Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AG2-182

"Doubs-Bismark 500 kV"

Introduction

This Facilities 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 Facility 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. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a Solar Generating Facility located in, Fredrick County, Virginia with a designated PJM Project ID of AG2-182. The installed facilities will have a total Maximum Facility Output (MFO) of 200 MW with 133.3 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

AG2-182 will interconnect with the Dominion transmission system via a newly constructed 500 kV three-breaker ring substation, tapping the Doubs Substation – Bismark Substation 500 kV line, approximately 34.41 miles from Doubs Substation and 56.79 miles from Bismark Substation.

This project serves to cut in 500 kV line 583 into a new substation called AG2-182, which is to be located in Frederick County, VA. The line is to be cut-in between existing structures 583/296 and 583/297. Line 583 is being renumbered to 5XXX between AG2-182 substation and Doubs substation.

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

3. POINT OF CHANGE IN OWNERSHIP

The Point of Change in Ownership will be located between the Project Developer and this station will be the 115kV disconnect switch 4-hole pad inside the Dominion station by the common fence.

4. SCOPE OF PROJECT DEVELOPER INTERCONNECTION FACILITIES

Project Developer will design, build, own, operate and maintain the Project Developer Interconnection Facilities on Project Developer's side of the Point of Change in Ownership (PCO). This includes, but is not limited to:

- Circuit breakers and associated equipment located between the high side of the MPT(s) or GSU(s) and the Point of Change in Ownership
- Generator lead line from the Generating Facility to the Point of Change in Ownership
- Relay and protective equipment, telecommunications equipment, and Supervisory Control and Data Acquisition (SCADA) to comply with the TO's Applicable Technical Requirements and Standards

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AG2-182 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.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The Transmission Owner Interconnection Facilities include the portion of the interconnection switching station which is associated solely with the single feed to the generating facilities collector station. The equipment associated with the Transmission Owner Interconnection Facilities includes disconnect switch, conductors and connectors.

The proposed Transmission Owner Interconnection Facility scope is detailed in Attachment #3.

The proposed Option to Build (OTB) Transmission Owner Interconnection Facility scope is detailed in Attachment #4.

2. STAND ALONE NETWORK UPGRADES

The objective of this project is to build a 500kV three breaker ring bus to support the new solar farm built by Project Developer. The site is located along the existing 500kV, 583 line from Bismark Substation to Doubs Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 500kV feed from Project Developer's Collector Station for the new solar farm.

The proposed Stand Alone Network Upgrade scope is detailed in Attachment #3.

The proposed OTB Stand Alone Network Upgrade scope is detailed in Attachment #4.

3. NETWORK UPGRADES

Transmission Line Tie-in for new interconnection substation:

The 500kV transmission line will be cut and looped into the new interconnection substation.

The proposed Transmission Line Tie-in scope is shown in Attachment #5.

Upgrades to neighboring facilities:

Bismark Substation

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

Doubs Substation

Doubs Substation is owned by FirstEnergy. Remote end network upgrade work associated with Doubs is detailed in Attachment #7.

502 Junction – Woodside 500 KV / Gore – Stonewall 138 KV Corridor Scope

Upgrades to the FirstEnergy (Potomac Edison Co.) Gore – Stonewall 138 KV transmission line are detailed in Attachment #7.

4. OTHER SCOPE OF WORK

Other Scope includes metering accuracy CCVT's and metering accuracy CT's and associated equipment.

In the event the PD selects OTB, The proposed OTB scope is detailed in Attachment #4.

5. MILESTONE SCHEDULE FOR COMPLETION OF [TO] WORK

Facilities outlined in this report are estimated to take 96 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	86
Construction	76	96

The FirstEnergy scope of work outlined in this report is estimated to take 38 months to complete, from the time the Generation Interconnection Agreement is fully executed.

Description	**Start Month**	**Finish Month**
Preliminary Engineering	1	2
Siting, Permitting & Real Estate	5	31
Detailed Engineering	3	31
Equipment Delivery	33	33
Construction	34	37
Testing and Commissioning	37	38

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

Assumptions can be found in Attachments #3-6

7. REVENUE METERING REQUIREMENTS

All revenue metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AG2-182 GIA, and in PJM Manuals M01 and M14D. The details of applicable revenue metering requirements are given in the Dominion Energy Virginia – Electric Transmission Facility Interconnection Requirements (FIR) Rev 25.0 posted on PJM website.

The revenue metering will be installed on the Dominion side of the Point of Change in Ownership will be installed, owned and maintained by Dominion.

8. 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 Project Developer 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.

The Project Developer is responsible for the following expectations in the area Real Estate.

- Land and/or Permitting associated with the Generation Facility and the Generation Line to the Point of Change in Ownership (PCO) structure.

9. 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.

