Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-143

Brandy - Remington 115kV
41.2 MW Capacity / 60 MW Energy

July, 2020

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 Community Energy Solar Development LLC (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). Virginia Electric and Power Company is the Interconnected Transmission Owner (ITO) and provided the input to develop this study.

The IC has proposed a solar generating facility located in Culpeper County, VA. The installed facilities will have a total capability of 60 MW with 41.2 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 11/16/2023. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-143 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Brandy - Remington 115kV line.

Cost Summary

The AC1-143 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 500,559
Direct Connection Network Upgrades	$ 5,131,570
Non Direct Connection Network Upgrades	$ 941,300
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 6,699,547**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC1-143 is a request to interconnect a 60 MW new solar generating facility to be located in Culpeper County, Virginia. The proposed generating facility will interconnect with the ITO's new AC1-143 115kV switching station via a new three breaker ring-bus switching station. Attachment Facility and Network Upgrade construction is estimated to be 8 – 12 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 February 16, 2023
- Permits – state level Permit By Rule and county level final site plan approval complete January 16, 2023
- Substantial site work completed May 16, 2023
- Delivery of major electrical equipment August 16, 2023
- Back Feed Power October 31, 2023
- Commercial Operation November 16, 2023

4. Scope of Customer's Work

IC will build a solar generating facility comprised of solar arrays. AC1-143 consists of 30 x 2 MW SMA SC2200 inverters and 30 x 34.5/0.385 kV 2.2 MVA GSU transformers connected to the Point of Interconnection (POI) on the Brandy – Remington 115 kV circuit by a 115/34.5/13.8 kV wye ground/wye ground/delta main power transformer with a rating of 40/53/66 MVA.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC1-143 ring bus switching station adjacent to the #70 line between existing Brandy and Remington substations. The position of the switching station will be near the right of way of the existing 115 kV transmission line #70 between structures 70/101 and 70/102. The lines will consume two of the three positions in the ring bus. The third position will be for the 115 kV feed from the solar farm collector station.

The new 115kV three breaker ring substation will share a common foot print and fence line with the Interconnection Customer's collector station. The demarcation point between the two stations will be the 115kV breaker disconnect switch 4-hole pad in the Interconnection Customer's collector station by the common fence. The ITO 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.

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.

There will be transmission line protection and anti-islanding work required at the remote lines terminals at Remington and Mountain Run substations. Site plan (Attachment 2) was developed by the ITO during PJM's generation queue process. The single line is shown in Attachment 1.

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

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Attachment Facilities	$285,791	$148,329	$47,634	$18,805	$500,559
Total Attachment Facilities Cost					
AC1-143 115 kV Switching Station (n6648)	$2,256,775	$2,237,642	$377,700	$259,453	$5,131,570
Line #81 Transmission work (n6649)	$494,296	$331,986	$79,737	$35,281	$941,300
Remote relay (n6650)	$76,190	$28,077	$17,241	$4,610	$126,118
Total Network Upgrades	$2,827,261	$2,597,705	$474,678	$299,344	$6,198,988
Total Project Costs	$3,113,052	$2,746,034	$522,312	$318,149	$6,699,547

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

Facilities are estimated to take 14 - 24 months to construct and this 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 September 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 Point of Interconnection will be the 4-hole pads on the IC disconnect switch. Metering equipment will be installed in the ITO switching station. The equipment associated with the Attachment Facilities includes the following. 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) 115 kV, 2000A, 3-phase center break gang operated switch
2. Three (3) 115 kV metering accuracy CCVT's
3. Three (3) 115 kV metering accuracy CT's
4. Conductors, connectors, conduits, control cables, foundations, steel structures and grounding material

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 Metering Panel (Transmission & Generation Interconnect)
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4531 – Generator Interconnect 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 #n6649 - Re-arrange line #70 to loop into and out of the new three breaker AC1-143 115 kV switching station between existing Brandy and Remington substations. The line connection will require the installation of one (1) backbone structure and two (2) static pole structures. The conceptual design and estimate includes costs for the following:

ESTIMATE OF FACILITIES TO BE INSTALLED:

1. Install One (1) 115kV SC heavy duty backbone structure (70/101A) with foundation.
2. Install two (2) steel static poles with foundations.
3. Install approximately 160 feet of 3-phase 2-636 ACSR (24/7) from proposed backbone structure 70/101A to existing structure 70/101.
4. Install approximately 415 feet of 1-DNO 11410 OPGW from the proposed backbone structure 70/101A to the existing splice on structure 70/100. Re-use existing fiber hardware and coil bracket.
5. Install approximately 0.1 miles, a total of three spans, of 1-7#7 alumoweld shield wire between the proposed backbone structure and static poles inside the new substation.

