PJM Facilities Study Report

For

Network Upgrade N9138

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 N9138. The scope of this Network Upgrade includes the following:

- Upgrade 22.59 Miles of 500kV transmission line 511 from Carson Substation to Rawlings Substation

B. Transmission Owner Facilities Study Results

1. Detailed Scope of work for Network Upgrade N9138:

The following is a detailed description of Transmission Owner Upgrades for Network Upgrade N9138. 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 60 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	60

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
- Coordination with work on line 563

3. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

- 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 PERMITING

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 Carson

Attachment #2: Preliminary Scoping Summary – Substation Rawlings

Attachment #3: Preliminary Scoping Summary – Transmission

Attachment #1

Project Number: N9138 – Carson Substation

Project Description: Replace Line Lead for Line 511 & Wave Trap Removal

SUBSTATION SCOPE OF WORK

Date: 06/20/2025

Revision Number: 0

Project Summary

Network upgrade N9138 provides for the uprate of Line 511 at Carson Substation in Petersburg, Virgina. Remove Line 511 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:

1. Three (3), 396Kv, 318kV MCOV surge arrester
2. Conductors, connectors, foundations, bus support, steel, and grounding material as per engineering standards.

Relocate Substation Material:

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

Remove Substation Material:

1. One (1), 500kV, 5000A, wave trap
2. Conductors, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards.

Purchase & Install SPE Material:

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

Remove SPE Material:

1. Remove Panel No. 31
2. Remove Panel No. 32

Attachment #2

Project Number: N9138 – Rawlings Substation

Project Description: Replace Line Lead for Line 511 and Remove Wave Trap Removal

SUBSTATION SCOPE OF WORK

Date: 06/20/2025

Revision Number: 0

Project Summary

Network upgrade N9138 provides for the uprate of Line 511 at Rawlings Substation in Brunswick County, Virgina. Remove Line 511 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:

3. Three (3), 396kV 318kV MCOV surge arrester
4. Conductor, connectors, conduit, control cable, foundations, structures, and grounding material as per engineering standards.

Remove substation material – Network Upgrade:

3. One (1), 500kV, 5000A, wave trap
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

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. Remove Panel No. 11
2. Remove Panel No. 13

Attachment #3

500kV LINE #511

Carson Substation – Rawlings Substation

PROJECT N9138

PRELIMINARY SCOPING SUMMARY

This project serves to rebuild 500kV line 511 from Carson Substation to Rawlings Substation for approximately 22.59 miles, which is located in Brunswick and Dinwiddie County, 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 eighty-three (83) new structures. A Certificate of Public Convenience and Necessity (CPCN) filing will be required for this project.

The existing line consists mainly of single circuit galvanized steel lattice towers, built in 1995. The proposed structures to be installed are engineered steel single circuit monopoles. The existing triple-bundled (3) 1351.5 ACSR 45/7 conductor will be replaced with triple-bundled (3) 1351 ACSS/TW/HS. The existing 7#7 Alumoweld shield wire and DNO-8909 OPGW wire will be replaced with two (2) DNO-10100 OPGW.

Project N9250 plans to construct a new 500kV line, from Carson Substation to Rawlings Substation, within the same corridor as line 511. It is assumed that Project N9138 is independent of Project N9250; however, the rebuild herein is only required such that Project N9250 can be constructed while acquiring the minimal amount of additional ROW.

Design Considerations:

EXISTING FACILITIES TO BE REMOVED:

1. Remove seventy-two (72) existing 500kV single circuit suspension lattice towers as follows:
    a. Structures 511/215 – 511/220, 511/222 – 511/241, 511/243 – 511/245, 511/247 – 511/257, 511/259 – 511/264, 511/266 – 511/271, 511/273 – 511/276, 511/278 – 511/291, 511/293 and 511/297.

2. Remove one (1) existing 500kV single circuit steel double deadend lattice tower as follows:
    a. Structure 511/292.

3. Remove ten (10) existing 500kV single circuit steel running angle lattice towers as follows:
    a. Structures 511/221, 511/242, 511/246, 511/258, 511/265, 511/272, 511/277 and 511/294 – 511/296.