10. ENVIRONMENTAL AND PERMITTING

The Project Developer 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

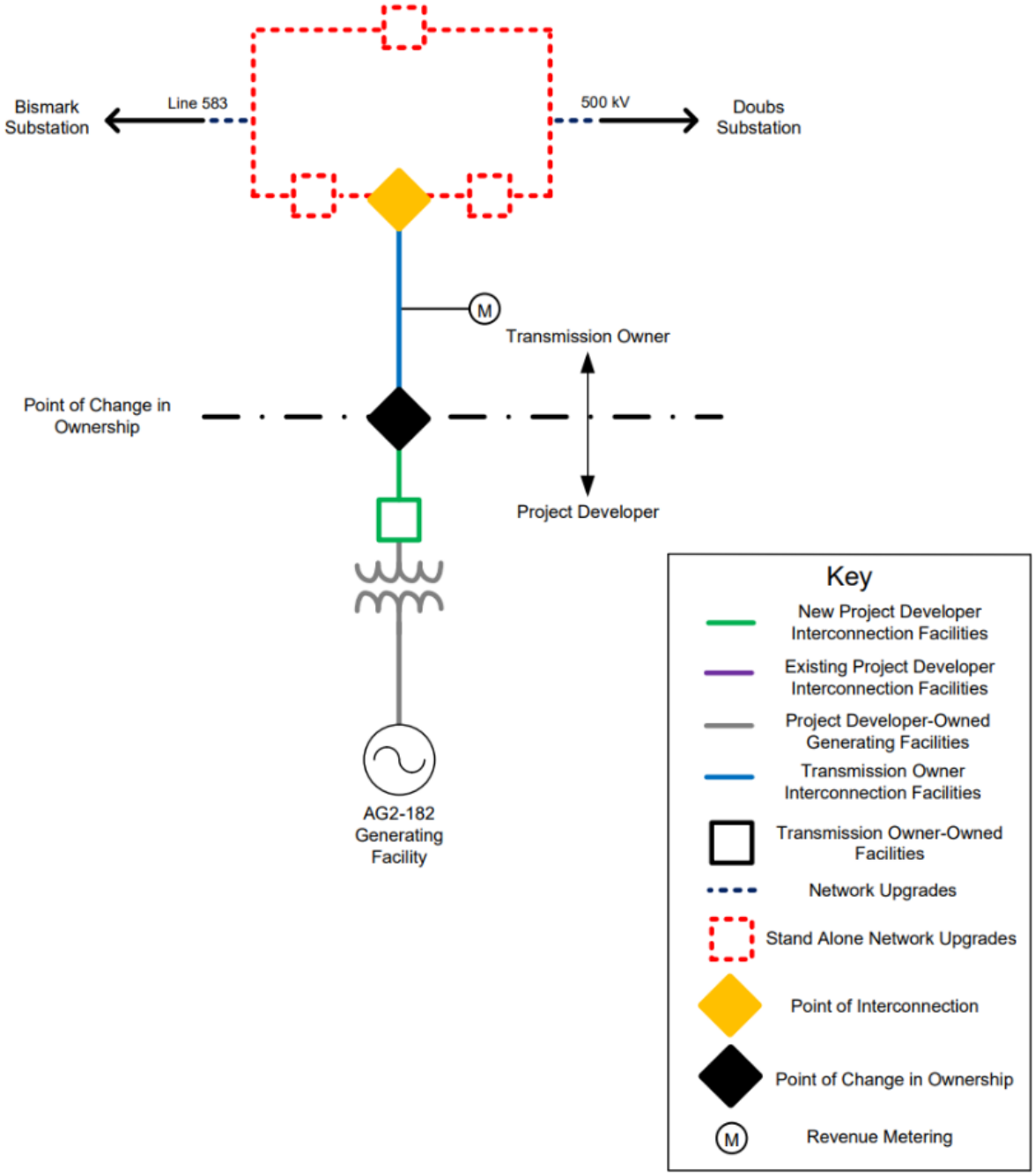
The Project Developer is responsible for the following expectations in the area Environmental and Permitting.

- Environmental and/or Permitting associated with the Generation Facility and the Generation Line to the Point of Change in Ownership (PCO) structure.

