Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AD1-088 & AE2-182

Briery-Clover 230 kV
83 MW Capacity / 122 MW Energy

June 2022

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 7 Bridges 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

AD1-088 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Briery – Clover 230kV line #235. The interconnection facilities being constructed under the AD1-088 project are sufficient to support the AE2-182 project.

Cost Summary

The AD1-088 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$604,308
Direct Connection Network Upgrades	$6,165,555
Non Direct Connection Network Upgrades	$1,859,389
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$8,629,252**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AD1-088 is a request to interconnect an 83MW new solar generating facility to be located in Mecklenburg County, Virginia. AD1-088/AE2-182 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Briery to Clover 230kV Line #235. 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

- Permits – state level Permit By Rule and county level final site plan approval complete August 1, 2022
- Substantial site work completed June 1, 2025
- Delivery of major electrical equipment September 1, 2025
- Back Feed Power June 1, 2025
- Commercial Operation December 31, 2025

4. Scope of Customer's Work

Generator Interconnection Request AD1-088 is for 105MW Maximum Facility Output (MFO) solar generation plant. AE2-182 is an uprate of AD1-088 with 17MW of additional MFO for a total of 122MW MFO for the two projects.

5. Description of Facilities Included in the Facilities Study

AD1-088/AE2-182 provides for the initial construction of a new 230kV three breaker ring switching station to be located near Structure 284 on Transmission Line 235.

The ITO will connect the proposed generator lead via Attachment Facilities to the new AD1-088/AE2-182 three-breaker ring bus switching station adjacent to the 230kV #235 line between the existing Briery to Clover substations. The cut line will consume two of the positions in the ring bus and the third position will be for the 230kV feed from 7 Bridges Solar, LLC Collector Station for the solar facility.

The new 230kV Three Breaker Ring Switching Station will share a common footprint and fence line with the developer Collector Station. The demarcation point between the switching station and the collector station will be the 4-hole pads on the Dominion disconnect switch. The grounding systems for each station will be tied together. The developer will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the developer.

Additional Work will be required at Farmville & Clover Substations.

Security and Fence Type – Design Level 4.

Note: Currently, the scope and estimate assume DVP standard spread footer foundations. Once the soil information is received and if it is decided to change that to "pile foundations" then DVP team should be informed at the earliest to adjust the project estimate.

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

Cost Estimates for Dominion to perform construction:

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Attachment Facilities	$314,168	$209,002	$55,160	$25,978	$604,308
Total Attachment Facilities Cost	$314,168	$209,002	$55,160	$25,978	$604,308
New Switching Station (n7438)	$2,522,233	$2,837,388	$416,514	$389,420	$6,165,555
Transmission Line #235 (n7437)	$986,757	$572,531	$163,776	$78,684	$1,801,748
Total Remote Changes (n7875 and n7876)	$30,582	$17,045	$7,051	$2,963	$57,641
Total Network Upgrades	$3,539,572	$3,426,964	$587,341	$471,067	$8,024,944
Total Project Costs	$3,853,740	$3,635,966	$642,501	$497,045	$8,629,252

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 August 31, 2024.

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, connectors, protection and metering equipment.

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, 500:5 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 #n7437 – Split existing Line #235 into two (2) circuits to incorporate the new interconnection

Project AD1-088/AE2-182 will tap into Dominion's Line #235 between Briery to Clover substations. To provide the demarcation point, a single span of the 230kV Gen-Tie transmission line will be installed from Dominion's interconnect substation towards Seven Bridges Solar station.

The new interconnect substation will consist of installing one (1) 230kV DC HD Backbone Structure, two (2) Galvanized Steel Static Poles, and two (2) 230kV SC H-Frame DDE Structure with Anchors. The new 230kV Gen-Tie transmission line will consist of installing one (1) 230kV SC HD Backbone Structure and one (1) 230kV SC 3-Pole Large Angle DDE Structure.

The project work summary is described below:

REMOVAL:

1. Remove two (2) single circuit wood H-frame type suspension structures: 235/283 and 235/284.

INSTALLATION:

New Interconnect Substation:

1. One (1) 230kV DC Heavy Duty Steel Double Dead-end Backbone Structure with Foundations.
2. Two (2) Steel Static Poles with Foundations.
3. Two (2) 230kV SC H-Frame DDE Structure with Anchors.

