Affected Transmission Owner Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AH1-170

“Columbia DP 115kV”

Introduction

This Affected Transmission Owner Study has been prepared in accordance with the PJM Open Access Transmission Tariff, as well as the Application and Studies Agreement between the Project Developer and PJM Interconnection, LLC (PJM or Transmission Provider (TP)). The Transmission Owner (TO) is Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion).

This Affected Transmission Owner Study was performed to satisfy the Phase 2 Facility Study requirement of the PJM Tariff. The Facility Study is intended to provide scope, cost and schedule estimates for the project as currently defined and approved for Phase 2 study. In the event project changes are made during DP2 that impact this report, updates will be provided as part of the Phase 3 report. Following execution of the project's final agreement, this report will not be updated to account for other changes made as part of the agreements modification clause and instead the scope change process will be followed.

A. Affected Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a Solar Generating Facility located in, Goochland County, Virginia with a designated PJM Project ID of AH1-170. The installed facilities will have a total Maximum Facility Output (MFO) of 20 MW with 12 MW of this output being recognized by PJM as Capacity.

The proposed generation interconnection is shown on the single line diagram in Attachment #1.

B. Affected Transmission Owner Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AH1-170 projects to Dominion transmission system. These facilities shall be designed according to all Dominion Applicable Technical Requirements and Standards in effect March 20th, 2026. Dominion Energy Virginia – Electric Transmission Facility Interconnection Requirements, Procedure Version 25.0, dated October 1, 2025, shall apply. Once built, Dominion will own, operate, and maintain these Facilities.

2. NETWORK UPGRADES

Three Breaker Ring at Line 4 Trices Lake Tap:

AG2-151 and AH1-170 both contribute to the need for a new three breaker ring will be constructed at the Trices Lake Tap on Line 4.

The proposed Three Breaker Ring scope is shown in Attachment #3 and Attachment #4.

Upgrades to neighboring facilities:

Bremo Substation

The proposed neighboring facility scope is detailed in Attachment #5.

James River Substation

The proposed neighboring facility scope is detailed in Attachment #6.

3. OTHER SCOPE OF WORK

No Other Scope of Work has been identified in this Affected Transmission Owner Study Report

4. MILESTONE SCHEDULE FOR COMPLETION OF [TO] WORK

Facilities outlined in this report are estimated to take 36 months to construct, from the time the Generation Interconnection Agreement is fully executed. This schedule may be impacted by the timeline for procurement and installation of long lead items, the ability to obtain outages to construct and test the proposed facilities.

Description	Start month	Finish month
Detailed Design	1	10
Permitting/Procurement	2	26
Construction	18	36

5. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

Assumptions can be found in Attachments #3-9

6. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

Land requirements for the Interconnection Substation needed for this interconnection project must meet the requirements in Dominion's Facility Interconnection Requirements and NERC Compliance Procedure FAC-001 posted on PJM's website.

The Dominion would be responsible for the following expectations in the area of Real Estate.

- The land required for Dominion's substation and project specific areas around must be deeded over title-in-fee.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Dominion Real Estate and Counsel will provide standard real estate checklist word document. Process needs to start at least 6 months prior to closing date.
- Required subdivision plat and associated documentation to be reviewed prior to subdividing parcel with the county.
- Suitable Access Road from Substation to a Virginia/North Carolina State Maintained Roadway.
- Dominion will require access road, transmission line and utilities easement to the Substation.
- Any other Land/Permitting requirements required by the Substation.

7. APPLICABLE TECHNICAL REQUIREMENTS AND STANDARDS

These facilities shall be designed according to all Dominion Applicable Technical Requirements and Standards in effect March 20th, 2026. Dominion Energy Virginia – Electric Transmission Facility Interconnection Requirements, Procedure Version 25.0, dated October 1, 2025, shall apply.

8. ENVIRONMENTAL AND PERMITTING

Dominion would be responsible for the following expectations in the area of Environmental and Permitting.

- Assessment of environmental impacts related to the Interconnection Facility and/or Network Upgrades including:

  Environmental Impact Study requirements

  Environmental Permitting

- Dominion will require a stormwater easement for substation specific stormwater design BMP's to allow access to and use of the facilities.