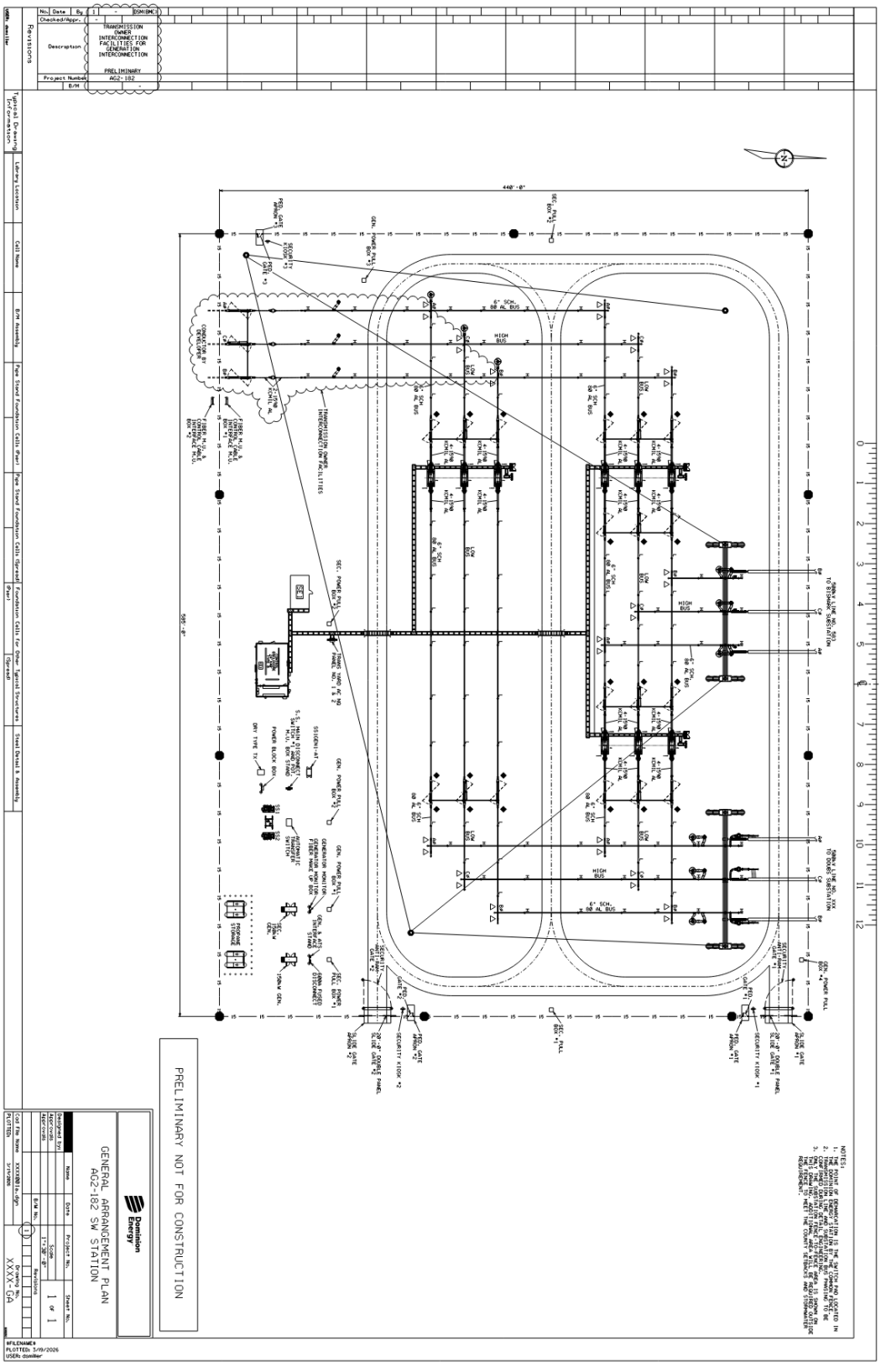
C. APPENDICES

Attachment #1:	Single line Diagram for the Physical Interconnection
Attachment #2:	Substation General Arrangement
Attachment #3:	Stand Alone Network Upgrade & Transmission Owner Interconnection Facility Scope
Attachment #4:	OTB Stand Alone Network Upgrade & OTB Transmission Owner Interconnection Facility Scope
Attachment #5:	Network Upgrade – Transmission Tie-in Scope
Attachment #6:	Network Upgrade – Bismark Substation
Attachment #7:	Network Upgrade – Doubs Substation (Owned by FirstEnergy)

Attachment #1: Single line Diagram for the Physical Interconnection



Attachment #2: Substation General Arrangement



Attachment #3: Stand Alone Network Upgrade & Transmission Owner Interconnection Facility Scope

Project Summary

Project number AG2-182 provides for the initial construction of a new 500kV three breaker ring switching station between transmission structures 583/296 and 583/297 in Frederick County, Virginia.

The objective of this project is to build a 500kV three breaker ring bus to support the new solar farm built by Project Developer. The site is located along Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion) existing 500kV, 583 line from Bismark Substation to Doubs Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 500kV feed from Project Developer's Collector Station for the new solar farm.

The Generating Facilities will share a common footprint and fence line with AG2-182 station. The Point of Change in Ownership between the Project Developer and this station will be the 500kV disconnect switch 4-hole pad inside the Dominion station by the common fence. The Project Developer will bring its conductor to the demarcation point. The bus structures, disconnect switch, and protections equipment will be Transmission Owner Interconnection Facilities. The Project Developer will provide the property and access to the switching station. The grounding systems for each station will be tied together. All station permitting, site preparation and grading activities will be performed by the Project Developer.

Transmission line engineering is to renumber the existing line segment between the new 500kV three breaker ring switching station and Doubs Substation. The existing line segment between the new 500kV three breaker ring switching station and Bismark Substation shall remain line 583.

Additional work to be required at Bismark Substation and Doubs Substation.

Other scope includes the metering accuracy CCVT's, metering accuracy CT's, and associated metering equipment.

Security and fence type – design level 1.

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 – Stand Alone Network Upgrade:

