h. Between structures 563/162 and 563/163 – Transmission Lines 219 and 2066
 - i. Between structures 563/164 and 563/165 – Commonwealth Centre Pkwy
 - j. Between structures 563/165 and 563/166 – Highway 288
 - k. Between structures 563/167 and 563/168 – Highway 360
 - l. Between structures 563/176 and 563/177 – Transmission Line 2066
 - m. Between structures 563/177 and 563/178 – Highway 604
 - n. Between structures 563/181 and 563/183 – Highway 76
 - o. Between structures 563/185 and 563/186 – Lucks Ln
 - p. Between structures 563/186 and 563/187 – Transmission Line I153
 - q. Between structures 563/198 and 563/199 – N Wooldridge Road
 - r. Between structures 563/201 and 563/202 – Highway 288
 - s. Between structures 563/206 and 563/207 – Railroad
10. In general, wire reel lengths of 15,000-ft were assumed for this line design.
 - a. Conductor is assumed to be able to have full tension splices installed as necessary to reduce the amount of in-line strain structures required.
 - b. OPGW is assumed to be able to be strained with the use of deadend assemblies

- installed on suspension structures as necessary.
- c. In detailed engineering, actual reel lengths should be further investigated.

11. This conceptual design assumes no two (2) double deadends should be spaced more than ten (10) miles apart for cascading failure prevention.
12. It is assumed that an outage will be able to be acquired for 500kV Line 563 for this project and no temporary arrangement will be required.

CONCEPTUAL ESTIMATE NOTES:

1. Engineered steel pole costs were determined based off typical wind and weight spans, line angles, and average structure heights in the typical right of way associated with the structure type.
2. The standard suspension structure is assumed to be similar in cost to the suspension structure with OPGW deadends installed on it.
3. Steel pole foundation costs were based off the projects' location and structure type in the regional soil profile map. The regional soil profile map used for this project is Piedmont.
4. Estimate assumes structure 563/1A, built in 2014, will remain in place.
5. The conceptual estimate assumes that a laydown yard is required for this project.
6. This project assumes that existing structure 563/1 will remain vacant for use with project N9149.
7. Prior to detailed engineering, a full land rights review would be required. A desktop review was completed to estimate the project cost.
8. Access estimate cost inputs include the following assumptions:
 - a. This estimate is assuming that the same access will be used as was estimated for Project N9249. The road will be installed one time and both circuits worked simultaneously or each separate estimate would be to install the access twice – once per project. No additional access costs estimated. Assumption would be to work the project similar fashion to the TL 588/5005.
 - b. No Additional rehabilitation costs associated with this new line due to no additional land/ROW as part of this scope.
 - c. Tangent Structures are allotted 40 mats. Angle structures are allotted 80 mats. Pull Pads are allotted 100 mats for the 500kV Wreck and Rebuild and New Lines.
 - d. DDE structures assumed based off of wire reel lengths - based off of pull pad locations.

- e. Pull pad locations based on location of major road/water crossings and line mileage.
- f. Assuming that existing stone in Substations will be used for access per SOW and that access is existing or will be built by others before the start of construction.
Assumes that the substations will be constructed with access roads built to and from Substations and work from inside the substations for Backbone installation.
- g. Assumes no delays due to permitting or real estate issues after work begins.
Assume no schedule compressions from SOC/PJM.
- h. Access matting costs not accounted for forestry work in between large spans that were not matted through for access.
- i. Assumes between a 10-20% Markup for contingency on Emtek specialty matting dependent on size and scope of material to be used in each project that requires the specialty matting in swamp/wetlands. Markup applied in Success.