2. Cut and transfer existing 3#6 Alumoweld shield wire and existing 2-545.6 ACAR conductor to proposed DDE structures (235/283 and 235/284) and proposed DDE backbone (235/283A) in the interconnect substation.
3. Install three (3) spans of 1-7#7 ALWD shield wire from proposed backbones to proposed static structures in new Interconnect Substation.
4. Renumber approximately XXX structures with new line number XXX between ... Substation and Substation.
    a. If the line is renumbered between Clover Substation and the new solar interconnect substation, then two-hundred and eighty-four (284) structures will need to be renumbered.
    b. If the line is renumbered between the new solar interconnect substation and Farmville Substation, then one-hundred and twenty-four (124) structures will need to be renumbered.

<u>New 230kV Interconnect Transmission Line:</u>

1. One (1) 230kV SC Heavy Duty Steel Double Dead-end Backbone Structure with Foundations.
2. One (1) 230kV SC 3-Pole Large Angle DDE Structures with Anchors. (Demarcation Structure)
3. Install *approximately* 72 feet of 3-phase 2-636 ACSR – "Rook" from new interconnect substation backbone to a new 3-Pole DDE demarcation structure.
4. Install *approximately* 72 feet of dual (2) DNO-11410 OPGW from new interconnect substation backbone to new 3-Pole DDE demarcation structure.

ESTIMATE ASSUMPTIONS:

1. The PLS-Pole Models for Structures 235/282 through 235/285 were designed based on existing PLS-CADD design and archived construction specification books.
2. The existing insulator assemblies on Line 235 are the original assemblies used when the line was first built and meet clearance requirements of the governing code at time of installation.
3. The proposed 230kV Gen-Tie line will require additional Right-of-Way. A width of 120' has been assumed for this estimate (per Dominion standard).
4. Line #556 is an existing 500kV line; the line was modeled based on available information. The only analysis that was conducted on Line #556 was Section Clearance Checks to Line 235.
5. The terrain data obtained from USGS is accurate and representative of current field conditions. It is recommended that additional survey be taken along the proposed route prior to final design.
6. The LiDAR survey provided is accurate and representative of existing Line #235 and Line #556. It is recommended that, at a minimum, a ground survey be conducted to verify wire tensions prior to finalizing design.
7. When replacing structures 235/283 and 235/284, the effects on structures 235/282 and 235/285 were taken into consideration and the structures should be analyzed further due to potential modifications necessary under existing conditions. Structures 235/282 and 235/285, however, do not fall within the scope of this estimate and any such modifications have not been included.

8. The existing 3#6 Alumoweld shield wire and existing 2-545.6 ACAR conductor are conditionally acceptable for construction, and there is adequate length for transferring and deadending using the future contractor's methods.
9. The final location and grading of Dominion's interconnect substation on Line # 235 was unavailable at the time of this estimate; the proposed location was used to estimate the elevation of the proposed substation equipment for crossing clearance purposes. The highest proposed equipment elevation was assumed to be 501'.
    a. Final foundation cost, structure cost, and locations may vary from this estimate as a result of this assumption.
    b. A 95'230kV DC Heavy Duty Steel Double Dead-end Backbone Structure was used in lieu of the 75' 230kV SC Heavy Duty Steel Double Dead-end Backbone Structure to achieve adequate clearance to substation equipment.

DESIGN NOTES:

1. A MOT of 302°F was selected for the new 230kV Gen-Tie Line to allow for future capacity expansion, however a lower MOT could be selected which could possibly allow for reduced structure heights.
2. The physical condition of the existing Line 235 structures have not been evaluated during this estimate, and will need to be approved prior to construction.
3. Analysis results are based on current Dominion standards and requirements.
4. Install lengths for the 3-phase 2-636 ACSR- "Rook" and dual (2) DNO-1140 and quantity of structures are subject to change depending on the finalized location of the demarcation structure.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n7438 - Build a three breaker AD1-088/AE2-182 230 kV switching station.

This project provides for the initial construction of a new 230kV Three Breaker Ring Switching Station to be located near Structure 284 on Transmission Line 235.

The objective of this project is to build a 230kV, 3-breaker ring bus to support the new Solar Farm built by 7 Bridges Solar LLC. The site is located along Dominion Energy's existing 230kV, 235 Line from Briery 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 7 Bridges Solar LLC Collector Station for the new Solar Farm.