ESTIMATE – FACILITIES TO BE REMOVED:

1. Transfer one (1) span of existing 3-phase 2-636 ACSR (24/7) conductor from existing structure 70/102 to the proposed backbone structure 70/101A.
2. Cut the existing span of 1-DNO 11410 OPGW near ex. Structure 70/100 and transfer back to the proposed backbone structure 70/101A, leaving 100' coiled up at the proposed backbone for splicing.

ESTIMATE ASSUMPTIONS:

1. Structures were spotted inside the substation using a preliminary general arrangement. Estimate assumes that detailed substation drawings with exact locations of structures, equipment, and fence will be provided during detailed design.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6648 - Build a three breaker AC1-143 115 kV switching station. The site is located along the ITO's 115kV line #70 from Brandy and Remington substations.

The position of the switching station will be near the right of way of the existing 115 kV transmission line #70 between structures 70/101 and 70/102. The lines will consume two of the three positions in the ring bus. The third position will be for the 115 kV feed from the solar farm collector station. The new 115kV three breaker ring substation will share a common foot print and fence line with the Interconnection Customer's collector station. The demarcation point between the two stations will be the 115kV breaker disconnect switch 4-hole pad in the Interconnection Customer's collector station by the common fence. The ITO 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.

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.

Detail engineering to inquire if pre-ordered material is available, otherwise the project will follow the current long lead time material ordering process.

Currently, the scope and estimate assumes the use of ITO standard spread footer foundations. Once the soil information is received and pile foundations may be required. The change to pile foundations will require adjustment to the project cost estimate.

The work required is as follows:

Purchase and install substation material:

1. Approximately 275' X 270' site preparation and grading as required for installation of the switching station (by the developer)
2. Approximately 1050 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), 115 kV, 3000A, 40 kA SF6 circuit breakers
5. Six (6), 115 kV, 2000A, 3-phase center break gang operated switches
6. Two (2), 115kV, 2000A, 2-pole center break switches (for PVT's)
7. Six (6), 115kV, CCVT's relay accuracy
8. One (1), 2000A, vertically mounted, wave trap
9. One (1), line tuner
10. Six (6), 90kV MO, station class, 74kV MCOV surge arresters
11. Four (4), 115kV, 100KVA power PT's for station service
12. One (1), 24' x 40' cControl enclosure, prewired by Trachte
13. One (1), 135VDC, 577Ah batteries with charger
14. Oil containment as required for 115kV PVT's.
15. Cable trough as required
16. Conductor, connectors, conduit, control cable, foundations and grounding material as required per engineering standards

Purchase and install relay material:

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 #n6650 - Remote protection and communication work. ITO protection requirements to reliably interconnect the proposed generating facility with the transmission system determined that work is required at Remington and Mountain Run115kV substations. These costs include the following:

Remington 115 kV Substation

Project Summary:

Drawing updates, fiber installation** and replacement of the line #70 relays with SEL-311Ls to support the new AC1-143 substation. Remove line #70 wave trap and install 2-2" PVC conduits from existing terminal structure to control enclosure for fiber installation.

Purchase and install:

1. Install 2-2" PVC conduit

Remove:

1. Existing line #70 wave trap

Purchase and install relay material:

1. One (1), 1809 – 28" Dual SEL-311L Line Diff. w/ Reclosing Panel
2. One (1), SEL – 2411 Islanding Transfer Trip Transmitter
3. One (1), SEL – 2830 Fiber Modem
4. Retire (1), Panel no. 15

**At structure 70/101, the distance from this point to Remington Sub will be aprox. ~4.98-5miles, that will require fiber and line current differential protection, per our transfer trip policy, this project accounts for that already since the original location was structure 70/103 & 70/104. If another structure before 70/101 is selected, ex 70/98, 70/97 etc, the line distance will increase to 5+ miles, and then the substation scope will change. These changes include keeping the existing PLC protection as it is. We will not have to remove the line 70 wave trap or change the existing Line relay panel at Remington sub, and we will install an additional wave trap at the new AC1-143 substation.