1. Approximate station fence line dimensions of 440’ x 585’. 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 2,050 linear ft of 5/8” chain link, 15 ft tall, perimeter fence around the station along with the security cameras and integrators as per design 1 fence standards
    a. Twelve (12), 20 ft tall super post
    b. Anti-dig barrier footing between the perimeter fence foundations.
    c. Foundations for fence posts, super posts, etc.
    d. Ground tail, miscellaneous grounding materials for fence posts, panel to panel connections, and security and communication boxes as per the current engineering standards
    e. Security integrations fence
3. Three (3), 500kV, 5000A, 63kAIC, SF-6 circuit breaker
4. Three (3), 500kV, 5000A, 3-phase double end break switch
5. Three (3), 500kV, relay accuracy CCVT
6. Six (6), 396kV, 318kV MCOV surge arrester (For Terminal)
7. Three (3), 396kV, 318 MCOV surge arrester (For Bus)
8. Three (2), 10kV, 8.4kV MCOV surge arrester
9. Two (2), SMD-20 fused disconnects with BCL fuse (to be verified during detail engineering)
10. Two (2), 167kVA, 13.2 - .12/.24kV transformer (to be verified during detail engineering)
11. One (1), dry type TX for security enclosure
12. One (1), 800A manual throwover switch
13. Three (3), 100A outdoor security AC NQ panel
14. One (1), 800A, 3-phase, outdoor utility distribution panel
15. Two (2), 150kW generator
16. Four (4), 1000-gallon liquid propane tank
17. Four (4), rosemount tank level monitor
18. Three (3) ATS (ratings to be verified during detail engineering)
19. Two (2), 500kV, heavy duty steel backbone (by Transmission)
20. Three (3), shield wire poles and five spans of shield wires (by Transmission)
21. One (1), 24' x 40' control enclosure
22. One (1), 14' x 24' security enclosure
23. One (1), 125 VDC, 400 Ah station battery and one 2-50 Amp chargers (size to be verified during detail engineering)
24. Approximately 872 ft of cable trough, with two (2) 20 ft road crossing section
25. One (1), 600A 1-phase outdoor security manual throwover switch (to be verified during detail engineering)
26. Eight (8), 38” x 38” x 42” precast concrete pull box
27. Station stone as required
28. Station lightning as required
29. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
30. Foundations as required including control house, equipment, and bus support stands
31. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Purchase and install relay material – Stand Alone 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. Three (3), 1515 - 500KV breaker panel (use with 1510)
4. Three (3), 4536 – 500KV breaker condition monitor
5. One (1), 1340 – 24” dual SEL-411L DCB/PLC line panel
6. One (1), 1340 - 24” dual SEL-411L CD/Fiber line panel
7. One (1), 4506 - 3-phase CCVT potential make-up box
8. Two (2), 4000 - station service potential make-up box
9. Two (2), 4018 - 500A station service AC distribution panel
10. Two (2), 4007 - 225A outdoor transmission yard AC NQOD
11. Two (2), 4019 - 225A 3-phase throw over switch
12. Two (2), 4016 - 600A PVT disconnect switch
13. One (1), 4042 – security utility ATS (level 1, 2)
14. One (1), 4042 – security generator ATS (level 1, 2)
15. One (1), 4153c - wall mount station battery monitor
16. One (1), 5618 - SEL-3555 communications panel
17. One (1), 1255 - station annunciator panel
18. One (1), 5021 - SEL-2411 RTU panel
19. One (1), 5609 - fiber optic management panel
20. Three (3), 4526_D – breaker with BCM fiber make-up box
21. One (1), 5202 - 26” APP 601 digital fault recorder
22. One (1), 5203 – traveling wave fault locator panel – TWS (to be verfied during detail engineering)
23. Eleven (11), 4040 – security fiber/power make-up box
24. One (1), 5603 - station network panel no. 1
25. One (1), 5603 - station network panel no. 2
26. One (1), 4051 - power block
27. One (1), 3102 – security enclosure alarm box
28. One (1), 4821 – generator and ATS interface box
29. Three (3), 4040 – 100A 2Ø outdoor security AC NQOD (Prov. By Sub Eng.)
30. Two (2), 4040 – 100A 2Ø indoor security AC NQOD (Prov. By Sub Eng.)
31. One (1), 4041 – Security enclosure 600A 2-phase I-line AC distribution panel (Provided w/ Enclosure).
32. One (1), 4526_G – generator monitor fiber make-up box
33. One (1), 4533 – security generator monitor
34. Two (2), 4800 generators
35. One (1), 5616 - station security panel
36. Two (2), 4018 - 225A station service AC distribution panel branch breaker
37. One (1), high voltage protection (HVP) box (provided by IT) (to be verified during detail engineering)
38. One (1), telephone interface box (to be verified during detail engineering)
39. One (1) 800A auto transfer switch (Provided by Sub Eng)
40. One (1), 800A disconnect switch

The Transmission Owner Interconnection Facilities include the portion of the interconnecting switching station which is associated solely with the single feed to the generating facilities collector station. The equipment associated with the Transmission Owner Interconnection Facilities includes disconnect switch, conductors and connectors.

Other Scope includes metering accuracy CCVT's and metering accuracy CT's.

Purchase and install substation material – Transmission Owner Interconnection Facilities Upgrade:

1. One (1), 500kV, 5000A, 3-phase double end break switch
2. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards

Purchase and install relay material – Transmission Owner Interconnection Facilities Upgrade:

1. One (1), 1340 - 24" dual SEL-411L CD/Fiber line panel
2. One (1), 1323 - 24" SEL-487E/735 PMU and PQ monitoring panel
3. Two (2), 4541 - control cable make-up box
4. Two (2), 4528A - generation fiber make-up box

Purchase and install metering material – Other:

1. Three (3), 500kV, metering accuracy CCVT
2. Three (3), 500kV, 500:5 metering accuracy CT
3. One (1), 1425 - 24" dual SEL-735 transmission and generator interconnect metering panel
4. One (1), 4524 - revenue metering CT make-up box
5. One (1), 4506 - 3-phase CCVT potential make-up box with metering (P4)

Attachment #4: OTB Stand Alone Network Upgrade & OTB Transmission Owner Interconnection Facility Scope

Project Summary

Project number AG2-182 provides for the initial construction of a new 500kV three breaker ring switching station between transmission structures 583/296 and 583/297 in Frederick County, Virginia. The Project Developer has selected 'Option to Build' as is their right to do so under the PJM Interconnection Service Agreement. By selecting this construction process method, the Project Developer shall secure all required real estate, obtain all necessary permits, perform site work including site preparation and grading, furnish equipment, construction personnel and ancillary materials as found in the facility study for construction of the switching station in compliance with Dominion Standards. Oversight by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion) will include, but is not limited to, project management, engineering, permitting, survey, real estate, and construction methods when on site.

All equipment procured by Project Developer will be reviewed and approved by Dominion engineering teams.

The details of the Project Developer and Dominion responsibilities and approval processes are described in the associated "Dominion Option to Build Execution Plan" document.

Project Description

Project number AG2-182 provides for the initial construction of a new 500kV three breaker ring switching station to support the new solar farm built by Project Developer. The site is located along Dominion's existing 500kV, 583 line from Bismark Substation to Doubs Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 500kV feed from Project Developer's Collector Station.

The Generating Facilities will share a common footprint and fence line with the AG2-182 station. The Point of Change in Ownership between the Project Developer and this station will be the 500kV disconnect switch 4-hole pad inside the Dominion station by the common fence. The grounding systems for each station will be tied together.

Dominion is to renumber the existing line segment between the new 500kV three breaker ring switching station and Doubs Substation. The existing line segment between the new 500kV three breaker ring switching station and Bismark Substation shall remain line 583.