Figure 1 – Project Location

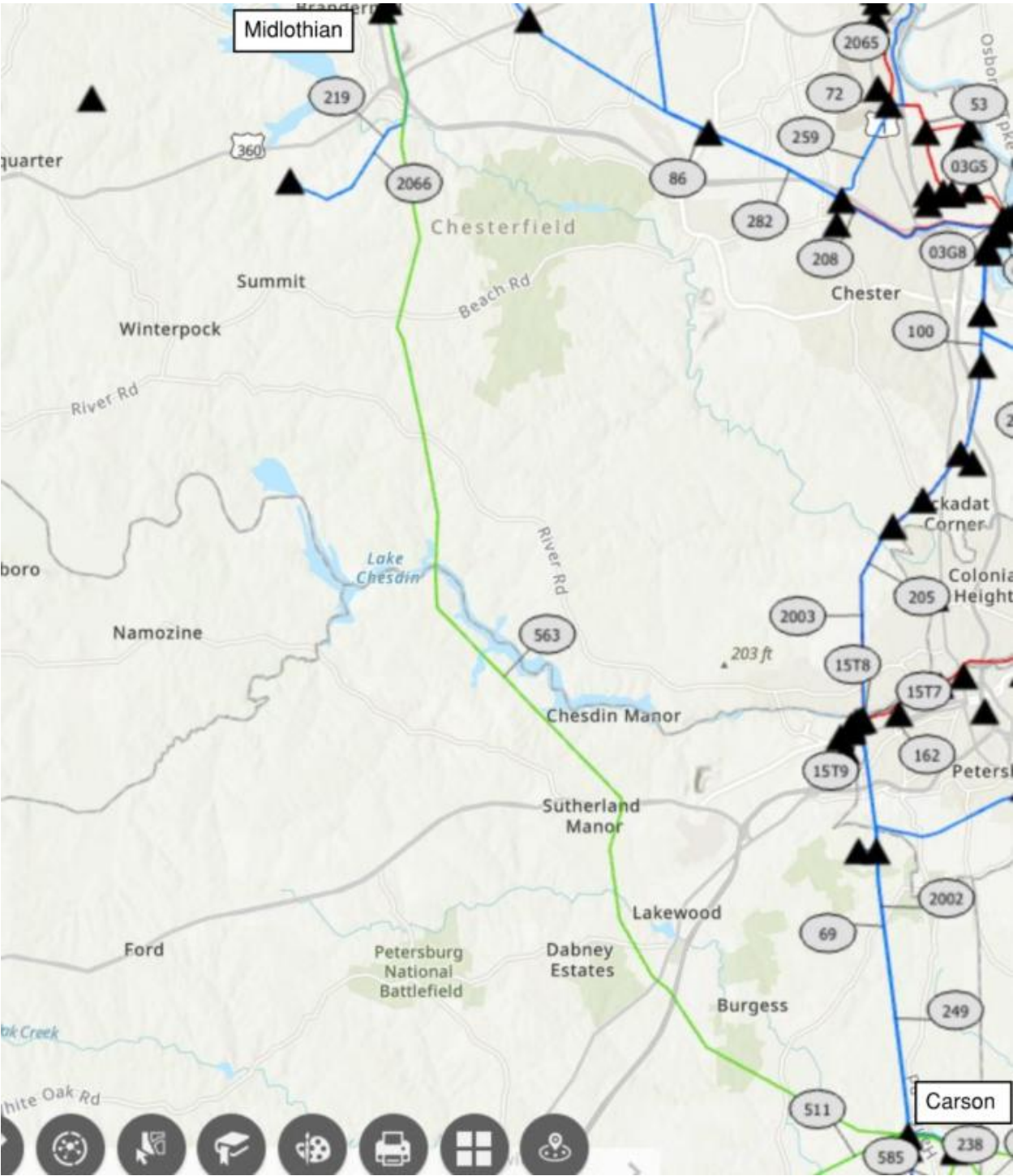


Figure 2 – Proposed Structure Configuration - Suspension

