Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AG1-154

Ladysmith CT 230 kV

December 2024

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff Part VII, and, if applicable, 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 (VEPCO or Dominion).

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a Storage Generating Facility located in Caroline, VA with a designated PJM Project ID of AG1-154. The installed facilities will have a total Maximum Facility Output (MFO) of 50 MW with 20 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

AG1-154 is a new service request project that will interconnect with the Dominion transmission system via a direct connection into Ladysmith CT 230 kV substation by adding (3) additional breakers.

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 the 230kV disconnect switch 4-hole pad on the transmission line structure outside Ladysmith CT station 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 AG1-154 project to the Dominion transmission system. These facilities shall be designed according to Dominion Applicable Technical Requirements and Standards. Once built, Dominion will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The Transmission Owner Interconnection Facilities will include, but not be limited to, the following:

A 230 kV backbone structure and foundation outside the fence of the Interconnection Substation, to terminate the Project Developer's generator lead line.

Line conductor from the backbone structure to the bus position in the switchyard of the interconnection substation. The new conductor and OPGW to be used will be twin bundled (2) 768.2 ACSS/TW/HS (20/7) "Maumee" conductor and two (2) DNO-11410 OPGW.

Purchase and install substation material – Transmission Owner Interconnection Facilities:

1. Three (3), 230kV, metering accuracy CCVT
2. Three (3), 230kV, 500:5 metering accuracy CT
3. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards

Purchase and install relay material – Transmission Owner Interconnection Facilities:

1. One (1), 1340 – 24" dual SEL-411L CD/Fiber line panel
2. One (1), 1425 – 24" dual SEL-735 transmission and generator interconnect metering panel
3. One (1), 4524 – revenue metering CT make-up box
4. One (1), 4506 – 3-phase CCVT potential make-up box with metering (P4)
5. One (1), 1323 – 24" SEL-487E/735 PMU and PQ monitoring panel - (Install 735 PQ Relay)

Permanent Facilities to be Installed – Transmission Owner Interconnection Facilities:

1. Install one (1) 230kV single circuit heavy duty backbone structure with switch attachment on foundations as follows:
    a. Structure 2XX1/2
2. Install approximately 0.09 miles of 3-phase twin bundled (2) 768.2 ACSS/TW/HS (20/7) "Maumee" conductor for Line 2XX1 from proposed backbone structure 2XX1/1 (256/72) to proposed Point of Change of Ownership backbone structure 2XX1/2.
3. Install approximately 0.09 miles of two (2) DNO-11410 OPGW from proposed backbone structure 2XX1/1 (256/72) to proposed Point of Change of Ownership backbone structure 2XX1/2.
    a. This includes the installation of five (5) OPGW splices as follows:
        i. Two (2) on proposed backbone structure 2XX1/2.
        ii. Three (3) on proposed backbone structure 256/72 (2XX1/1).
4. Install one (1) 4000A vertically mounted switch on proposed Point of Change of Ownership backbone structure 2XX1/2.

2. STAND ALONE NETWORK UPGRADES

Dominion's Technical Requirements for Generation Interconnect Substation (EP_REF_2200-23-00) prevents this project from having the option to build for the Stand Alone Network Upgrades.

3. NETWORK UPGRADES

The Network Upgrades will include, but not be limited to, the following:

Transmission Line Tie-in for new interconnection substation:

This project serves to construct one (1) new 230kV developer tie line between Ladysmith CT and a new point of change in ownership structure located outside of the substation, which is to be located in Caroline County, VA. This project also consists of rearranging the connection of existing 230kV line 256 into Ladysmith CT to allow for the connection of the new developer tie line.

The proposed structure to be installed within the substation is one (1) 230kV single circuit heavy duty backbone structure. 7#7 Alumoweld shield wire will also be installed inside of the substation.