The new 230kV Three Breaker Ring Switching Station will share a common footprint and fence line with the developer Collector Station. The demarcation point between the switching station and the collector station will be the 4-hole pads on the Dominion disconnect switch. The grounding systems for each station will be tied together. The developer will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the developer.

The work required is as follows:

Purchase and install substation material – Direct Network Upgrade:

1. Approximately 310’ x 285’ 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 as per Design 4 fence standards.
3. Three (3), 230 kV, 3000A, 50 kAIC, SF-6 Circuit Breakers.
4. Six (6), 230 kV, 3000A, 3-Phase Center Break Gang Operated Switches.
5. Six (6), 230kV, Relay Accuracy CCVTs.
6. Two (2), 230 kV, 3000 A Wave Traps.
7. Two (2), Line Tuners.
8. Nine (9), 180 kV, 144 kV MCOV surge arresters.
9. Two (2), 230kV, 3000A, 2-Phase Center Break Gang Operated Switches (for PVT’s).
10. Four (4), 230kV, 100KVA Power VT's for Station Service.
11. Oil Containment for 230kV PVT’s.
12. One (1), 24’ x 40’ Control Enclosure.
13. One (1), 125 VDC, 200 Ah Station Battery and 50 Amp Charger (size to be verified during detail engineering).
14. Approximately 240 FT of Cable Trough, with a 20FT road crossing section.
15. Full substation ground grid as per engineering standards.
16. Station access driveways and stone as required.
17. Station Lighting as required.
18. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports.
19. Foundations as required including control house, equipment and bus support stands.
20. 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. Two (2), 1320 – 28” Dual SEL-421-5 DCB Line Panel
4. Two (2), 4506 – 3 Phase CCVT Potential M.U. Box
5. One (1), 1603 – 28” SEL-451 Islanding Control Scheme Panel
6. Two (2), 4000 – Station Service Potential M.U. Box
7. Two (2), 4018 – 500A Station Service AC Distribution Panel
8. Two (2), 4007 – 225A Outdoor Transmission Yard AC NQOD
9. Two (2), 4019 – 225A Three Phase Throw over Switch
10. Two (2), 4016 – 600A PVT Disconnect Switch
11. One (1), 4153 – Wall Mount Station Battery Monitor
12. One (1), 5618 - SEL-3555 Data Concentrator Panel
13. One (1), 1255 – Station Annunciator Panel
14. One (1), 5021 – SEL-2411 RTU Panel
15. One (1), 5609 – Fiber Optic Management Panel
16. Three (3), 4526_A – Circuit Breaker Fiber Optic M.U. Box
17. One (1), 5202 – 26” APP 601 Digital Fault Recorder
18. One (1), 5603 – Station Network Panel No. 1

19. One (1), 5603 – Station Network Panel No. 2
20. One (1), 4523 – Security Camera Interface Box
21. One (1), 5616 – Station Security Panel
22. One (1), Telephone Interface Box
23. One (1), High Voltage Protection (HVP) Box (Provided by IT)

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n7875 and n7876 - Remote protection and communication work.

Additional Work to be required at Clover and Farmville 230kV substations.

Clover 230 kV Substation

Project Summary
This project provides for the drawing work, relay resets, and field support necessary to change the Line 235 destination from Farmville Substation to the new AD1-088/AE2-182 Generator Interconnect Substation. The existing RAS Islanding scheme between Clover & Farmville will stay in place and will pass through the new AD1-088/AE2-182 project. Replace the existing Line 235 Islanding Transfer Trip Receiver with a CS-51C in order to continue receiving the RAS Islanding Transfer Trip Signal from Farmville as well as send Islanding Transfer Trip to AD1-088/AE2-182 project. This project is the Non-Direct Connect for the AD1-088/AE2-182 Generator Interconnect project.