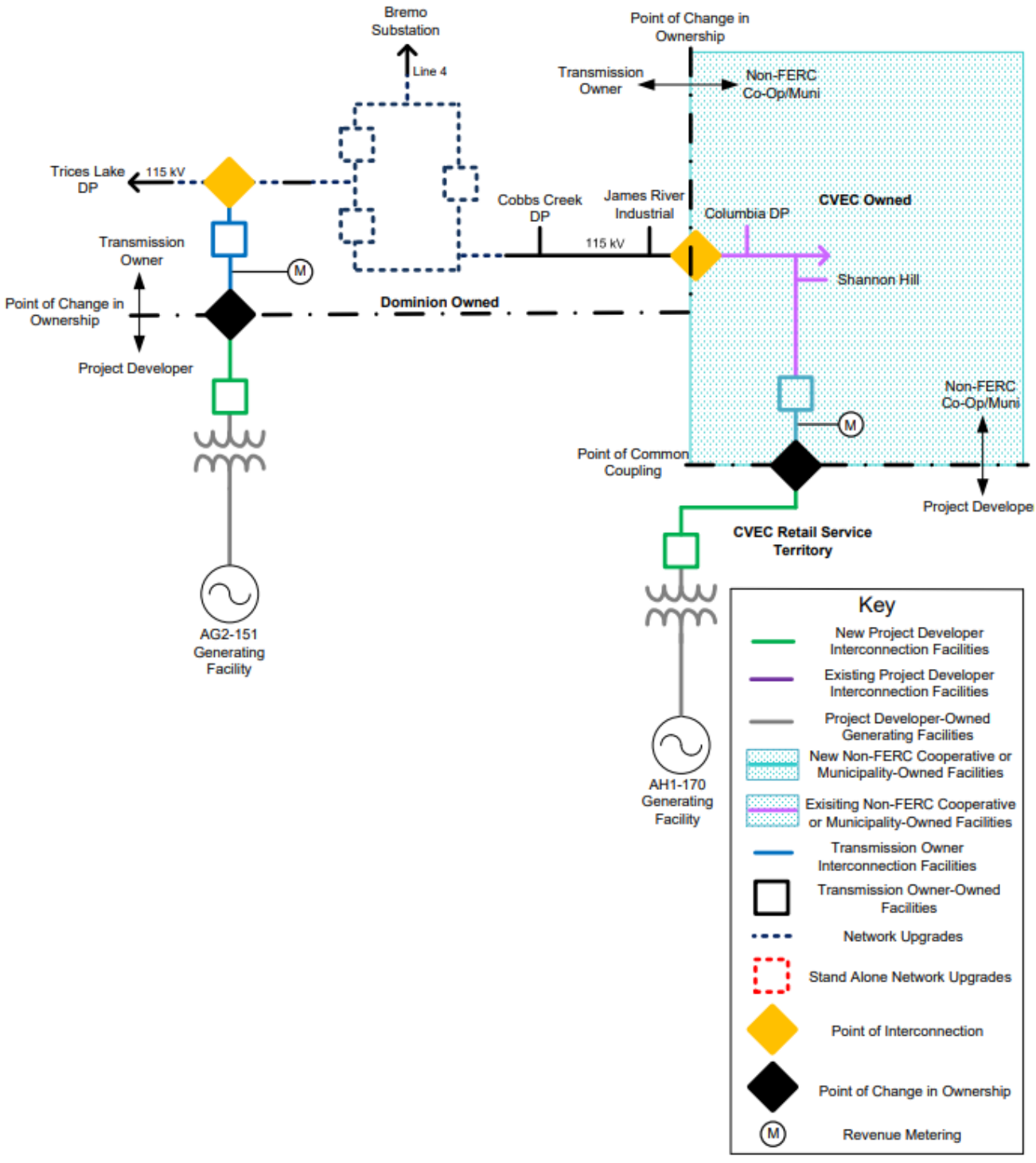
  A maintenance agreement should be in place in perpetuity for said stormwater facilities.