Additional work to be required at Bismark Substation and Doubs Substation.

Security and fence type – design level 1.

Option to Build, Stand Alone Network Upgrade Physical Facilities & Oversight – Dominion:

1. All Physical Engineering related oversight and approvals of activities related to equipment procurement, design, construction, and energization of switching station
2. All Real Estate related oversight and approval of activities related to construction of switching station
3. All Permitting related oversight and approval of activities related to construction of switching station
4. All Survey related oversight and approval of activities related to construction of switching station
5. All Construction and Methods oversight and approval of activities related to construction and energization of switching station
6. All Project Management oversight activities related to construction and energization of switching station
7. Review and approve all riser conductor, connectors, spacers, and bolts related to connection of the switching station to the Bulk Electric Transmission System
8. Review and approve all material related to the integration of the security fence software package back to the Corporate Security Fusion Center

Option to Build, Stand Alone Network Upgrade Physical Facilities – Project Developer:

1. Approximate station fence line dimensions of 585’ x 440’. 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 2,050 linear ft of 5/8” chain link, 15 ft tall, perimeter fence around the station along with the security cameras and integrators as per design 1 fence standards
    a. Twelve (12), 20 ft tall super post
    b. Anti-dig barrier footing between the perimeter fence foundations.
    c. Foundations for fence posts, super posts, etc.
    d. Ground tail, miscellaneous grounding materials for fence posts, panel to panel connections, and security and communication boxes as per the current engineering standards
    e. Security integrations fence
3. Three (3), 500kV, 5000A, 63kAIC, SF-6 circuit breaker
4. Six (6), 500kV, 5000A, 3-phase double end break switch
5. Three (3), 500kV, relay accuracy CCVT
6. Six (6), 396kV, 318kV MCOV surge arrester (For Terminal)
7. Three (3), 396kV, 318 MCOV surge arrester (For Bus)
8. Two (2), 10kV, 8.4kV MCOV surge arrester
9. Two (2), SMD-20 fused disconnects with BCL fuse (to be verified during detail engineering)
10. Two (2), 167kVA, 13.2 - .12/.24kV transformer (to be verified during detail engineering)
11. One (1), dry type TX for security enclosure
12. One (1), 800A manual throwover switch

13. Three (3), 100A outdoor security AC NQ panel
14. One (1), 800A, 3-phase, outdoor utility distribution panel
15. Two (2), 150kW generator
16. Four (4), 1000-gallon liquid propane tank
17. Four (4), rosemount tank level monitor
18. Three (3) ATS (ratings to be verified during detail engineering)
19. Two (2), 500kV, heavy duty steel backbone (by Transmission)
20. Three (3), shield wire poles and five spans of shield wires (by Transmission)
21. One (1), 24' x 40' control enclosure
22. One (1), 14' x 24' security enclosure
23. One (1), 125 VDC, 400 Ah station battery and one 2-50 Amp charger (size to be verified during detail engineering)
24. Approximately 872 ft of cable trough, with two (2) 20 ft road crossing section
25. One (1), 600A 1-phase outdoor security manual throwover switch (to be verified during detail engineering)
26. Eight (8), 38” x 38” x 42” precast concrete pull box
27. Station stone as required
28. Station lightning as required
29. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
30. Foundations as required including control house, equipment, and bus support stands
31. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Option to Build, Stand Alone Network Upgrade Relay Protection Equipment – Dominion:

1. All Protection & Controls Engineering oversight and approval of activities related to equipment procurement, design, construction, and energization of switching station
2. All relay panel installation methods oversight and approval of activities related to construction and energization of switching station
3. All relay, communications, security settings related to the connection of the switching station to the Bulk Electric Transmission System
4. One (1), 5616 – station security panel
5. One (1), 5603 – station network panel no. 1
6. One (1), 5603 – station network panel no. 2
7. One (1), high voltage protection (HVP) box (Provided by IT) (to be verified during detail engineering)
8. One (1), telephone interface box (to be verified during detail engineering)

Option to Build, Stand Alone Network Upgrade Relay Protection Equipment – Project Developer:

1. Three (3), 1510 - 24” dual SEL-351-7 transmission breaker with reclosing panel
2. Three (3), 4510 - SEL-2411 breaker annunciator
3. Three (3) 1515 – 500kV breaker panel (use with 1510)

4. Three (3) 4536 – 500KV breaker condition monitor
5. One (1), 1340 - 24” dual SEL-411L DCB/PLC line panel
6. One (1), 1340 - 24” dual SEL-411L CD/Fiber line panel
7. One (1), 4506 - 3-phase CCVT potential make-up box
8. Two (2), 4000 - station service potential make-up box
9. Two (2), 4018 - 500A station service AC distribution panel
10. Two (2), 4007 - 225A outdoor transmission yard AC NQOD
11. Two (2), 4019 - 225A 3-phase throw over switch
12. Two (2), 4016 - 600A PVT disconnect switch
13. One (1), 4153c - wall mount station battery monitor
14. One (1), 4042 – security utility ATS (level 1,2)
15. One (1), 4042 – security generator ATS (level 1, 2)
16. One (1), 5618 - SEL-3555 communications panel
17. One (1), 1255 - station annunciator panel
18. One (1), 5021 - SEL-2411 RTU panel
19. One (1), 5609 - fiber optic management panel
20. Three (3), 4526_D – breaker with BCM fiber make-up box
21. One (1), 5202 - 26” APP 601 digital fault recorder
22. One (1), 5203 – traveling wave fault locator panel – TWS (to be verified during detail engineering)
23. Eleven (11), 4040 - security fiber/power make-up box
24. One (1), 4533 – security generator monitor
25. One (1), 4526_G-generator monitor fiber make-up box
26. Two (2), 4800 - generator
27. One (1), 4051 - power block
28. One (1), 3102 – security enclosure alarm box
29. One (1), 4821 – generator and ATS interface box
30. Three (3), 4040 – 100A 2Ø outdoor security AC NQOD (prov. By Sub Eng.)
31. Two (2), 4040 – 100A 2Ø indoor security AC NQOD (prov. By Sub Eng.)
32. One (1), 4041 – security enclosure 600A 2-phase I-Line AC distribution panel (Provided w/ Enclosure)
33. Two (2), 4018 - 225A station service AC distribution panel branch breaker
34. One (1), 800A auto transfer switch (Provided by Sub Eng)
35. One (1), 800A disconnect switch