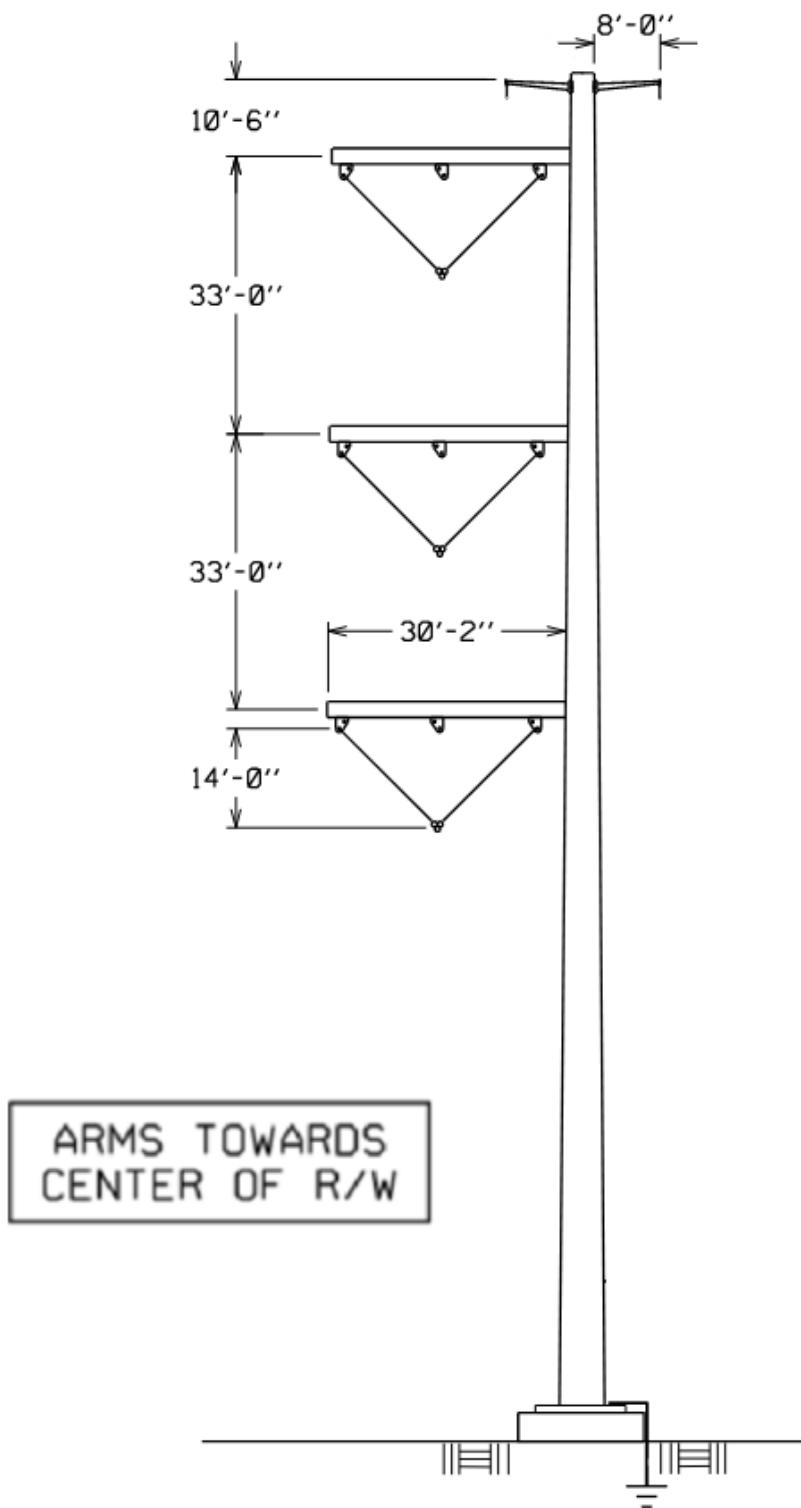


Figure 3 – Proposed Structure Configuration – Small Angle/Tension Imbalance