- 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 Substation

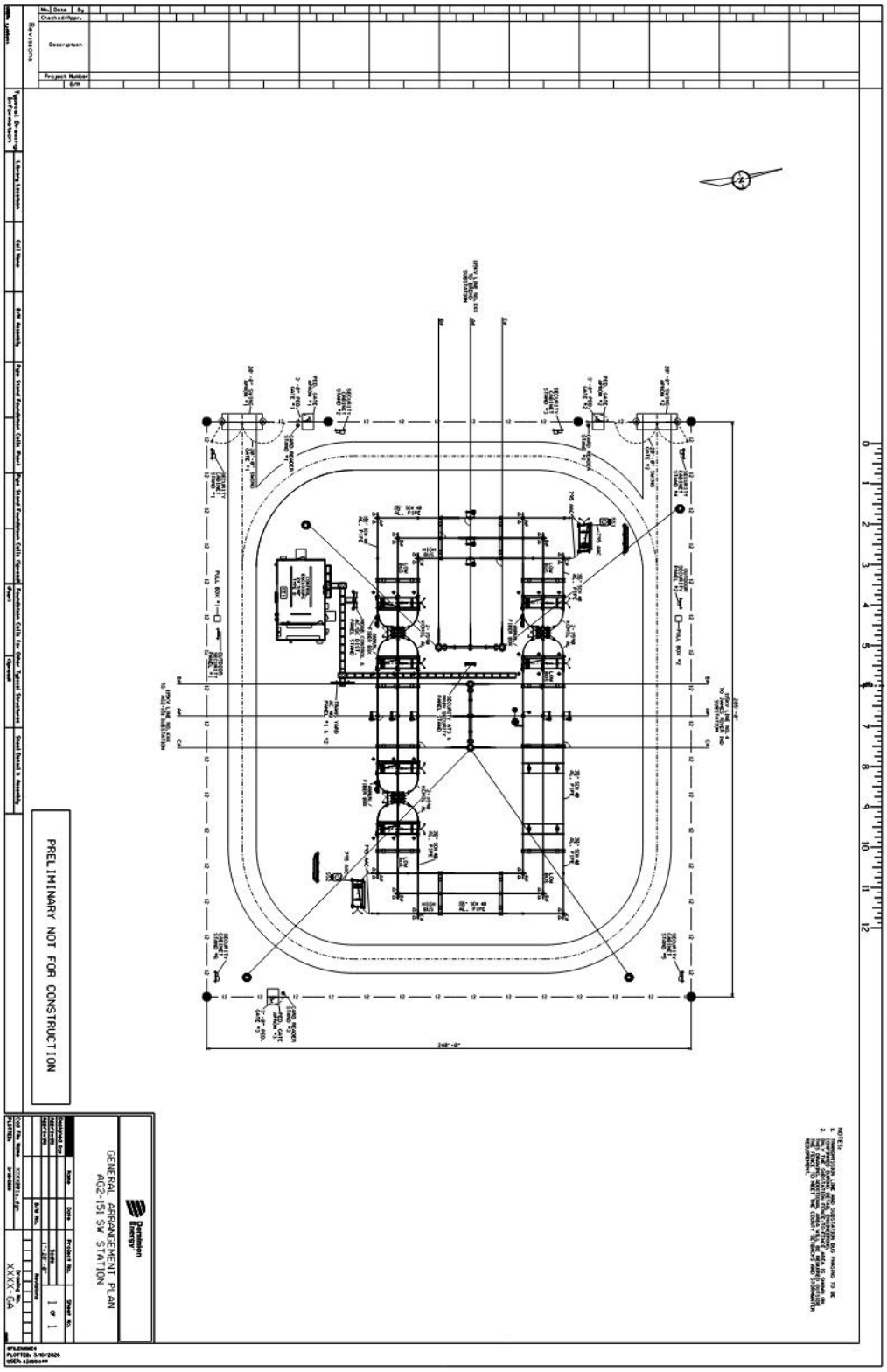
C. APPENDICES

Attachment #1:	Single line Diagram for the Physical Interconnection
Attachment #2:	Substation General Arrangement
Attachment #3:	Network Upgrade – Three Breaker Ring at Trice Lake Tap – Substation
Attachment #4:	Network Upgrade – Three Breaker Ring at Trice Lake Tap – Transmission
Attachment #5:	Network Upgrade – Bremo Substation
Attachment #6:	Network Upgrade – James River Substation

Attachment #1: Single line Diagram for the Physical Interconnection



Attachment #2: Substation General Arrangement



Attachment #3: Network Upgrade – Three Breaker Ring at Trice's Lake Tap – Substation

Project Summary

The Generation Interconnect project AH1-170 requires the construction of a new 115kV three breaker ring switching station at transmission structures 4/700 named the Trice's Lake Tap in Cumberland County, VA.