Option to Build, Transmission Owner Interconnection Facilities; Physical Facilities & Oversight – Dominion:

1. All Physical Engineering related oversight and approvals of activities related to equipment procurement, design, construction, and energization of switching station
2. All Construction and Methods oversight and approval of activities related to construction and energization of switching station
3. All Project Management oversight activities related to construction and energization of switching station

Option to Build, Transmission Owner Interconnection Facilities; Physical Facilities – Project Developer:

1. One (1), 500kV, 5000A, 3-phase double end break switch
2. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards

Option to Build, Transmission Owner Interconnection Facilities Relay Protection Equipment – Dominion:

1. All Protection & Controls Engineering oversight and approval of activities related to equipment procurement, design, construction, and energization of switching station
2. All relay panel installation methods oversight and approval of activities related to construction and energization of switching station
3. All relay, communications, security settings related to the connection of the switching station to the Bulk Electric Transmission System

Option to Build, Transmission Owner Interconnection Facilities Relay Protection Equipment – Project Developer:

1. One (1), 1340 - 24” dual SEL-411L CD/Fiber line panel
2. One (1), 1323 - 24” SEL-487E/735 PMU and PQ monitoring panel
3. Two (2), 4541 - control cable make-up box
4. Two (2), 4528A - generation fiber make-up box

Option to Build, Other – Project Developer:

1. Three (3), 500kV, metering accuracy CCVT
2. Three (3), 500kV, 500:5 metering accuracy CT
3. One (1), 1425 - 24” dual SEL-735 transmission and generator interconnect metering panel
4. One (1), 4524 - revenue metering CT make-up box
5. One (1), 4506 - 3-phase CCVT potential make-up box with metering (P4)

Attachment #5: Network Upgrade - Transmission Tie-in Scope

Preliminary Scoping Summary

This project serves to cut in 500 kV line 583 into a new substation called AG2-182, which is to be located in Frederick County, VA. The line is to be cut-in between existing structures 583/296 and 583/297. Line 583 is being renumbered to 5XXX between AG2-182 substation and Doubs substation. See **Figure 1** for the project location.

The proposed structures to be installed are two (2) 500 kV single circuit steel double deadend 3-poles, two (2) 500 kV single circuit steel backbones, and three (3) steel static poles. The new conductor and shield wire to be used will be triple bundled (3) 1351.1 ACSS/TW (Type 13) "Martin" conductor, and two (2) DNO-10100 OPGW. 7#7 Alumoweld will be utilized for shielding within AG2-182 substation.

Length of Route	**0.21 miles**
Location of the subject line (County/State)	**Frederick County, VA**
Total Number of Permanent Structures	**7**
Total Number of Temporary Structures	**0**
CPCN/SCC Required?	**No**
New ROW Required?	**No**

This project will utilize current Dominion 500 kV standards. The conceptual estimate includes cost for the following:

Transmission Owner Build - Existing Facilities to be Removed

Wire: Mileage listed is per circuit.

Length (Miles)	Circuit	# if Bundled-Wire Type "Name"	Start-End
0.13	2	DNO-7122 OPGW	Proposed Str. 583/297 – Existing Str. 5XXX/297

Transmission Owner Build - Permanent Facilities to be Installed

Structures: See attached spreadsheet for heights and loading information. All structures will be galvanized steel.

Structure Type	Dwg Number	Str. Qty.
500 kV SC ENGR Steel DDE 3-Pole (Large Angle) Structure	15.242	2
500 kV SC Steel Backbone Structure	15.900	2
Steel Static Poles	9.008	3

Wire:

1. Mileage listed is per circuit
2. Conductor includes dampers and spacers. Static and Fiber includes dampers and splices.
    - Estimate includes approximately ten (10) fiber splices

Length (Miles)	Circuit	# if Bundled-Wire Type "Name"	Start-End
0.05	1	Triple Bundled (3) 1351.5 ACSS/TW Type 13 "MARTIN" Conductor	Proposed Str. 583/297 – Proposed BB 583/298
0.05	1	Triple Bundled (3) 1351.5 ACSS/TW Type 13 "MARTIN" Conductor	Proposed BB 5XXX/295 – Proposed Str. 5XXX/296
0.05	2	DNO-10100 OPGW	Proposed Str. 583/297 – Proposed BB 583/298
0.16	2	DNO-10100 OGPW	Proposed BB 5XXX/295 – Existing Str. 5XXX/297
0.35	1	7#7 Alumoweld Shield Wire	Between proposed static poles and backbones in AG2-182 substation

Transmission Owner Build - Existing Facilities to be Transferred or Modified

1. Cut and transfer the existing triple bundled (3) 1351 ACSR Dipper conductor for Line 583 from existing structure 583/296 onto proposed structure 583/297.