Mountain Run 115 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #70 destination from Remington to the new AC1-143 substation. Also update line #70 islanding transfer trip scheme to work with the new AC1-143 substation.

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Remington	$7,609	$0	$2,123	$0	$9,732
Mountain Run	$68,581	$28,077	$15,118	$4,610	$116,386
Total Remote Relay Upgrades	$76,190	$28,077	$17,241	$4,610	$126,118

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 publically 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

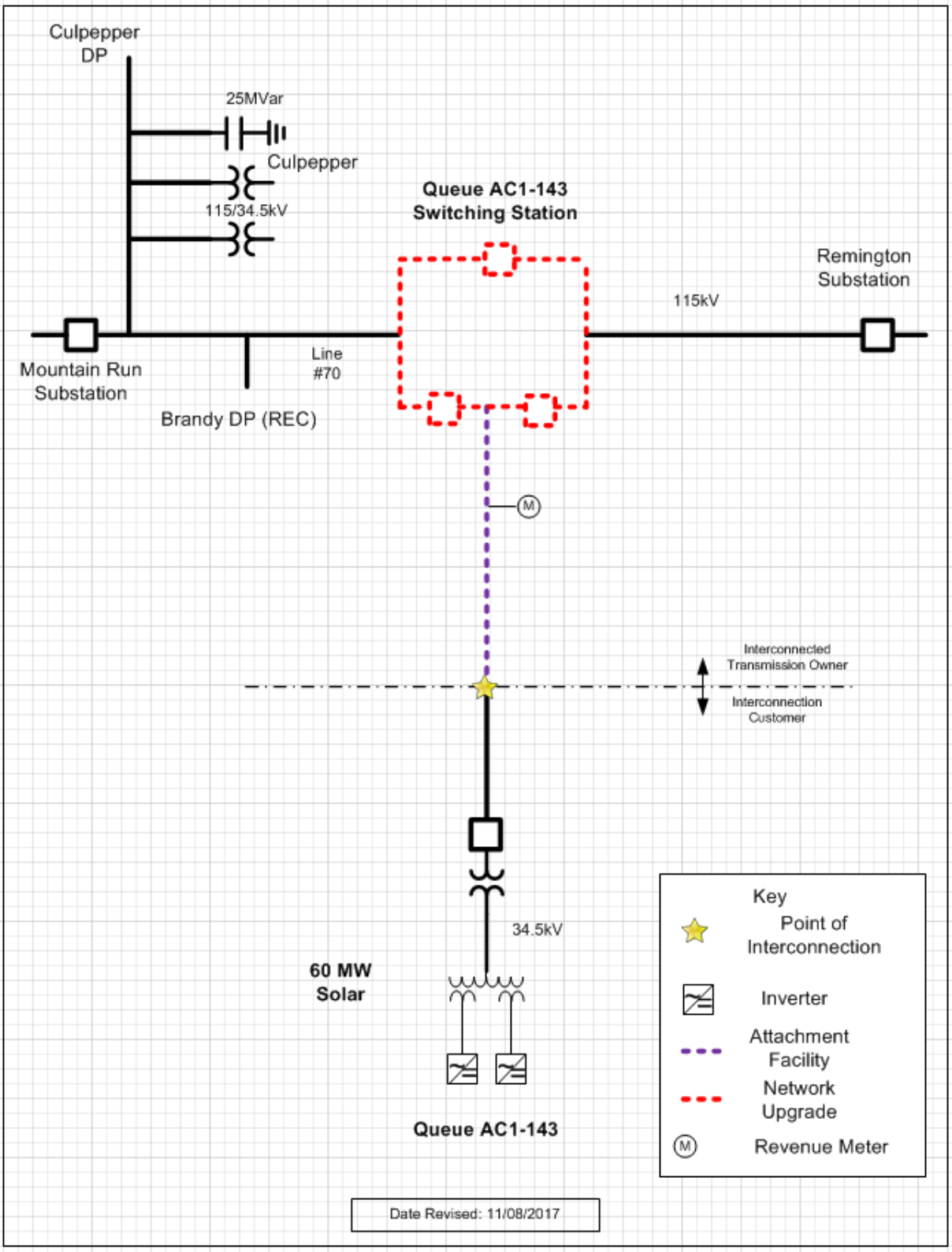
The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

- 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 275'x 270' 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 September 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.

AC1-143 Switching Station General Arrangement