4. Remove one (1) existing 500kV single phase double deadend monopole as follows:
    a. Structure 511/292C
        i. Structure is used for transposing phase C between structures 511/292 and 511/293.

5. Remove approximately 22.59 miles of triple-bundled (3) 1351.5 ACSR 45/7 conductor from existing backbone structure 511/214 to existing backbone structure 511/299.

6. Remove approximately 0.22 miles of two (2) DNO-9809 OPGW wire from existing backbone structure 511/214 to existing structure 511/215.

7. Remove approximately 22.37 miles of two (2) 7#7 Alumoweld shield wire from existing structure 511/215 to existing backbone structure 511/299.

EXISTING FACILITIES TO BE MODIFIED:

1. Replace three (3) conductor strain assemblies [Reference Drawing 35.250] and two (2) OPGW deadend assemblies [Reference Drawing 96.051] on the following two (2) structures
    a. Structure 511/214 and 511/299.

2. Replace six (6) conductor strain assemblies [Reference Drawing 35.250], three (3) jumper loop assemblies [Reference Drawing 39.500] and four (4) OPGW deadend assemblies [Reference Drawing 96.050] on the following two (2) structures:
    a. Structures 511/298 and 511/298A.

PERMANENT FACILITIES TO BE INSTALLED:

1. Install sixty-six (66) 500kV engineered steel single circuit suspension monopole structures [Reference Drawing 15.200] on foundations as follows:
    a. Structures 511/215 – 511/220, 511/222 – 511/228, 511/230 – 511/235, 511/237 – 511/241, 511/243 – 511/245, 511/247 – 511/255, 511/257, 511/259 – 511/264, 511/266 – 511/271, 511/273 – 511/276, 511/277 – 511/281, 511/283 – 511/290 and 511/297.
    b. See **Figure 2** for a visual of the proposed structure design.

2. Install four (4) 500kV engineered steel single circuit suspension monopole structures [Reference Drawing 15.200] with shield wire deadend assemblies on foundations as follows:
    a. Structures 511/229, 511/236, 511/256 and 511/282.
    b. See **Figure 2** for a visual of the proposed structure design.

3. Install ten (10) 500kV engineered steel single circuit small angle (0°-25°) DDE monopole structures [Reference Drawing 15.210] on foundations as follows:
    a. Structures 511/221, 511/242, 511/246, 511/258, 511/265, 511/272, 511/277 and 511/294 – 511/296.
    b. See **Figure 3** for a visual of the proposed structure design.

4. Install two (2) 500kV engineered steel single circuit tension imbalance DDE monopole structures [Reference Drawing 15.210] on foundations as follows:

a. Structures 511/291 and 511/293.
b. See **Figure 3** for a visual of the proposed structure design.

5. Install one (1) 500kV engineered steel single circuit large angle (0-60) DDE monopole structure [Reference Drawing 15.212] on a foundation as follows:
    a. Structure 511/292
    b. See **Figure 4** for a visual of the proposed structure design.

6. Install approximately 22.59 miles of 3-phase triple-bundled (3) 1351 ACSS/TW/HS from existing backbone structure 511/214 to existing backbone structure 511/299.

7. Install approximately 22.59 miles of two (2) DNO-10100 OPGW from existing backbone structure 511/214 to existing backbone structure 511/299.
    a. This includes the installation of twenty-two (22) splices at the eleven (11) locations as follows:
        i. Two (2) on structures 511/214, 511/221, 511/229, 511/236, 511/246, 511/256, 511/265, 511/272, 511/282, 511/292, and 511/299.

CONCEPTUAL SCOPE NOTES:

1. The existing line consists primarily of steel lattice towers, built in 1995. There will be a new 500kV line constructed next to this one as part of Project N9250, resulting in the need for the line to be rebuilt on steel monopoles in order to acquire the minimum additional amount of ROW as part of Project N9250. 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, ¾" Ice & 30 mph wind regardless of project location.

3. It is assumed for detailed engineering that a LiDAR survey will be required.

4. Any potential height restrictions were not accounted for in this design.

5. An existing right of way width of 150' between Rawlings substation and structure 511/295, and 100' between structure 511/295 and Carson substation is assumed based on existing plan and profiles. No new right of way will be needed.