2. Cut and transfer the existing triple bundled (3) 1351 ACSR Dipper conductor for Line 5XXX from existing structure 5XXX/297 onto proposed structure 5XXX/296.
3. Cut and transfer the existing two (2) DNO-7122 OGPW for Line 583 from existing structure 583/296 onto proposed structure 583/297.
4. Cut and transfer the existing two (2) DNO-7122 OGPW for Line 5XXX from existing suspension attachments on structure 5XXX/297 to proposed deadend attachments on the same structure.
5. Install four (4) new OPGW deadend assemblies [Reference Drawing 96.060] on existing structure 5XXX/297. This will be used to convert the existing suspension to a deadend to allow for additional fiber to be added to the line.

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 existing structures 583/296 and 5XXX/297 can also 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. Specifically, it is assumed that the proposed deadends don't cause uplift issues on the adjacent structures and that converting the shield attachments on 5XXX/297 to deadends does not result in structure overstresses. If the assumption is incorrect, it could result in structure reinforcements or replacements being required.

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

4. The generalized structure heights for this project are 185/155/185 ft for proposed structures 583/297 and 5XXX/296. See below for justification on cut-in structure heights:

    a. The existing FirstEnergy 138 kV line is currently in detailed engineering design to be rebuilt and converted to a 500 kV -138 kV line (Project Black Oak-Woodside 500 kV / Gore – Stonewall 138 kV).

    b. This scope and estimate assume that FirstEnergy will be phase rolling from vertical to horizontal configuration near proposed structures 62P and 63P such that project AG2-182 substation cut-in structures can cross over. A preliminary .kmz was provided for structure heights and locations for the FirstEnergy project Black Oak-Woodside 500 kV / Gore – Stonewall 138 kV.

c. It is assumed that FirstEnergy structures 62P and 63P will be approximately 120 ft in height based off a preliminary .kmz and discussion with the detailed transmission engineering team. Additional items that contributed to the proposed structure heights for 583/297 and 5XXX/296 included a 30 ft minimum clearance between FirstEnergy's 500kV line and Dominions 500kV line as well as 25.5 ft from Dominion's 500kV line to the top of the pole shaft based off DEV standard structure drawing 15.242. FirstEnergy's design is subject to change, which could affect the scope and estimate of project AG2-182.

5. All deadend engineered steel structures outside the substation (Structures 583/297 & 5XXX/296) will be designed for full-construction deadend loading for construction conditions.

6. Project area code required loading include: NESC Heavy, 95 mph wind, ¾" Ice & 30 mph wind.

7. For detailed engineering, it is assumed LiDAR survey is required, including ROW file.

8. Crossing insulators will be used whenever crossing over substation fence, and other transmission lines.

9. An existing right of way width of 270 ft is assumed based on DEV MapViewer.

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

11. A substation general arrangement was provided by the conceptual substation engineering team. See **Figure 2** for the general arrangement used for this project.

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

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

14. The collector station will share a fence, and the developer switchyard will be located to the south.

15. This project scope assumes that it is independent from other projects in the Transition Cycle.

Estimate Notes/Assumptions

1. This scope and estimate for project AG2-182 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.

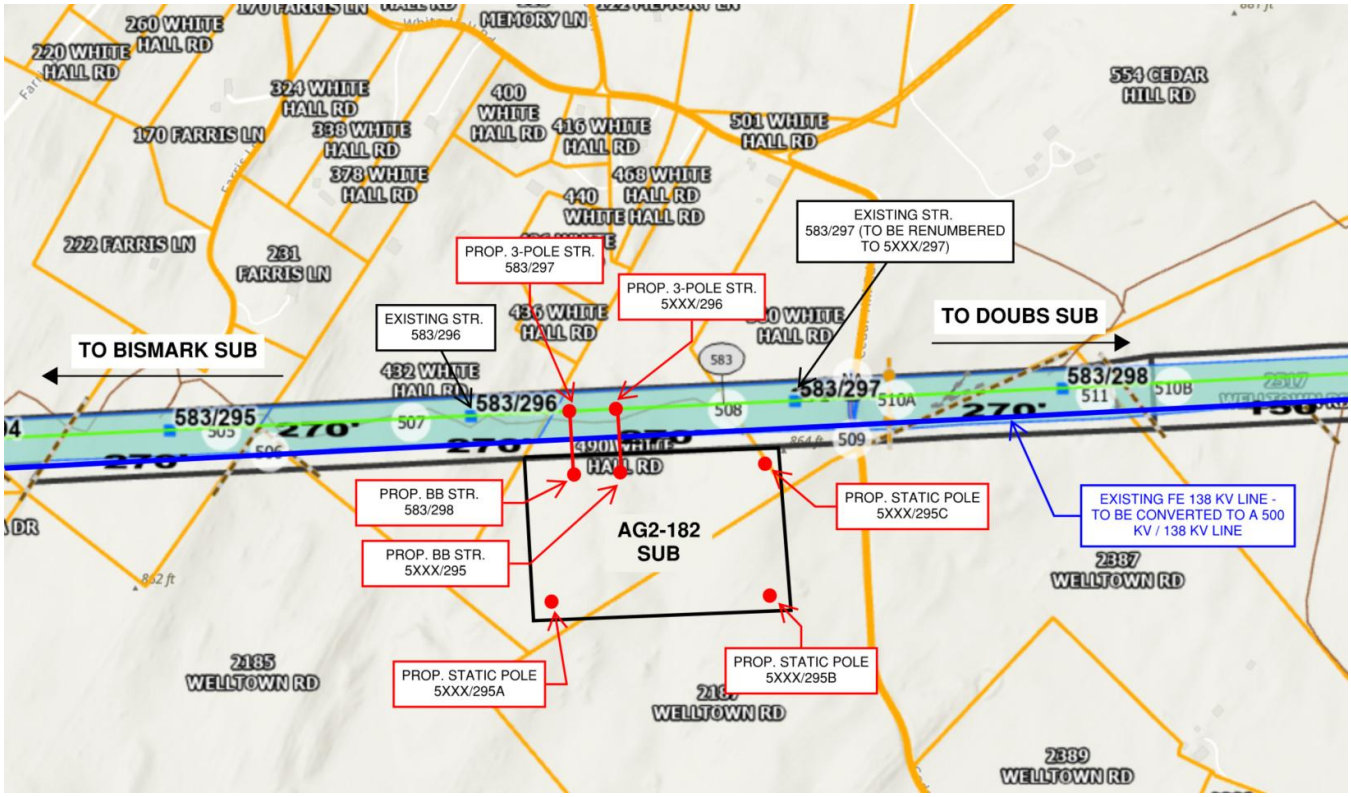
    a. Due to allocated amount of time, proposed structures 583/297 and 5XXX/296 engineered steel pole costs were derived based off the standard high-level estimate weights and the percentage height increase. The standard high-level estimate height for structure drawing 15.242 is 120/95/120 ft. The expected height for the proposed structures is 185/155/185 ft, which is approximately 50% taller than standard design for the high-level estimates. It was assumed that the engineered steel weight would be proportional to the increase in height.

