Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Positions AD1-087 & AD2-202

Clover-Sedge Hill 230KV
56.5 MW Capacity / 83 MW Energy

December, 2021

General

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff §207, as well as the Facilities Study Agreement between Foxhound Solar, LLC, the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Point of Interconnection

AD1-087/AD2-202 will interconnect with the ITO transmission system via a new three-breaker ring bus switching station that connects on the Clover-Sedge Hill 230kV line #2068. The interconnection facilities being constructed under the AD1-087 project are sufficient to support the AD2-202 project.

Cost Summary

The AD1-087/AD2-202 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$553,814
Direct Connection Network Upgrades	$6,920,803
Non Direct Connection Network Upgrades	$1,438,453
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$8,913,070**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AD1-087 is a request to interconnect a 64.2MW new solar generating facility to be located in Halifax County, Virginia. AD1-087 will interconnect with the ITO transmission system via a new three-breaker ring bus switching station that connects on the Clover – Sedge Hill 230kv line #2068. AD2-202 is an 18.8 MW uprate to AD1-087.

Attachment Facility and Network Upgrade construction is estimated to be 14-24 months.

2. Amendments to the System Impact Study data or System Impact Study Results

None

3. Interconnection Customer's Milestone Schedule

- Plan to break ground December 31, 2022
- Permits – state level Permit By Rule and county level final site plan approval complete December 31, 2022
- Substantial site work completed June 1, 2023
- Delivery of major electrical equipment June 1, 2023
- Back Feed Power June 1, 2023
- Commercial Operation December 31, 2023

4. Scope of Customer's Work

Generator Interconnection Request AD1-087 is for 64.2 MW Maximum Facility Output (MFO) solar generation plant. AD2-202 is an 18.8 MW uprate to AD1-087 for a total of 83MW between the two projects.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AD1-087/AD2-202 (Black Walnut Substation) three-breaker ring bus switching station adjacent to the #2068 line between the existing Clover-Sedge Hill substations. The site is located along Dominion Energy's existing 230 kV, 2068 Line from Clover substation to Sedge Hill substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 230 kV feed from Foxhound Solar, LLC Collector Station for the new 83 MW Solar Farm.

The new 230kV Three Breaker Ring Substation will share a common foot print and fence line with Foxhound Solar, LLC's Collector Station. The demarcation point between the two stations will be the 230kV Breaker Disconnect Switch 4-hole pad in the Foxhound Solar, LLC's Collector Station by the common fence. Dominion Energy will bring its bus to the demarcation point. The bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, protection and metering equipment will be Attachment Facilities. The grounding systems for each station will be tied together.

Due to the short line segment between the Three Breaker Ring Substation and Clover Power Station (approximately 1100'), a Fiber Optic Cable will be required between the 2 substations for line protection.

Detail Engineer to inquire if pre-ordered material for Solar Projects is available, otherwise follow current Long Lead Time Material Ordering process.

The existing line segment between the new Three Breaker Ring Substation and Clover Substation will be renumbered. The existing line segment between the new Three Breaker Ring Substation and Sedge Hill Substation shall remain Line 2068.

Additional work will be completed at the Sedge Hill and Clover 230 kV stations.

6. Total Costs of Transmission Owner Facilities included in Facilities Study

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Attachment Facilities					
Attachment Facilities	$285,388	$196,719	$49,429	$22,278	$553,814
Total Attachment Facilities Cost	$285,388	$196,719	$49,429	$22,278	$553,814
New Switching Station (n6134)	$2,944,511	$3,138,043	$468,132	$370,117	$6,920,803
Transmission Line #2068 (n6135)	$743,663	$326,088	$132,669	$76,467	$1,278,887
Total Remote Changes (n6136)	$104,015	$30,713	$20,292	$4,546	$159,566
Total Network Upgrades	$3,792,189	$3,494,844	$621,093	$451,130	$8,359,256
Total Project Costs	$4,077,577	$3,691,563	$670,522	$473,408	$8,913,070

7. Summary of Milestone Schedules for Completion of Work Included in Facilities Study:

Facilities are estimated to take 14-24 months from ISA execution and is based on the ability to obtain outages to construct and test the proposed facilities.

Proposed Schedule

- Detailed design: 6-12 months
- Permitting: 6-12 months (Timeline runs concurrent with design)
- Construction 8-12 months

ITO requires the site to be fully graded and permitted site so they can start construction by December 31, 2022.

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

The Attachment 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 Attachment Facilities include the metering accuracy CCVT's, metering accuracy CT's, disconnect switch, conductors and connectors.