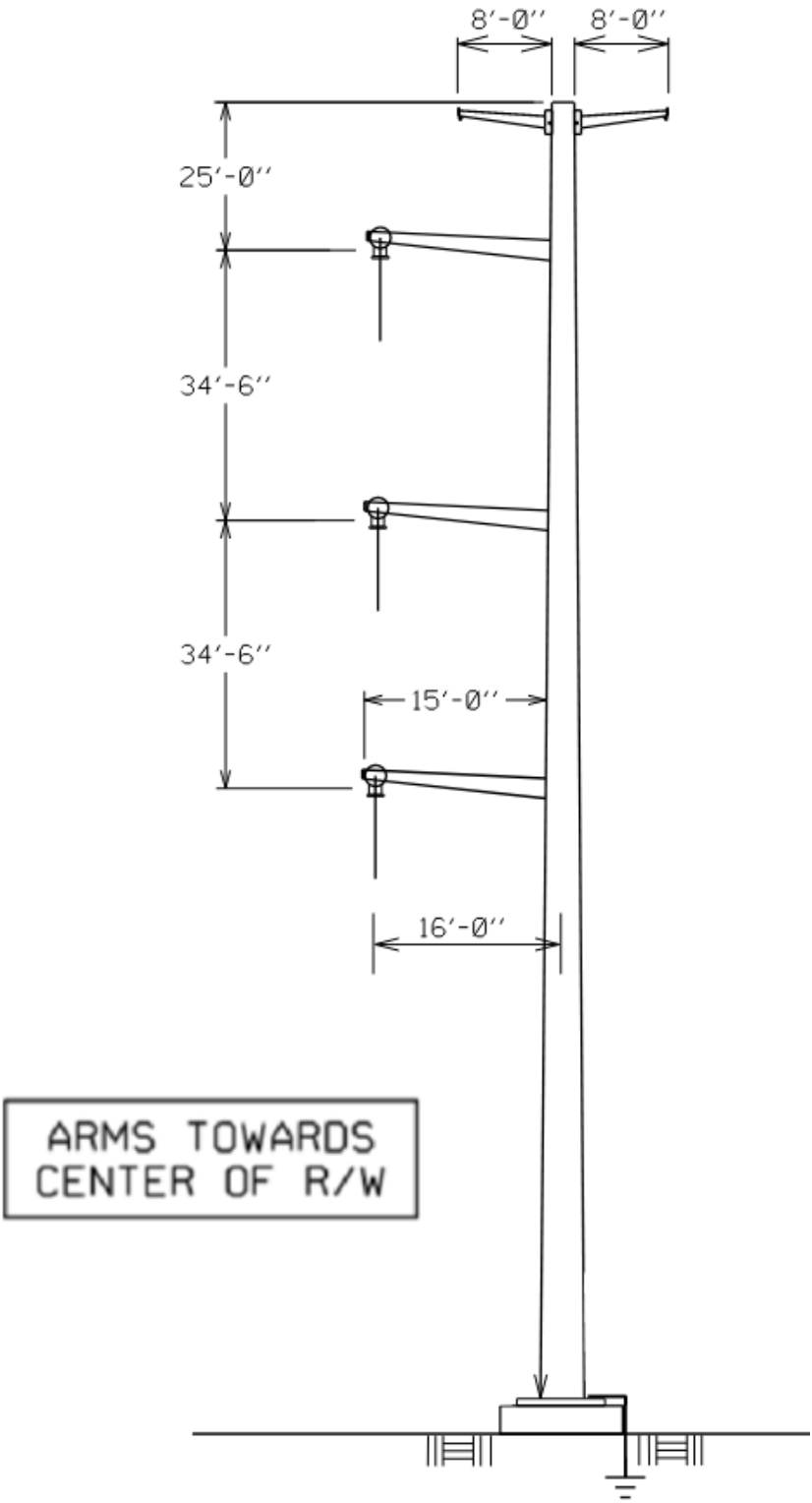
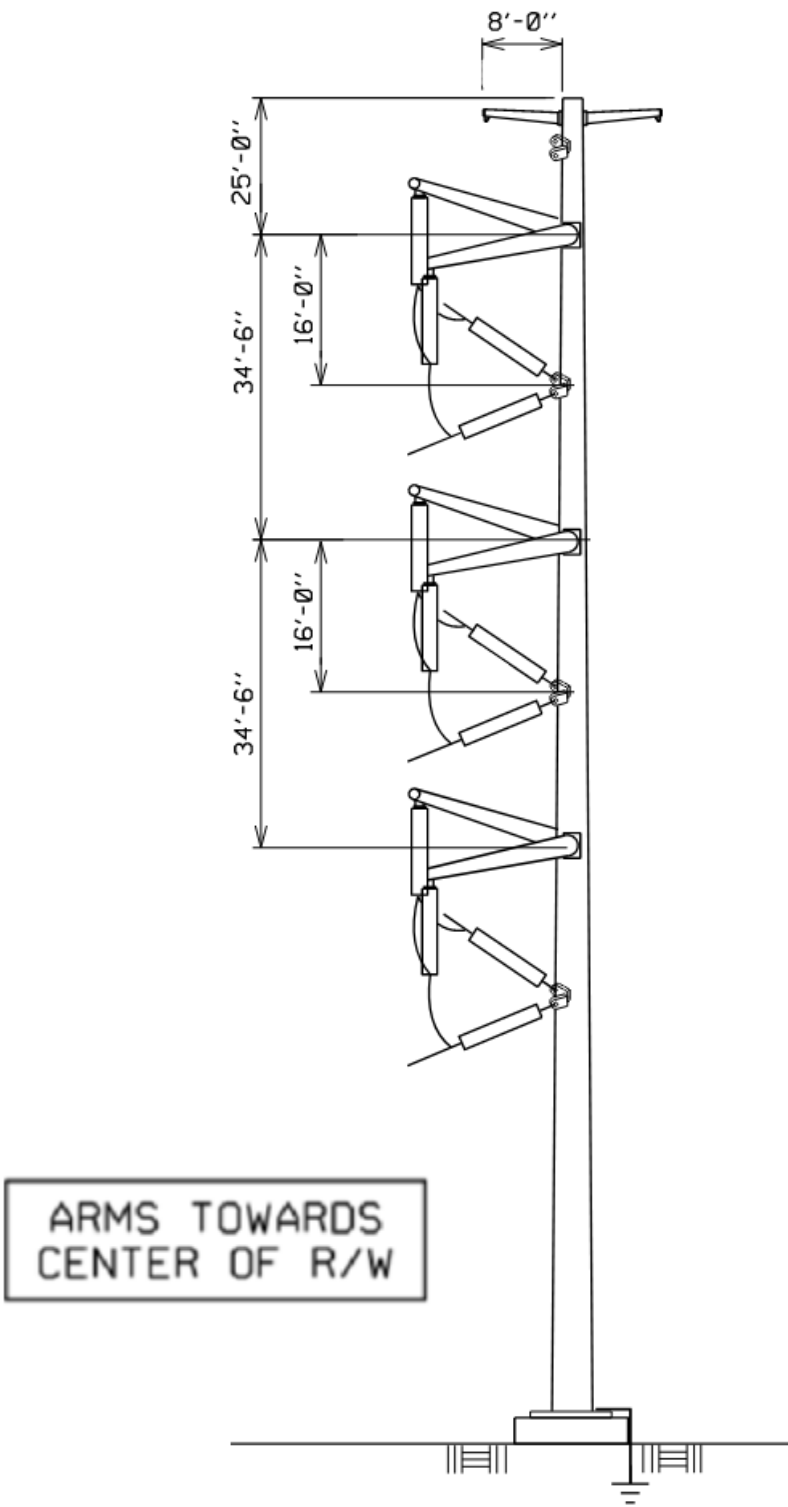


Figure 4 – Proposed Structure Configuration – Large Angle (0°-60°) Deadend



Required Material Summary

Item	Qty
Engineered Structures	210
15,000-Ft OPGW Reels	34
15,000-Ft Conductor Reels	132