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 Shenandoah Valley.

4. Survey costs were determined based on substation proposed location, fiber installation, and impacts on existing line.

5. Transition Cycle 2 - Phase 2 estimates utilize Dominion 2025 labor and material adjustment rates.

Figure 1 – Project Location



Attachment #6: Network Upgrade – Bismark Substation

Project Summary

Project AG2-182 provides for drawing work, relay resets, and field support necessary to change line 583 destination from Doubs Substation to AG2-182 Generator Interconnect. This project is the Remote End Network Upgrade for the AG2-182 Generator Interconnect project.

Purchase and install relay material:

1. One (1),1340 - Dual SEL-411L DCB/Fiber, CD/Fiber Line Panel 500kV w/ 2 Fiber Cables
2. One (1), retire Panel No. 4
3. One (1), retire Panel No. 8

Attachment #7: Network Upgrade – Doubs Substation (Owned by FirstEnergy)

Project Summary

Doubs Substation is owned by FirstEnergy. The following remote end Network Upgrade work associated with Doubs was identified by FirstEnergy.

PE Scope of Work

502 Junction – Woodside 500 KV / Gore – Stonewall 138 KV Corridor Scope:

1. Description:
    a. Replace structures, transfer and install new conductors and fiber to accommodate a new generator Interconnection loop line crossing at approximately 39.283, -78.137 (Lat/Long).
2. Install
    a. (2) double circuit, steel, H-frame, dead-end structures on concrete foundations
    b. (1) double circuit, steel, H-frame, tangent structure on a concrete foundation\
    c. (3) double circuit, steel, monopole, tangent structures on concrete foundations
    d. 500kV circuit: 0.3 miles of triple-bundled conductor 1113 kcmil 54/19 ACSS shielded by (1) OPGW
    e. 138kV circuit: 0.3 miles of conductor 795 kcmil 26/7 ACSS shielded by (1) OPGW
    f. Transfer existing conductor and OPGW to new Strs. 59 through 62 and 63 to 64.
3. Removals
    a. (6) double circuit, steel, monopole, tangent structures on concrete foundations
    b. 0.3 miles of triple-bundled conductor 1113 kcmil 54/19 ACSS shielded by (1) OPGW
    c. 0.3 miles of conductor 795 kcmil 26/7 ACSS shielded by (1) OPGW
4. Scope of Work Assumptions:
    a. Full Application will be required.
    b. Assume minimal social and ecological impacts.
    c. Assume no local opposition to the project.
    d. The location of interconnection substation assumed.
    e. Ground survey will be required for design and for as-built.
    f. Assumed LiDAR was gathered at the time of as-built for the Junction - Woodside 500/138kV rebuild project.
5. Ancillary Scope of Work

a. Project Management
    i. Provide project management, coordination, administration, scheduling, material management and project development if required.
b. Access Road
    i. Access roads will be required, terrain is flat, approximately 1.6 miles.
c. Forestry
    i. Minor clearing/grubbing may be needed where the (2) monpole structures are being exchanged for the (2) horizontal structures to facilitate the Dominion line crossing and ROW expansion.
d. Information Technology
    i. Install/Test 0.25 miles of new 96F/SM ADSS cable from Structure 62 to Structure 63 on the Gore-Stonewall 138kV transmission line. The new ADSS line will tie into the existing “Gore to Stonewall (138kV)”
    ii. Install/Test 0.25 miles of new 96F/SM ADSS cable from Structure 62 to Structure 63 on the Gore-Stonewall 500kV transmission line. The new ADSS line will tie into the existing “502 Junction to Woodside (500kV)”
e. Testing and Commissioning
    i. Testing and commissioning services as required for revised relay settings.

Doubs Substation Protection Upgrade:

1. General Description of Work
    a. Upgrade relay equipment at Doubs substation
2. Relay & Control Scope of Work
    a. Replace the existing line relays connecting to Bismark station with Two (2) SEL-411L relays for primary and backup line protection over dedicated fiber.
    b. Additional auxiliaries as needed to support the line protection.
3. Scope of Work Assumptions:
    a. Assumes new Relay Panel for #420 for the (2) new SEL-411L's. Remove old relay panel #420 and old relays/auxillaries.
    b. Assumes reuse of conduit and conductors coming to Relay Panel #420.
    c. SEL-451 not needed and can be removed from standard SAGE panel
4. Ancillary Scope of Work
    a. Project Management
        i. Provide project management, coordination, administration, scheduling, material management and project development if required.
    b. Information Technology

        i. Integrate new relays to FE system and points list.

c. Testing and Commissioning
        i. Testing and commissioning services as required.