6. A wetland delineation has not been completed as part of this conceptual package.

7. 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.

8. This conceptual design assumes no two (2) double deadends should be spaced more than ten (10) miles apart for cascading failure prevention.

9. It is assumed that an outage will be able to be acquired for 500kV Line 511 for this project and no temporary arrangement will be required.

10. Critical Crossing were found here:
    a. Between structures 511/222 and 511/223 – State Highway 1
    b. Between structures 511/225 and 511/226 – Interstate Highway I-85
    c. Between structures 511/234 and 511/235 – Beaver Canal
    d. Between structures 511/240 and 511/241 – Unknown voltage transmission line
    e. Between structures 511/271 and 511/272 – Stony Creek
    f. Between structures 511/293 and 511/294 – Transmission Lines 69 and 238
    g. Between structures 511/298 and 511/298A – Transmission Lines 238 and 249

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 that existing structures 511/298 and 511/298A, built in 2015, and existing backbone structures 511/214 and 511/299 will remain in place. This will need to be analyzed further in detailed design.

5. The conceptual estimate assumes that a laydown yard is required for this project.
6. Prior to detailed engineering, a full land rights review would be required. A desktop review was completed to estimate the project cost.

7. 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 N9250. 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 are estimated. Assumption would be to work the project similar fashion to the TL 588/5005.
b. Access matting costs do not account for forestry work in between large spans that were not matted through for access.
c. Tangent Structures are allotted 40 mats. Angle structures are allotted to 80 mats. Pull Pads are allotted 100 mats for the 500kV Wreck and Rebuild and New Lines.
d. 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 Enterprise.