Purchase and install relay material:

1. Trench CS-51C Transfer Trip Transmitter/Receiver

Farmville 230 kV Substation

Project Summary
This project provides for the drawing work, relay resets, and field support necessary to change the Line 235 destination from Clover substation to the new AD1-088/AE2-182 Generator Interconnect Substation. The existing RAS Islanding scheme between Clover & Farmville will stay in place and will pass through the new AD1-088/AE2-182 project. This project is the Non-Direct Connect for the AD1-088/AE2-182 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	$16,759	$17,045	$3,824	$2,963	$40,591

Sedge Hill 230kV Substation	$13,823	$0	$3,227	$0	$17,050
Total Remote Relay Upgrades	$30,582	$17,045	$7,051	$2,963	$57,641

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:

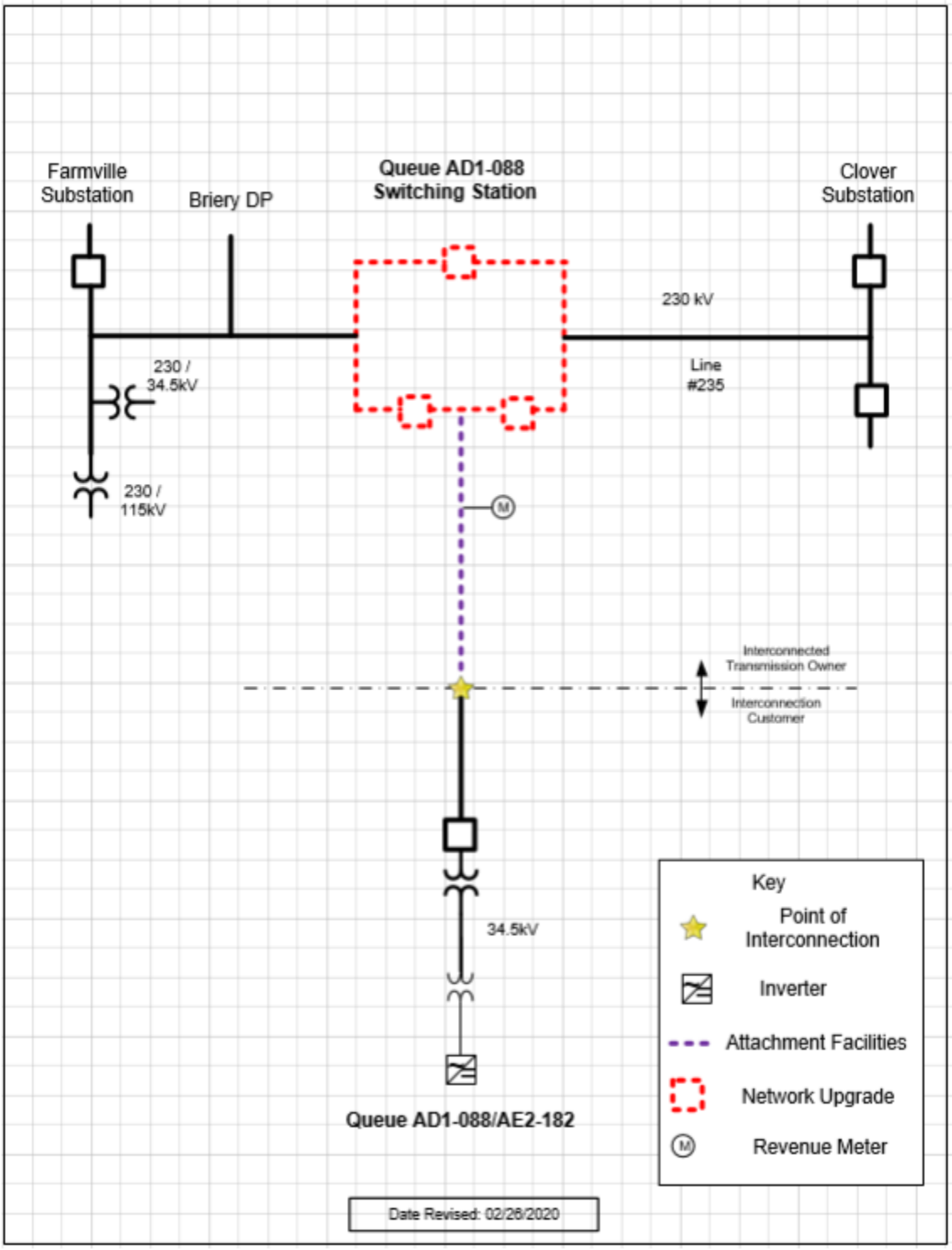
- Suitable Access Road from Substation to a Virginia State Maintained Roadway.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Conditional Use Permit for Substation.
- Any other Land/Permitting requirements required by the Substation.

ITO Real Estate Needs:

- The substation layout is complete and ITO requires a 310' x 285' 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 August 2024.
    - 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.
AD1-088/AE2-182 Switching Station General Arrangement