

***Generation Interconnection
Facility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-208***

***Halifax - South Justice Branch 115kV
55.4 MW Capacity / 80 MW Energy***

Revised June 2020

April, 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 Halifax County Solar 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 Halifax County, NC. The installed facilities will have a total capability of 80 MW with 55.4 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 11/15/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-208 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Halifax - South Justice Branch 115kV line #81.

Cost Summary

The AC1-208 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 510,305
Direct Connection Network Upgrades	\$ 5,321,068
Non Direct Connection Network Upgrades	\$ 1,960,580
Allocation for New System Upgrades	\$ 0
Contribution for Previously Identified Upgrades	\$ 20,009
Total Costs	\$ 7,811,962

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC1-208 is a request to interconnect an 80 MW new solar generating facility to be located in Halifax County, North Carolina. The proposed generating facility will interconnect with the ITO's new AC1-208 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 15, 2022 |
| • Permits – state level Permit By Rule and county level final site plan approval complete | January 15, 2022 |
| • Substantial site work completed | May 15, 2022 |
| • Delivery of major electrical equipment | August 15, 2022 |
| • Back Feed Power | October 15, 2022 |
| • Commercial Operation | November 15, 2022 |

4. Scope of Customer's Work

IC will build a solar generating facility in Halifax County, North Carolina. The generating facility will be comprised of solar arrays. AC1-208 consists of 40 x SMA SC 2200-US 2.0 MW solar inverters. The 40 x 34.5 / 0.385 kV grounded wye / delta 2.2 MVA generator step up (GSU) transformers will connect to the solar inverters to the 34.5 kV collector system. The generating facility will connect to the Point of Interconnection (POI) via a 115/34.5/0.385 kV wye ground/wye ground/delta main power transformer with a rating of 50/67/83 MVA.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC1-208 ring bus switching station adjacent to the # 81 line between existing South Justice Branch and Darlington DP substations. The position of the switching station will be near the right of way of the existing 115 kV transmission line #81 and 230 kV transmission line #2056. The line will be cut near the structure 81/133 and diverted perpendicular to the right of way with the use of angled structures. The lines will be taken to the two backbones located across the gas line easement and the risers will be dropped to the bus sections directly underneath the line. 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 Point of Interconnection will be the 4-hole pads on the ITO disconnect switch. Metering equipment will be installed in the ITO switching station. The grounding systems for both the

stations 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 Carolina and South Justice Branch 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	\$288,725	\$151,696	\$50,907	\$18,977	\$510,305
Total Attachment Facilities Cost					
AC1-208 115 kV Switching Station (n6468)	\$2,425,775	\$2,232,378	\$406,437	\$256,478	\$5,321,068
Line #81 Transmission work (n6469)	\$992,545	\$585,439	\$162,620	\$69,708	\$1,810,312
Remote relay (n6470)	\$73,691	\$53,318	\$18,608	\$4,651	\$150,268
Battleboro breaker leads (n6118)	\$8,968.27	\$7,446.55	\$2,460.66	\$1,133.16	\$20,009
	\$3,500,979	\$2,878,582	\$590,126	\$331,970	\$7,301,657
Total Network Upgrades	\$3,789,704	\$3,030,278	\$641,033	\$350,947	\$7,811,962
Total Project Costs					

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 January 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 ITO 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 #n6469 - Re-arrange line #81 to loop into and out of the new three breaker AC1-208 115 kV switching station between existing Darlington DP and south Justice Branch substations. The line connection will require the installation of two (2) 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 two (2) 115kV SC steel DDE backbone structure with foundations.
2. Install two (2) steel static poles with foundations.
3. Install two (2) engineered 3-pole structures.
4. Install 0.1 miles of 3 phase 636 ACSR 24/7 conductor from proposed backbones to proposed 3 pole structures.
5. Install 0.1 miles of two 3#6 ALWD shield wire from proposed backbones to proposed 3 pole structures.
6. Cut and transfer existing spans of 3-phase conductor to the new 3 pole structures.
7. Cut and Transfer existing spans of AWLD shield wire to new 3 pole structures.

ESTIMATE – FACILITIES TO BE REMOVED:

1. Remove one (1) wood suspension structure

ESTIMATE – MISCELLANEOUS:

2. Obtain additional R/W leading into proposed substation

3. New Substation/Switchyard Facilities**PJM Network Upgrade #n6468 - Build a three breaker AC1-208 115 kV switching station.**

The site is located along the ITO's 115kV line #81 from Darlington DP and South Justice Branch substations.

The position of the switching station will be near the right of way of the existing 115 kV Transmission Line #81 & 230 kV transmission line #2056. The line will be cut near the structure 81/133 and diverted perpendicular to the right of way with the use of angled structures. The lines will be taken to the two backbones located across the gas line easement and the risers will be dropped to the bus sections directly underneath the line. 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 demarcation point between the switching station and the collector station will be the 4-hole pads on the ITO disconnect switch. Metering equipment will be installed in the ITO switching station. The grounding systems for both the stations 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. Nine (9), 90 kV MO, 74 kV MCOV Station Class Arresters
7. Six (6), 115 kV CCVTs, Relay Accuracy
8. Two (2), 115 kV, 2000 Amps Wave Traps and Line Tuners
9. One (1), 24' X 40' Control Enclosure
10. One (1), 125 VDC, 200 Ah Station Battery and 50 Amp Charger
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. Two (2), 115 kV, 2000A, 2-phase Center Break Gang Operated Switches

14. Oil Containment system for the 115 kV PVTs.
15. High Voltage Protection Cabinet
16. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
17. Foundations as required including control house, equipment and bus support stands
18. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as 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. 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 Throwover Switch
10. Two (2), 4016 – 600A PVT Disconnect Switch
11. One (1), 4153 – Wall Mount Station Battery Monitor
12. One (1), 5612 - SEL-3530 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 1
19. One (1), 5603 – Station Network Panel 2
20. One (1), 5616 – Station Security Panel
21. One (1), Telephone Interface Box
22. One (1), High Voltage Protection (HVP) Box

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6470 - 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 Carolina and South Justice Branch 115kV substations. These costs include the following:

Carolina 115 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #81 destination from South Justice Branch substation to the AC1-208 substation. Also install line #81 breaker failure & islanding transfer trip scheme to work with the new AC1-208 substation.

Purchase and install relay material:

1. One (1), 1604 – 24” Transmission Transfer Trip Panel
2. One (1), CS-51C Breaker Failure Transfer Trip Set

South Justice Branch 115 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #81 destination from Carolina substation to AC1-208 Substation. Also install line #81 breaker failure and islanding transfer trip scheme to work with the new AC1-208 substation.

Purchase and install relay material:

1. One (1), CT-51C Islanding Transfer Trip Set
2. One (1), SEL-2411 Maintenance Switch
3. One (1), CS-51C Breaker Failure Transfer Trip Set

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Carolina	\$46,079	\$27,462	\$12,156	\$295	\$85,992
South Justice Branch	\$27,612	\$25,856	\$6,452	\$4,356	\$64,276
Total Remote Relay Upgrades	\$73,691	\$53,318	\$18,608	\$4,651	\$150,268

PJM Network Upgrade #n6118 Battleboro breaker leads: Replace breaker leads at the Battleboro substation on the line to the Rocky Mountain substation. It is estimated to 12-16 months to engineer and construct. Estimated cost is \$100,000. The AC1-208 project has a cost allocation to this upgrade of \$20,009.

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 North Carolina 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 January 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