Purchase and install substation material:

1. One (1), 230kV, 3000A, 3-Phase Center Break Gang Operated Switch.
2. Three (3), 230kV, Metering Accuracy CCVT's.
3. Three (3), 230kV, Metering Accuracy CT's.
4. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards.

Purchase and install relay material:

1. One (1), 1109 – 28" Dual SEL-587Z Transmission Bus Panel
2. One (1), 4200 – Bus Differential C.T. M.U. Box
3. One (1), 1425 – 28" Dual SEL-735 Transmission & Generator Interconnect Metering Pnl.
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4506 – CCVT Potential M.U. Box
6. One (1), 1323 – 28" SEL-487E/735 PMU & PQ Monitoring Panel
7. Two (2), 4541 - Control Cable M.U. Box

2. Transmission Line – Upgrades

PJM Network Upgrade #n6135 – Connecting line #2068 to a new 230kV switching station

This project connects line number 2068 to a new 230kV switching station located on the line number 2068 right-of-way between structure number 2068/381 and 2068/382. The estimate includes the cost to replace structure number 2068/381 if necessary.

The project work summary is described below:

REQUIRED WORK:

1. Install one 230kV single circuit heavy-duty steel backbone structure with foundations in the proposed switching station along the existing transmission structure centerline.
2. Transfer the existing 2-636 ACSR conductor and 3#6 alumoweld shield wire to the proposed backbone. This will include the installation of dampers and two sets of 3-phase tee connectors at the proposed backbone structure for the substation installed risers.
3. Remove approximately 0.16 miles (two spans) of 3#6 alumoweld shield wire between the proposed backbone and the backbone located inside the Clover switching station (2068/380).

4. Install approximately 0.16 miles (two spans) of one OPGW between the proposed backbone and the backbone located inside the Clover switching station (2068/380). This will include the installation of dampers, deadend clamps, and splicing.
5. Install two shield wire poles with foundations inside the proposed switching station.
6. Install three spans of 7#7 alumoweld shield wire between the backbone and shield wire poles. This will include the installation of dampers.
7. Renumber line number 2068 between Black Walnut and Sedge Hill. This will include 139 structures and one backbone at Sedge Hill.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6134 - Build a three breaker AD1-087/AD2-202 230 kV switching station.

The facilities identified provides for the initial construction of a new 230 kV Three Breaker Ring Substation at Transmission Structure 2068/382.

The objective of this project is to build a 230kV, 3-Breaker Ring Bus to support the new 48.3MW Solar Farm built by Foxhound Solar, LLC. The site is located along Dominion Energy's existing 230kV, 2068 Line from Sedge Hill Substation to Clover Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 230kV feed from Foxhound Solar LLC's Collector Station for the new 48.3MW Solar Farm.

The new 230kV Three Breaker Ring Substation will share a common footprint and fence line with Foxhound Solar, LLC's Collector Station. The demarcation point between the two stations will be the 230kV Breaker Disconnect Switch 4-hole pad in the Foxhound Solar, LLC's Collector Station by the common fence. Dominion Energy will bring its bus to the demarcation point. The bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, protection and metering equipment will be Attachment Facilities. The grounding systems for each station will be tied together.

Due to the short line segment between the Three Breaker Ring Substation and Clover Power Station (approximately 1100'), a Fiber Optic Cable will be required between the 2 substations for line protection.

The work required is as follows:

Purchase and install substation material – Direct Network Upgrade:

1. Approximately 310' X 245' site preparation and grading as required for installation of the switching station (by the developer)
2. Approximately 1150 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. Full substation ground grid as per engineering standards
4. Three (3) 230 kV, 3000A, 50 kA SF6 Circuit Breakers
5. Six (6) 230 kV, 3000A, 3-phase Center Break Gang Operated Switches
6. Nine (9) 180 kV, Station Class Arresters
7. Six (6) 230 kV CCVTs, Relay Accuracy

8. One (1), 230 kV, 3000 Amps Wave Trap and Line Tuner
9. One (1) 24’ X 40’ Control Enclosure
10. One (1) 125 VDC, 200 Ah Station Battery and 50 Amp Charger (size to be verified during detail engineering)
11. Approximately 240 FT of Cable Trough, with a 20 FT road crossing section
12. Four (4) 100 KVA Power Potential Transformers for station service
13. Oil Containment system for the 230 kV PVTs.
14. Two (2) 230 kV, 3000A, 2-phase Center Break Gang Operated Switches
15. Two (2), 2” conduits from the substation backbone to the cable trough along with tracer wire
16. Fence as required (Security Design Level 4).
17. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
18. Foundations as required including control house, equipment and bus support stands
19. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Purchase and install relay material – Direct Network Upgrade:

1. Three (3), 1510 – 28” Dual SEL-351-7 Transmission Breaker w/ Reclosing Panel
2. Three (3), 4510 - SEL-2411 Breaker Annunciator
3. One (1), 1320 – 28” Dual SEL-421-5 DCB Line Panel
4. One (1), 1809 – 28” Dual SEL-311L Line Diff. w/ Reclosing Panel
5. Two (2), 4506 – 3 Phase CCVT Potential M.U. Box
6. One (1), 1603 – 28” SEL-451 Islanding Control Scheme Panel
7. Two (2), 4000 – Station Service Potential M.U. Box
8. Two (2), 4018 – 500A Station Service AC Distribution Panel
9. Two (2), 4007 – 225A Outdoor Transmission Yard AC NQOD
10. Two (2), 4019 – 225A Three Phase Throwover Switch
11. Two (2), 4016 – 600 A Disconnect Switch Fused @ 500A
12. One (1), 4153 – Wall Mount Station Battery Monitor
13. One (1), 5612 - SEL-3530 Data Concentrator Panel
14. One (1), 1255 – Station Annunciator Panel
15. One (1), 5021 – SEL-2411 RTU Panel
16. One (1), 5609 – Fiber Optic Management Panel
17. Three (3), 4526_A – Circuit Breaker Fiber Optic M.U. Box
18. One (1), 5202 – 26” APP 601 Digital Fault Recorder
19. One (1), 5603 – Station Network Panel 1
20. One (1), 5603 – Station Network Panel 2
21. One (1), 4523 – Security Camera Interface Box
22. One (1), 5616 – Station Security Panel
23. One (1), High Voltage Protection (HVP) Box (Provided by IT)
24. One (1), Telephone Interface Box

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6136 - Remote protection and communication work.

Additional Work to be required at the Clover and Sedge Hill 230kV substations. These costs include the following:

Clover 230 kV Substation

Project Summary
This project provides for the drawing work, relay resets, and field support necessary to change Line 2068 destination from Sedge Hill substation to AD1-087/AD2-202 substation. Due to the short line AD1-087/AD2-202 will create between the GI and Clover Substation, the existing line protection will be replaced by Fiber Optic line protection and the Wave Trap will be removed. All existing Transfer Trip/Carrier equipment will be replaced by Fiber Optic equipment. The existing RAS Islanding scheme between Sedge Hill and Clover will remain and an Islanding Transfer Trip scheme for AD1-087/AD2-202 GI will be added. Fiber is to be installed between AD1-087/AD2-202 Substation and Clover Substation and brought inside the control enclosures.

This project is the Non-Direct Connect for the AD1-087/AD2-202 Generator Interconnect project.

Purchase and install substation material:

1. Conductors, connectors, conduits.

Purchase and install relay material:

1. One (1) – 1809 – 24" Dual SEL-311L Line Diff. w/ Reclosing Panel
2. One (1), SEL-2411 I/O
3. One (1), SEL-2830 Fiber Modem
4. One (1), Panel Retirement (Panel 18)

Sedge Hill 230 kV Substation

Project Summary
This project provides for the drawing work, relay resets, and field support necessary to change Line 2068 destination from Clover Substation to AD1-087/AD2-202 Substation. This project is the Nin-Direct connect for the AD1-087/AD2-202 Generator Interconnect project.

Purchase and install relay material:

1. No relay material

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Clover 230kV Substation	$89,225	$30,540	$16,546	$4,519	$140,830
Sedge Hill 230kV Substation	$14,790	$173	$3,746	$27	$18,736
Total Remote Relay Upgrades	$104,015	$30,713	$20,292	$4,546	$159,566

5. Metering & Communications

PJM Requirements

The IC will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O Appendix 2.

ITO Requirements

Metering and SCADA/Communication equipment must meet the requirements outlined in section 3.1.6 Metering and Telecommunications of ITO's Facility Interconnection Connection Requirement NERC Standard FAC-001 which is publicly available at www.dom.com.

At the IC's expense, the ITO will supply and own at the Point of Interconnection bi-directional revenue metering equipment that will provide the following data:

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

The IC 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 ISA.