The objective of this project is to build a 115kV three breaker ring bus to support AH1-170 at the existing Trice's Lake Tap. The site is located along Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion) existing 115kV, 4 line from Bremo Substation, James River Ind. and Trice's Lake DP. Dominion will be responsible for land acquisition, permitting, site preparation, and grading activities.

Transmission line engineering is to renumber the existing line segment between the new 115kV three breaker ring switching station and Bremo Station as well as between the new 3 breaker ring station and Trice's Lake DP. The existing line segment between the new 115kV three breaker ring switching station and James River Substation shall remain line 4.

Additional work to be required at Bremo, Trice's Lake DP, and James River Ind.

Security and fence type – design level 4.

Assumption:

Currently, the scope and estimate assume Dominion standard spread footer foundations. Once the soil information is available and it is prudent to change the design to "helical pile foundations" the Dominion team should be informed to adjust the project estimate at the earliest possible opportunity.

Purchase and install substation material – Network Upgrade:

1. Approximate station fence line dimensions of 285'x 240'. At a minimum, site preparation and grading will be required to extend 15' beyond these dimensions for station grounding. Additional property and site prep may be required for proper grading and stormwater management, etc.
2. Approximately 1,050 linear ft of 5/8" chain link, 12 ft tall, perimeter fence around the station along with the security cameras and integrators as per design 4 fence standards
3. Three (3), 115kV, 3000A, 40kAIC, SF-6 circuit breaker
4. Six (6), 115kV, 2000A, 3-phase center break gang operated switch
5. Nine (9), 115kV, relay accuracy CCVT
6. One (1), 115kV, 2000A wave trap
7. One (1), line tuner
8. Nine (9), 90kV, 74kV MCOV surge arrester
9. Two (2), 115kV, 2000A, 2-phase center break switch (for PVT's)
10. Two (2), 115kV, 100KVA power PT's for station service
11. Two (2), 115kV, 10 in-lb., 125VDC motor operator
12. Two (2), 115kV, heavy duty steel backbone (by Transmission)
13. Four (4), shield wire poles and four spans of shield wire (by Transmission)
14. One (1), 24' x 40' control enclosure
15. One (1), 125 VDC, 300 Ah station battery and 50 Amp charger (size to be verified during detail engineering)
16. Approximately 164 ft of cable trough
17. Two (2), 38" x 38" x 42" precast yard pull box
18. Station stone as required
19. Station lighting as required
20. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
21. Foundations as required including control house, equipment, and bus support stands
22. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Purchase and install relay material – Network Upgrade:

1. Three (3), 1510 - 24" dual SEL-351-7 transmission breaker with reclosing panel
2. Three (3), 4510 - SEL-2411 breaker annunciator
3. One (1), 1340 - 24" dual SEL-411L DCB/PLC line panel
4. Two (2), 1340 – 24" dual SEL-411L CD/Fiber line panel
5. Three (3), 4506 - 3-phase CCVT potential make-up box
6. One (1), 1603 - 24" SEL-451 islanding control scheme panel
7. Two (2), 4000 - station service potential make-up box
8. Two (2), 4548 - non-earthing switch MOAB control box
9. One (1), 4103 - non-earthing switch MOAB AC/DC distribution box
10. Two (2), 4018 - 500A station service AC distribution panel

11. Two (2), 4007 - 225A outdoor transmission yard AC NQOD
12. Two (2), 4019 - 225A 3-phase throw over switch
13. Two (2), 4016 - 600A PVT disconnect switch
14. One (1), 4153c - wall mount station battery monitor
15. One (1), 5618 - SEL-3555 communications panel
16. One (1), 1255 - station annunciator panel
17. One (1), 5021 - SEL-2411 RTU panel
18. One (1), 5609 - fiber optic management panel
19. Three (3), 4526_A - circuit breaker fiber optic make-up box
20. One (1), 5202 - 26” APP 601 digital fault recorder
21. Six (6), 4040 - security fiber/power make-up box
22. One (1), 5603 - station network panel no. 1
23. One (1), 5603 - station network panel no. 2
24. One (1), 4051 - power block
25. One (1), 4042_D1B - security utility - utility ATS
26. One (1), 4044 - 225A 1Ø outdoor main security AC NQOD
27. Two (2), 4040 – 100A 1Ø outdoor security AC NQOD
28. One (1), 5616 - station security panel
29. One (1), 5616 - station security fence panel
30. Two (2), 4018 - 225A station service AC distribution panel branch breaker
31. One (1), high voltage protection (HVP) box (provided by IT) (to be verified during detail engineering)
32. One (1), telephone interface box (to be verified during detail engineering)