Existing Facilities to be Removed:

1. Remove one (1) existing 230kV single circuit steel monopole structure as follows:
    a. Structure 256/72
2. Remove approximately 0.05 miles of twin bundled (2) 795 ACSR (26/7) conductor from existing backbone structure 256/71 to existing structure 256/72.
3. Remove approximately 0.05 miles of one (1) 3#6 Alumoweld shield wire from existing backbone structure 256/71 to existing structure 256/72.
4. Remove approximately 0.05 miles of one (1) 45/45MM OPGW from existing backbone structure 256/71 to existing structure 256/72.

Modification to Existing Facilities:

1. Cut and transfer the existing twin bundled (2) 795 ACSR (26/7) conductor for Line 256 in the span between existing structure 256/72 and existing structure 256/73 to the ahead side of proposed backbone structure 256/72 (2XX1/1).
2. Cut and transfer the existing one (1) 45/45MM OPGW for Line 256 in the span between existing structure 256/72 and existing structure 256/73 to the ahead side of proposed backbone structure 256/72 (2XX1/1) and train the wire down the pole shaft to be used with a splice.

Permanent Facilities to be Installed:

1. Install one (1) 230kV single circuit heavy duty backbone structures with switch attachment on foundations as follows:
    a. Structures 2XX1/1 (256/72)
2. Install approximately 0.06 miles of one (1) 7#7 Alumoweld shield wire from proposed backbone structure 256/72 (2XX1/1) to existing structure 256/73.

Expanding existing TO substation:

Ladysmith CT 230 kV substation will be expanded/upgraded to interconnect AG1-154 with the Dominion transmission system.

The objective of this project is to add one new line position and three new 230kV breakers installed at Ladysmith CT Substation to support the new Battery Energy Storage System (BESS) built by

Project Developer. The existing 230kV Ladysmith CT Line # 256 will need to be relocated for the addition of this interconnect. Additionally, a 10' expansion on the control enclosure will be required to accommodate this additional infrastructure.

Substation design and relay protection are based on Dominion's Facility Interconnection Requirements, NERC Compliance Procedure FAC-001 (version 23), that is posted on PJM's website. This standard meets or exceeds the PJM Transmission and Substation Design Subcommittee Technical Requirements and the PJM Protection Standards (PJM Manual 7).

The scope of work includes the following:

Purchase and Install Substation Material - Network Upgrade:

1. Three (3), 230kV, 4000A, 63kAIC, SF-6 circuit breaker
2. Six (6), 230kV, 4000A, 3-phase double end break switch
3. Four (4), 230kV, relay accuracy CCVTs
4. One (1), 230kV, 4000A Wave Trap
5. One (1), line tuner
6. Six (6) , 180kV, 144kV MCOV surge arresters
7. One (1), 10' x 20' control enclosure expansion
8. One (1) , 125 VDC, 400 Ah station battery and two (2) 50 Amp chargers (size to be verified during detail engineering)
9. Approximately 228 ft of cable trough with a 20 ft road crossing section
10. Station stone as required
11. Station lighting as required
12. Steel structures as required, including switch stands, bus supports, and CCVT supports
13. Foundations as required, including equipment and bus support stands
14. Conductors, connectors, conduits, control cables, and grounding materials as per engineering standards

Remove Substation Material – Network Upgrade:

1. One (1), 125 VDC, 400 Ah station battery
2. Three (3), 230kV, relay accuracy CCVTs
3. One (1), 230kV, 3000A Wave Trap
4. One (1), line tuner
5. Three (3), 180kV, 144kV MCOV surge arresters

Purchase and Install Relay Protection Equipment - Network Upgrade:

1. One (1), 1110 – 24" dual SEL-587Z/351A transmission bus panel
2. One (1), 4200_W1 – Transmission Bus CT MU Box
3. One (1), 4507 – 1-phase CCVT make-up box
4. Three (3), 1510 – 24" dual SEL-351-7 transmission breaker with reclosing panel
5. Three (3), 4510 – SEL-2411 breaker annunciator
6. Three (3), 4526_A – circuit breaker fiber optic make-up box
7. One (1), 1340 – 24" dual SEL-411L DCB/PLC line panel
8. One (1), 4506 – 3-phase CCVT make-up box
9. One (1), panel retirement (Panel 4)

10. One (1), 1603 – 24” SEL-451 islanding control scheme panel
11. One (1), UPLC II transfer trip TX/RX set

Upgrades to neighboring facilities:

Additional work to be required at Four Rivers Substation, Fredericksburg Substation, Ladysmith Substation and New Post Substation.