Figure 1 – Project Location

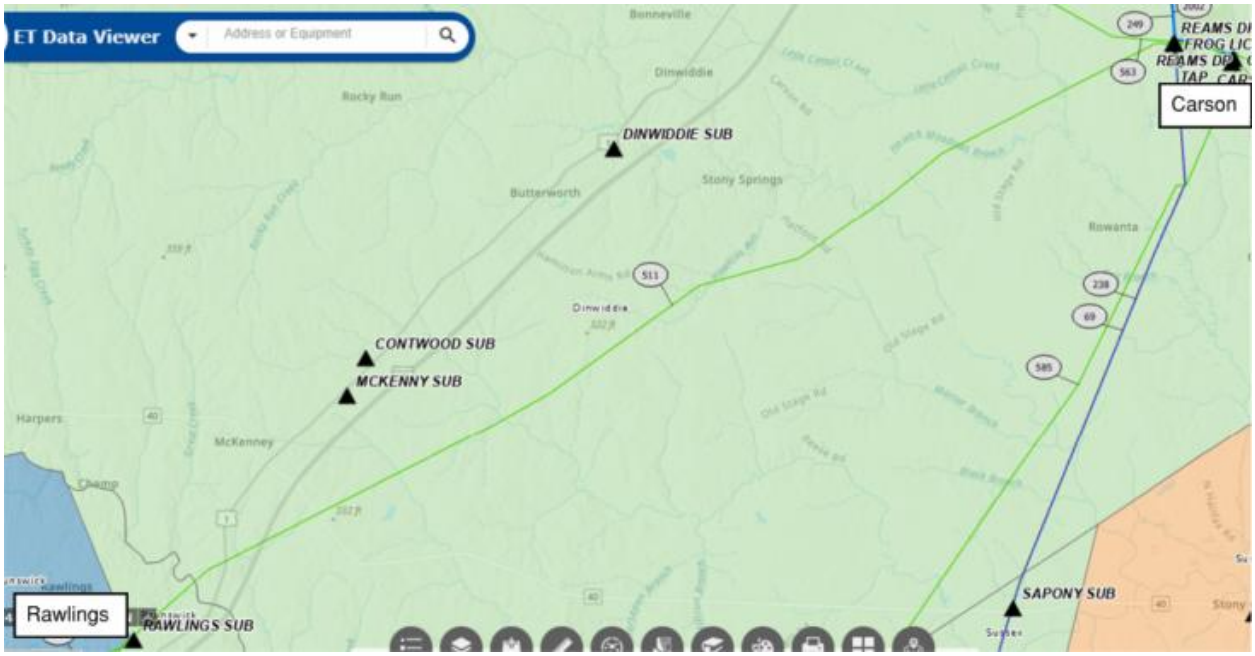


Figure 2 – Proposed Structure Configuration - Suspension

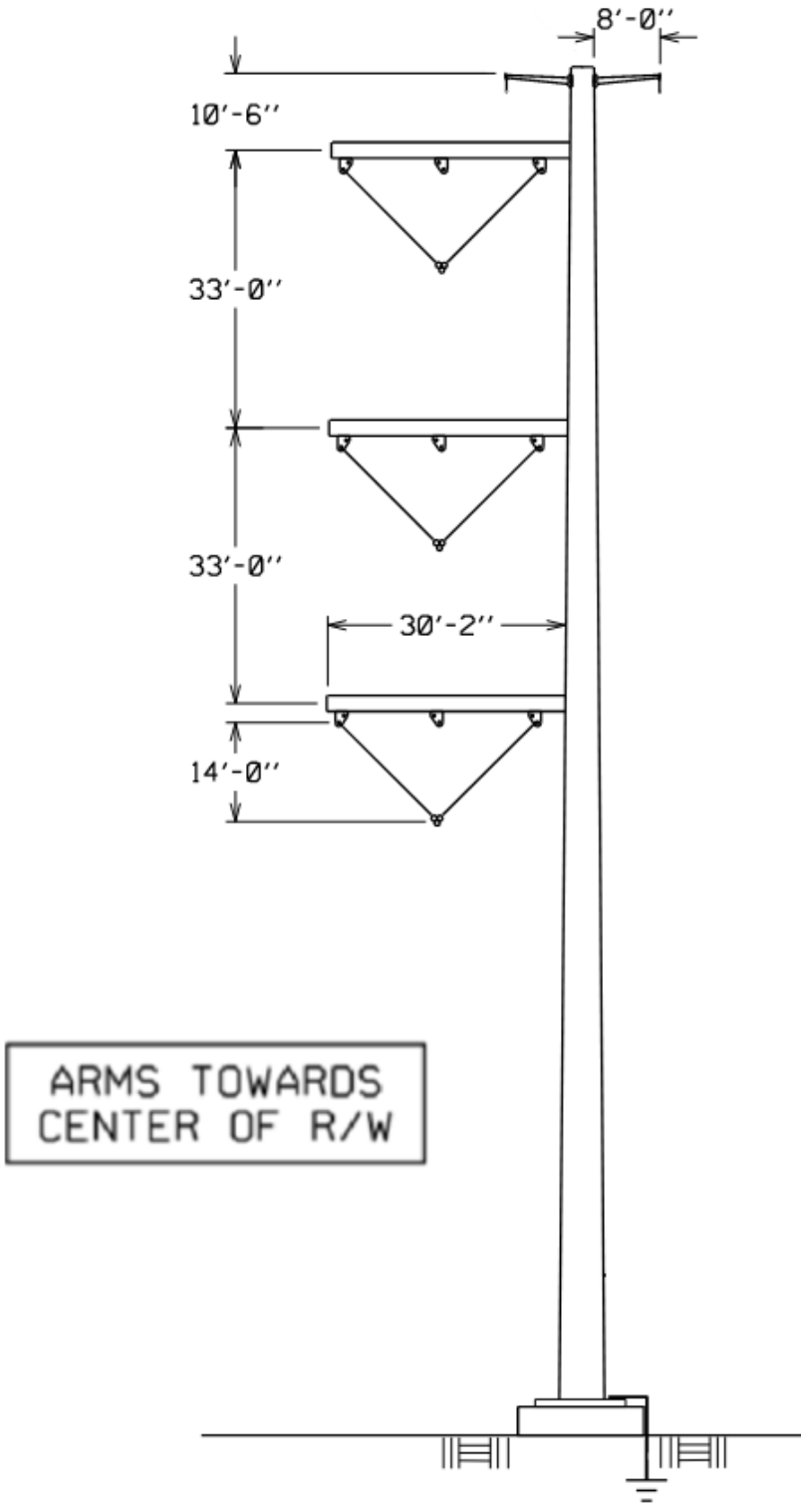