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

6. Environmental, Real Estate and Permitting Issues

The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

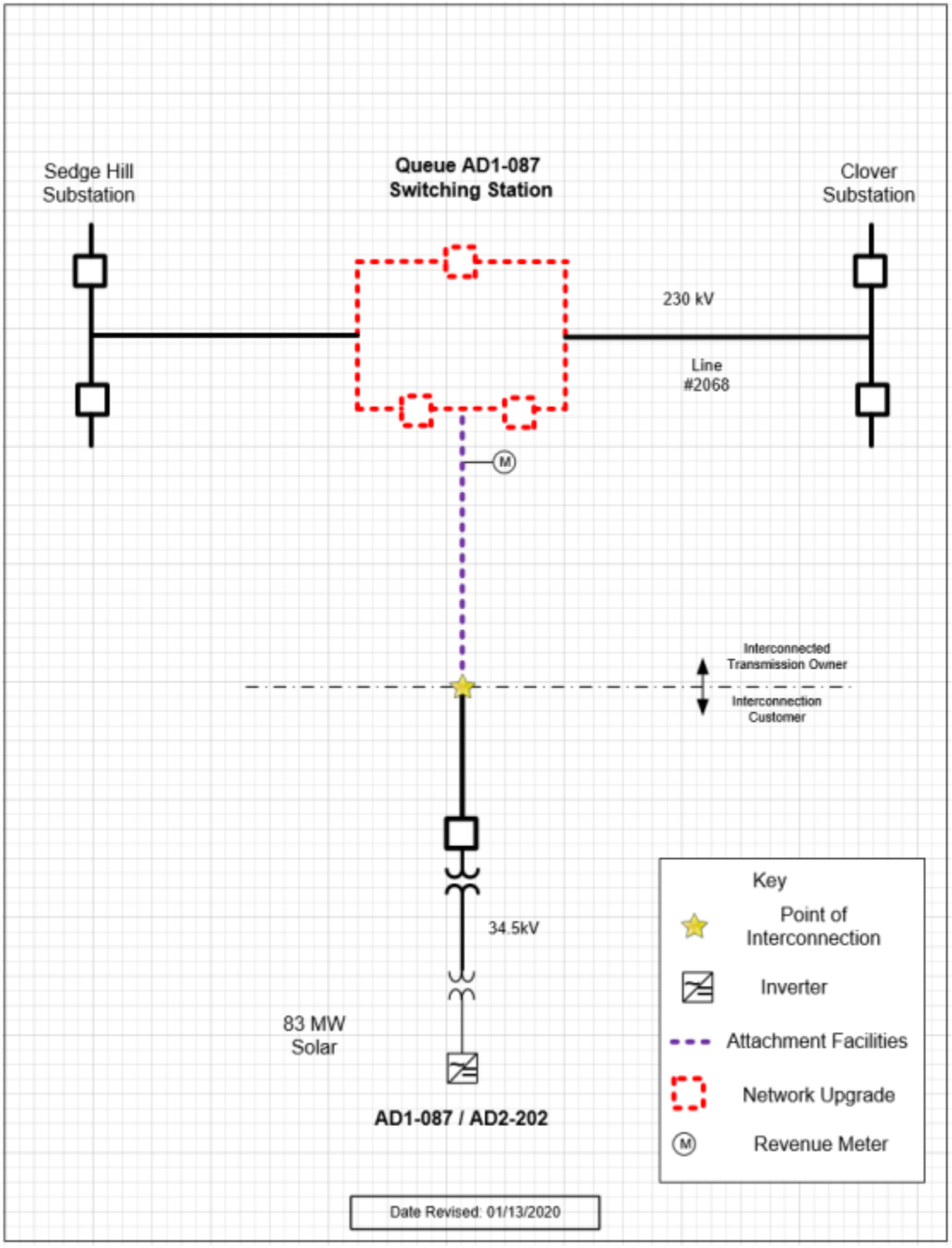
- Suitable Access Road from Substation to a Virginia State Maintained Roadway.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Conditional Use Permit for Substation.
- Any other Land/Permitting requirements required by the Substation.

ITO Real Estate Needs:

- The substation layout is complete and ITO requires a 310' x 245' piece of property (title in fee) to build the substation. The property includes the piece of property between the substation and collector station for the strain bus.
    - ITO requires ownership transfer of the substation site before they start construction. Target for the deed by December 31, 2022.

    - The size of the station assumes ITO will not need a separate storm water management system for the substation. If the county rules differently than the ITO will need to revisit the land requirements.
- ITO will need a letter similar to the zoning letter from the county stating that if the solar farm is retired and / or decommissioned the substation will remain.

Attachment 1.
Single Line



Attachment 2.
AD1-087/AD2-202 Switching Station General Arrangement