Four Rivers Substation

Project AG1-154 provides for drawing work, islanding equipment addition, relay resets, and field support necessary at Four Rivers Substation.

Purchase and install relay material:

1. One (1), UPLC II transfer trip TX/RX set

Fredericksburg Substation

Project AG1-154 provides for drawing work, islanding panel addition, relay resets, and field support necessary at Fredericksburg Substation.

Purchase and install relay material:

2. One (1), 1603 – 24” SEL-451 islanding control scheme panel

Ladysmith Substation

Project AG1-154 provides for drawing work, islanding panel addition, relay resets, and field support necessary at Ladysmith Substation.

Purchase and install relay material:

1. One (1), 1603 – 24” SEL-451 islanding control scheme panel

New Post Substation

Project AG1-154 provides for drawing work, islanding panel addition, relay resets, and field support necessary at New Post Substation.

Purchase and install relay material:

1. One (1), 1603 – 24” SEL-451 islanding control scheme panel

4. OTHER SCOPE OF WORK

The Project Developer will supply and own metering equipment that will provide instantaneous net MW and MVar per unit values in accordance with PJM Manuals M-01 and M-14D, and Sections 8.1 through 8.5 of Appendix 2 to the GIA.

5. MILESTONE SCHEDULE FOR COMPLETION OF TO WORK

Facilities outlined in this report are estimated to take 46 months to construct, from the time the Generator 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	8
Permitting	3	38
Construction	36	46

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

General Assumptions:

1. The estimated procurement lead time for breakers is based on current Dominion pre-ordered breaker production slots. These production slots will be assigned after the agreement is executed.
2. The preliminary construction schedule is dependent on outage availability.
3. The Point of Change of Ownership structure will be located outside of Ladysmith CT Substation.

Conceptual Design Notes:

1. 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.
2. The current scope and estimate assume a new battery charger and increases battery capacity with the control house expansion. Once the AC/DC study information is available and it is prudent to change the design the Dominion team should be informed to adjust the project estimate at the earliest possible opportunity.
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. Survey costs were determined based on substation proposed location, fiber installation, and impacts on existing line.
5. The conceptual estimate assumes that a laydown yard is required for this project.

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 AG1-154 GIA, and in PJM Manuals M01 and M14D. The details of applicable revenue metering requirements are given in section 4.1.6 Metering and Telecommunications of Dominion's Facility Interconnection Connection Requirement NERC Standard FAC-001 posted on PJM website.

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

a. Hourly compensated MWh received from the Generating Facility to the TO;
b. Hourly compensated MVARh received from the Generating Facility to the TO;
c. Hourly compensated MWh delivered from the TO to the Generating Facility; and
d. Hourly compensated MVARh delivered from the TO to the Generating Facility.

The Project Developer will access revenue meter via wireless transceivers or fiber cabling to meter with RS-485 or Ethernet communication port for dial-up reads. Project Developer must provide revenue and real time data to PJM from Project Developer Market Operations Center per "PJM Telemetry Data Exchange Summary" document available at PJM.com.

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, NERC Compliance Procedure FAC-001 (version 23), that is 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.