Preliminary Scoping Summary

This project serves to cut in 115 kV line 4 into a new substation called AH1-170, which is to be located in Cumberland County, VA. The line is to be cut-in near existing structure 4/700 at Trices Lake Tap. Line 4 is being renumbered to 1XX1 between AH1-170 substation and Bremo substation. Additionally, the existing tap line to Trices Lake DP will be re-routed and terminated at AH1-170 Substation. Line 4 is being renumbered to 1XXX between AH1-170 Substation to Trices Lake DP. See **Figure 1** for the project location.

The proposed structures to be installed are five (5) 115 kV single circuit engineered steel double deadend 3-poles, one (1) 115 kV single circuit steel double deadend monopole, two (2) 115 kV single circuit steel backbones, and four (4) steel static poles. The new conductor and shield wire to be used will be single (1) 768.2 ACSS/TW (20/7) "Maumee" conductor and two (2) DNO-11410 OPGW. One (1) DNO-11410 will be installed from existing structure 1XX1/8516 to proposed structure 1XX1/8475. 7#7 Alumoweld will be utilized for shielding with AH1-170 substation.

Length of Route	**4.72 miles**
Location of the subject line (County/State)	**Cumberland County, VA**
Total Number of Permanent Structures	**12**
Total Number of Temporary Structures	**0**
CPCN/SCC Required?	**No**
New ROW Required?	**Yes**

New ROW Required:

ROW Length	ROW Width
0.07 Miles (See Note 1)	120 ft.
0.06 Miles (See Note 2)	120 ft.

Notes:

1. Additional ROW to be acquired will be from edge of ROW near proposed structure 1XX1/8475 to AH1-170 substation fence.
2. Additional ROW to be acquired will be from the AH1-170 substation fence to edge of gas line easement near proposed structure 1XXX/601.

This project will utilize current Dominion 115 kV standards. The conceptual estimate includes cost for the following:

Transmission Owner Build - Existing Facilities to be Removed

Structures – Seven (7) existing structures to be removed: 4/601, 4/601A, 4/601B, 4/700, 4/700A, 4/700B, and 4/8475.

Structure Type	Dwg Number	Str. Qty.
115 kV SC DOM DDE H-Frame	11.617	1
115 kV SC DOM DDE H-Frame	11.610	1
115 kV SC DOM DDE H-Frame	1-0004-02-039A	1
115 kV SC DOM SUS H-Frame	1-0004-03-95A	1
Wave Trap Pole	11.840	1
115 kV Self-Supporting Switch	11.830	2

Wire: Mileage listed is per circuit.

Length (Miles)	Circuit	# if Bundled-Wire Type "Name"	Start-End
0.12	1	Single (1) 636 ACSR (24/7) conductor	Existing Str. 4/8475 – Existing Str. 4/8474
0.11	1	Single (1) 636 ACSR (24/7) conductor	Existing Str. 4/701 – Existing Str. 4/601
0.11	1	3#6 Alumoweld Shield Wire	Existing Str. 4/701 – Existing Str. 4/601

0.12	2	3#6 Alumoweld Shield Wire	Existing Str. 4/8475 – Existing Str. 4/8474
3.66	1	3#6 Alumoweld Shield Wire	Existing Str. 4/8475 – Existing Str. 4/8508
0.62	1	DNO-9700 OPGW	Existing Str. 4/8508 – Existing Str. 4/8513
0.11	1	3#6 Alumoweld Shield Wire	Existing Str. 4/8513 – Existing Str. 4/8516

Transmission Owner Build - Permanent Facilities to be Installed

Structures: See attached spreadsheet for heights and loading information. The proposed structure finishes are to be weathering steel within the existing corridor based on existing structure finishes in the area. Otherwise, all structures will be galvanized steel.