Figure 3 – Proposed Structure Configuration – Small Angle/Tension Imbalance

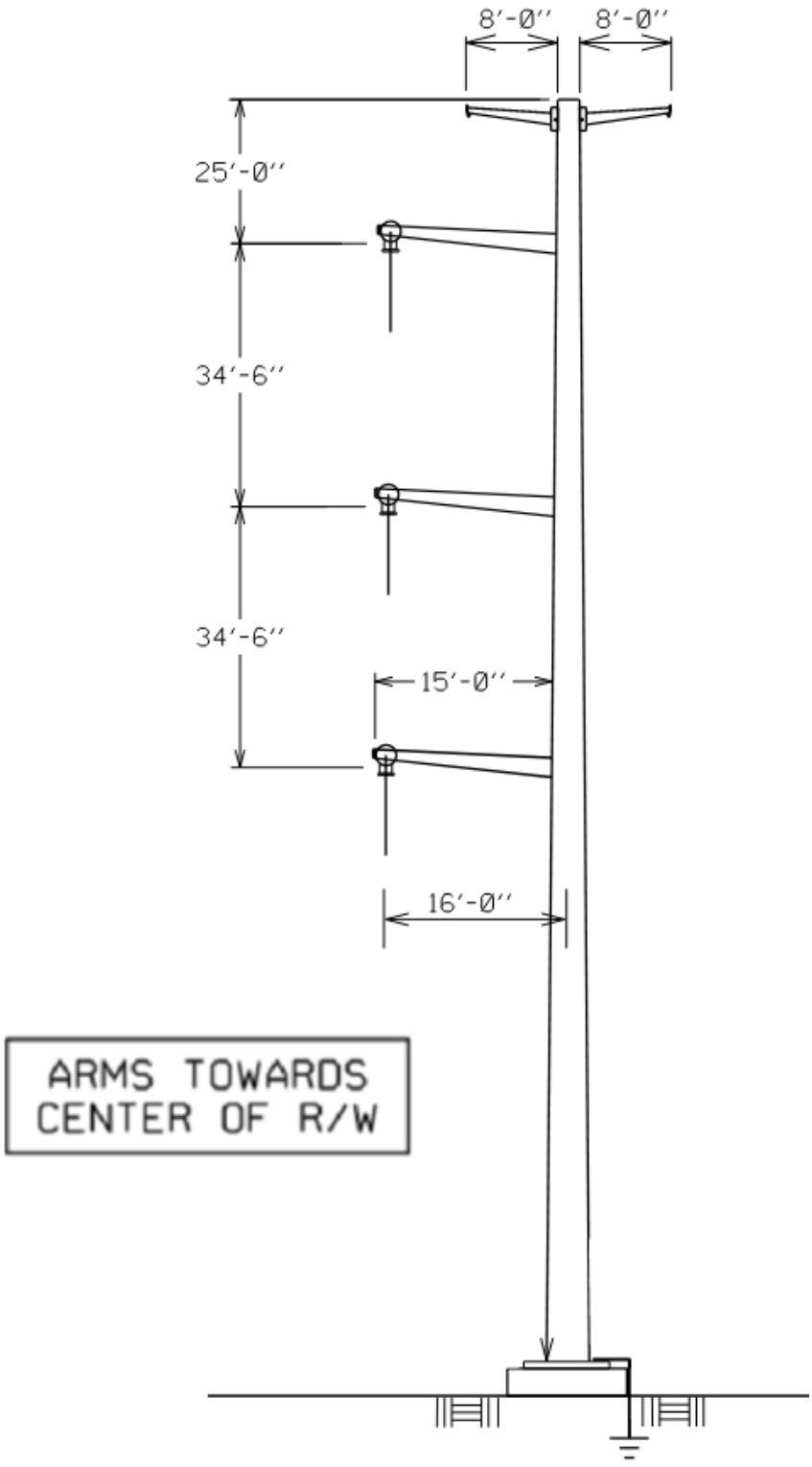
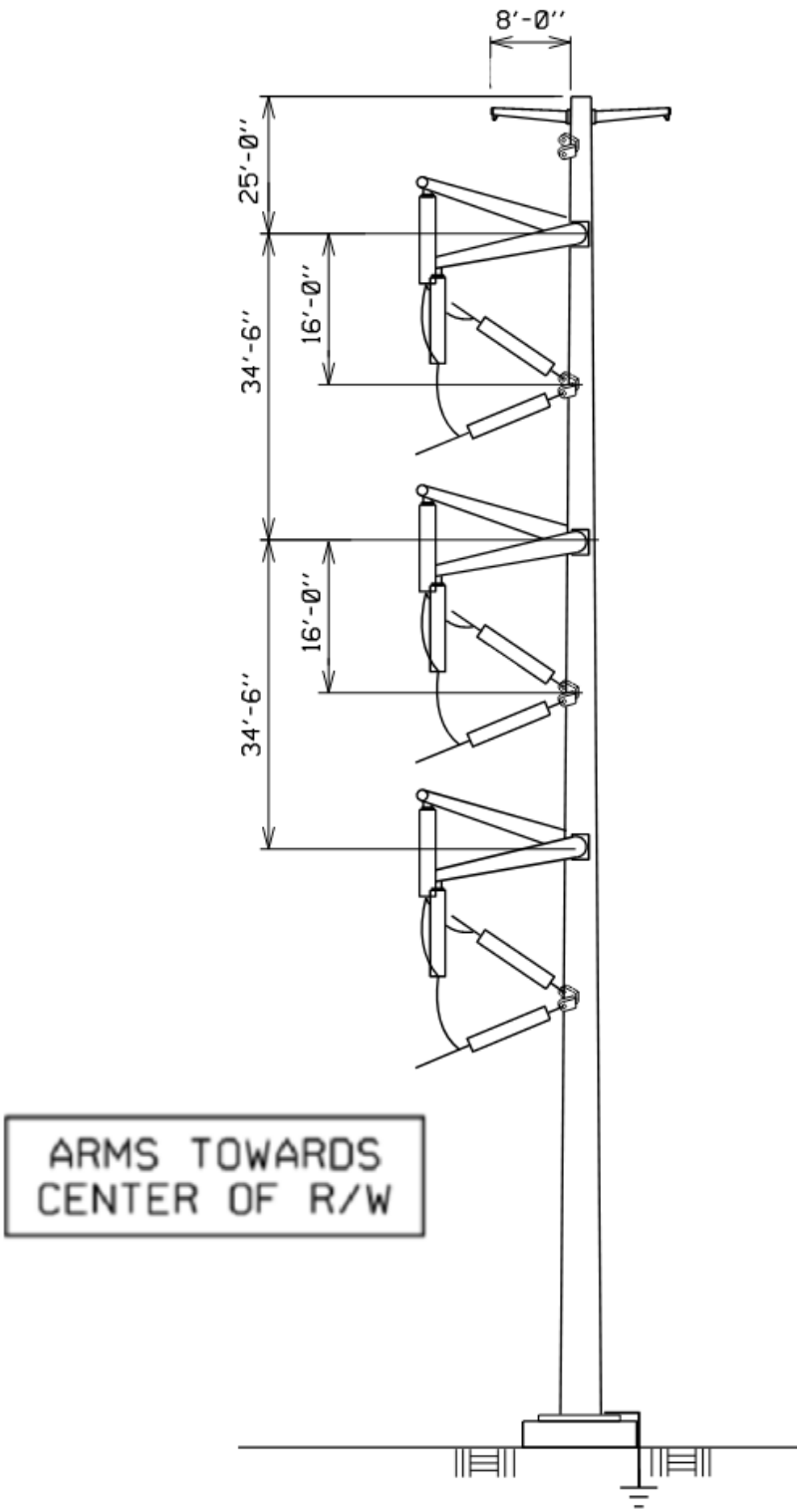


Figure 4 – Proposed Structure Configuration – Large Angle (0°-60°) Deadend



Required Material Summary

Item	Qty
Engineered Structures	83
15,000-Ft OPGW Reels	20
15,000-Ft Conductor Reels	81