9. ENVIRONMENTAL AND PERMITING

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

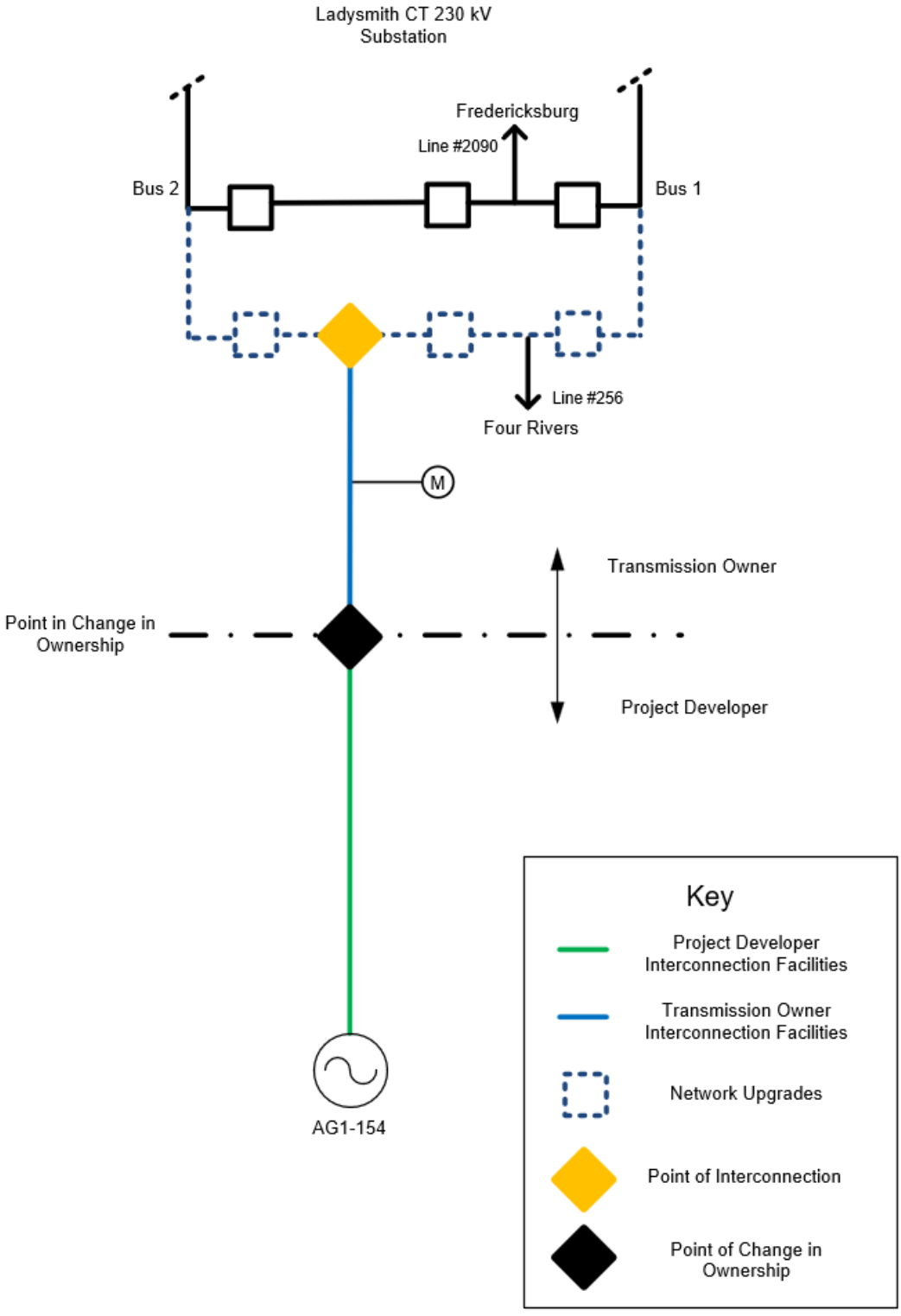
- Dominion will require a stormwater easement for substation specific stormwater design BMP's to allow access to and use of the facilities.

    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

C. APPENDICES

Attachment #1: Single line Diagram for the Physical Interconnection



Attachment #2: Substation General Arrangement