Structure Type	Dwg Number	Str. Qty.
115 kV SC ENGR Steel DDE 3-Pole	12.158 – 115 kV Config.	5
115 kV SC ENGR Steel DDE Monopole	12.235 – 115 kV and Single Circuit Config.	1
115 kV SC Steel Backbone Structure	11.955	2
Steel Static Poles	9.008	4

Wire:

1. Mileage listed is per circuit
2. Conductor includes dampers and spacers. Static and Fiber includes dampers and splices.
    - Estimate includes approximately twenty-one (21) fiber splices

Length (Miles)	Circuit	# if Bundled-Wire Type "Name"	Start-End
0.12	1	Single (1) 768 ACSS/TW (20/7) "Maumee" conductor	Proposed BB. 4/698 (1XXX/599) – Existing Str. 4/701
0.09	1	Single (1) 768 ACSS/TW (20/7) "Maumee" conductor	Proposed BB. 4/698 (1XXX/599) – Proposed Str. 1XXX/601
0.10	1	Single (1) 768 ACSS/TW (20/7) "Maumee" conductor	Proposed BB. 1XX1/8473 – Proposed Str. 1XX1/8475
0.12	2	DNO-11410 OPGW	Proposed BB. 4/698 (1XXX/599) – Existing Str. 4/701
0.09	2	DNO-11410 OPGW	Proposed BB. 4/698 (1XXX/599) – Proposed Str. 1XXX/601
0.10	2	DNO-11410 OPGW	Proposed BB. 1XX1/8473 – Proposed Str. 1XX1/8475
4.39	1	DNO-11410 OPGW	Proposed Str. 1XX1/8475 – Existing Str. 1XX1/8516
0.02	1	Underground Fiber Conduit	Existing Str. 4/8516 – Bremo Substation (See Note 1)
0.09	1	7#7 Alumoweld Shield Wire	Between proposed static poles and backbones in AH1-170 substation

Notes:

1. Underground fiber cable will be brought to Bremo substation fence. Conceptual substation scope of work will include the underground cable fiber work to be installed inside the station.

Transmission Owner Build - Existing Facilities to be Transferred or Modified

1. Cut and transfer the existing single (1) 636 ACSR (24/7) conductor for Line 1XX1 from existing structure 1XX1/8476 onto proposed structure 1XX1/8475.
2. Cut and transfer the existing single (1) 636 ACSR (24/7) conductor for Line 1XXX from existing structure 1XXX/602 onto proposed structure 1XXX/601.
3. Cut and transfer the existing one (1) 3#6 Alumoweld Shield Wire for Line 1XX1 from existing structure 4/8476 onto proposed structure 1XX1/8475.
4. Cut and transfer the existing one (1) 3#6 Alumoweld Shield Wire for Line 1XXX from existing structure 1XXX/602 onto proposed structure 1XXX/601.
5. Install three (3) new conductor strain assemblies [Reference Drawing 31.540] on one (1) existing structure 4/701.
6. Install one (1) new OPGW deadend assembly [Reference Drawing 96.060] on one (1) existing structure 4/8516 (Outside Bremo Sub).
7. Install two (2) new OPGW deadend assemblies [Reference Drawing 96.060] on thirteen (13) existing structures 4/8484, 4/8487, 4/8490, 4/8491, 4/8493, 4/8498, 4/8499, 4/8507, 4/8508, 4/8510, 4/8513, 4/8514, and 4/8515.
8. Install one (1) new OPGW jumper loop assembly [Reference Drawing 96.210] on eleven (11) existing structures 4/8484, 4/8487, 4/8490, 4/8491, 4/8498, 4/8499, 4/8507, 4/8510, 4/8513, 4/8514, and 4/8515.
9. Install one (1) new OPGW suspension assembly [Reference Drawing 96.020] on twenty-eight (28) existing structures 4/8476 – 8483, 4/8485 – 8486, 4/8488 – 8489, 4/8492, 4/8494 – 8497, 4/8499A, 4/8500 – 8506, 4/8509, 4/8511 - 8512.

Scope Notes/Assumptions

1. Due to allocated amount of time, no PLS-CADD modeling was done for this project, which results in higher level scopes. Projects in the Transition Cycle 2 – Phase 2 will need to go through full conceptual engineering design prior reaching detailed engineering.

2. It is assumed that all existing structures can be re-used as part of this project. More information will need to be obtained on these structures during detailed design to confirm that they do not need to be replaced.

3. This project does require acquisition of a laydown yard.

4. The generalized structure heights for this project are 65/50/65 ft for structures 4/700, 4/699, 1XXX/600, 1XX1/8474, and 1XX1/8475 and 110 ft for structure 1XXX/601. This was determined for the high-level estimate projects for Dominion Generation Interconnection Projects.

5. In detailed engineering, it will need to be determined if the adjacent 230 kV line 2027 structures near Trices Lake Tap will need to be replaced to make taller due to the re-routing of the line 4 into AH1-170 substation.

6. All deadend engineered steel structures outside the substation (Structures 4/699, 4/700, 1XXX/600, 1XXX/601, 1XX1/8474, 1XX1/8475) will be designed for full-construction deadend loading for construction conditions.

7. Project area code required loading include: NESC Medium, 100 mph wind, ¾" Ice & 30 mph wind.

8. For detailed engineering, it is assumed LiDAR survey is required, including underground survey and ROW file.

9. Crossing insulators will be used whenever crossing over substation fence.

10. An existing right of way width of 50' from Trices Lake DP to Columbia DP and 195' from Trices Lake Tap to Bremo Substation is assumed based on existing plan and profiles and DEV MapViewer. An additional 0.13 miles of 120 ft of right of way will be acquired to AH1-170 substation for this project to accommodate the over-insulated 115 kV Dominion ROW preferences.

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

12. A non-location specific substation general arrangement was provided by the conceptual substation engineering team. See **Figure 2** for the general arrangement used for this project.

13. The assumed reel lengths for this project are 12,000 feet.

14. Cross slopes are not accounted for in this conceptual design. Structures designed assuming a 1.5' foundation reveal at the center of the structure.

15. This project scope assumes that it is independent from other projects in the Transition Cycle. The following projects may impact the project scope if this assumption is incorrect.
    a. AG2-151 (SB) – Line 4 Substation Cit-In near existing structure 4/612

16. Projects AG2-151 (3B) and AH1-170 each include the same project scope since they are dependent on each other. Should one of the two (2) projects withdraw from the Transition Cycle, the scope would transfer to the other remaining scope in the Transition Cycle.

Estimate Notes/Assumptions

1. This scope and estimate for project AH1-170 refers to the "transmission-owner-to-build" execution approach. The transmission owner estimate includes the engineering, project management, and construction costs for the transmission assets on this project.

    a. One estimate has been provided for this scope.

        i. Transmission Owner Build (TO)

2. Engineered steel pole costs were determined based off typical wind and weight spans, line angles, and average structure heights for each voltage. These inputs were used to derive an estimated steel pole weight, which was used to develop the structure costs. This was determined for the high-level estimate projects for Dominion Generation Interconnection Projects.

3. Engineered 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. Since the proposed project is less than 5 miles from an existing substation, fiber will need to be installed for communication purposes. An additional 5k will be included on the general permitting cost due to the fiber installation.
5. Survey cost were determined based on substation proposed location, fiber installation, and impacts on existing line.

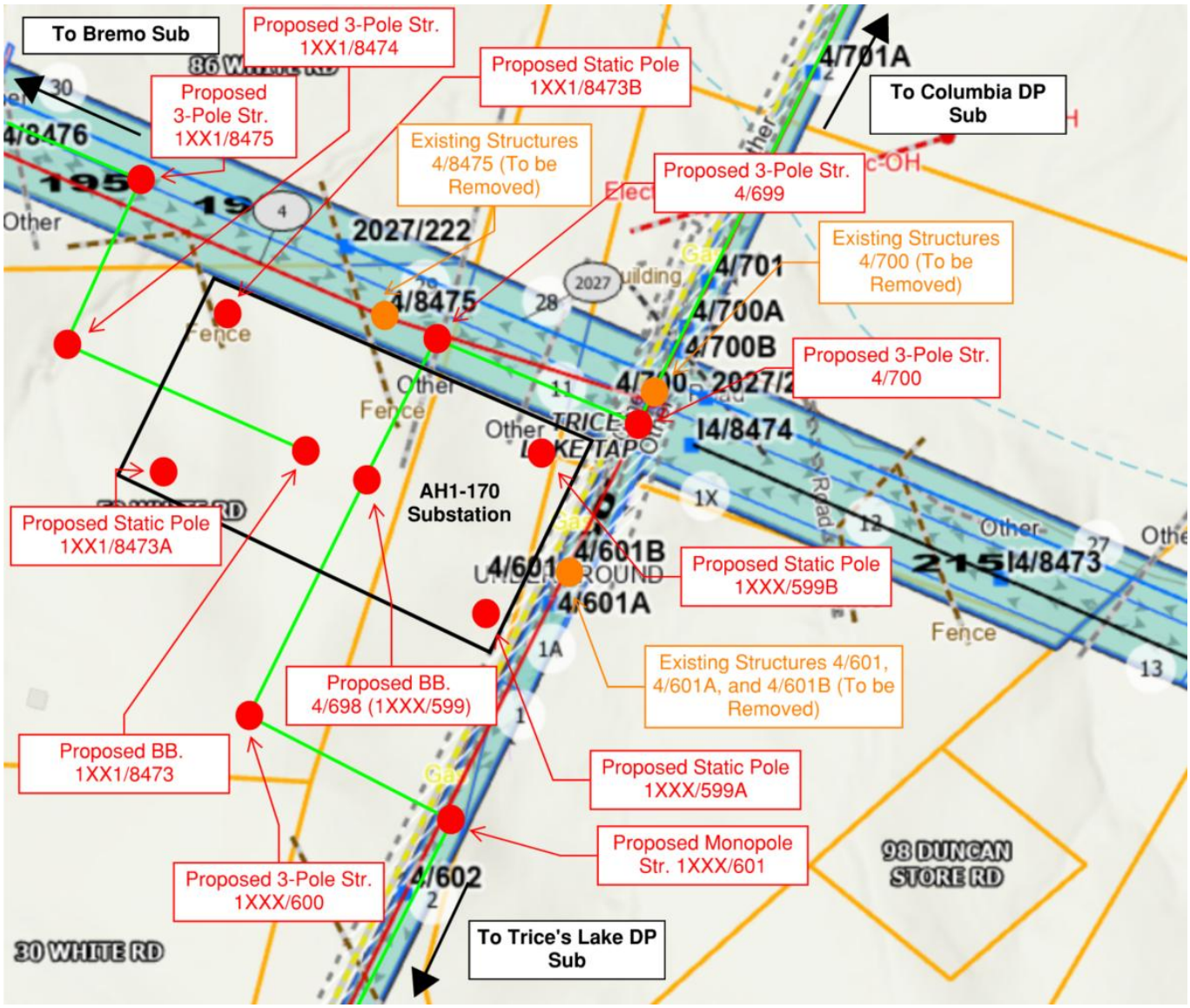
6. The estimate associated with this scope includes a $50,000 cost to account for the AC mitigation study for cathodic protection crossing the UG gas line that runs parallel to line 4.

7. The estimate includes a $25,000 cost to account for the labor and material cost associated with installing the underground fiber conduit.

8. It should be determined in detailed engineering if 115 kV over-insulated conductor assemblies are required for this project. For this estimate, over-insulated conductor assemblies were utilized.

9. Transition Cycle 2 – Phase 2 estimates utilize Dominion 2025 labor and material adjustment rates.

Figure 1 – Project Location



Attachment #5: Network Upgrade – Bremo Substation

Project Summary

Project AG2-151/AH1-170 provides for drawing work, islanding panel addition, relay resets, and field support necessary to change line 4 destination from Columbia to AG2-151/AH1-170 Trice's Lake Tap network upgrade. This project is the network upgrade for the AG2-151 and AH1-170 generation interconnection projects. The line number may or may not be changed. Consult the Construction One Line. This scope is a Remote End Network Upgrade for the AG2-151/AH1-170 Trice's Lake Tap Network upgrade. Also replace the existing line 4 relay protection with line differential protection utilizing fiber optics due to the shortening of the line and remove line 4 wave trap at Bremo Substation due to the powerline 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 new static pole to the control enclosure.

Purchase and Substation - Network Upgrade:

1. Remove - One (1), 115kV, 1200A wave trap
2. Two (2) runs of 2" conduits from backbone leg to the cable trough
3. Conduit tracer wires, 1/C #10, green
4. Foundations as required
5. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards.

Purchase and install relay material - Network Upgrade:

1. One (1), 1603 – 24" SEL-451 islanding control scheme panel
2. One (1), 1340 – 24" Dual SEL-411L CD/Fiber line panel
3. One (1), Panel retirement (Panel 9)

Attachment #6: Network Upgrade – James River Substation

Project Summary

Project AG2-151 and AH1-170 provides for drawing work, relay resets, and field support necessary to change line 4 destination from Bremo to AG2-151/AH1-170 Trice's Lake Tap point network upgrade. This scope is a Remote End Network Upgrade for the AG2-151/AH1-170 network upgrade project.