Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC2-100/AD1-131

Person - Sedge Hill 230kV
45.6 MW Capacity / 70 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 Powells Creek Farm 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 70 MW with 45.6 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC2-100/AD1-131 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Sedge Hill – Person 230kV line #296.

Cost Summary

The AC2-100/AD1-131 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 552,454
Direct Connection Network Upgrades	$ 6,250,052
Non Direct Connection Network Upgrades	$ 1,216,798
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 8,019,304**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC2-100/AD1-131 is a request to interconnect a 70 MW new solar generating facility to be located in Halifax County, North Carolina. The proposed generating facility will interconnect with the ITO's new AC2-100 230kV 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 March 15, 2022
- Permits – state level Permit By Rule and county level final site plan approval complete March 11, 2022
- Substantial site work completed August 31, 2022
- Delivery of major electrical equipment April 15, 2022
- Back Feed Power October 31, 2022
- Commercial Operation December 31, 2022

4. Scope of Customer's Work

IC will build a solar generating facility in Halifax County, Virginia. The generating facility will be comprised of solar arrays. AC2-100/AD1-131 consists of 37 x Schneider Conext Smartgen CS 2000 2 MW solar inverters, 37 x 34.5/0.575 kV GSU transformers and a 230/34.5 kV wye ground/wye ground main power transformer with a rating of 45/60/75 MVA. A 17MVAR cap bank will be connected at the 34.5kV collector bus.

5. Description of Facilities Included in the Facilities Study

The Facilities Study scope provides for the construction of a new interconnect station and necessary network upgrades to tie a 70 MW solar generating facility into the ITO transmission network. The work scope includes the construction, by the ITO, of a 230 kV switching station with a three breaker ring bus and the required 230 kV transmission line modifications.

There will be transmission line protection and anti-islanding work required at the remote lines terminals at Person and Sedge Hill substations. Person substation is owned by Duke Energy/Progress (DEP) and it will be the responsibility of the Interconnection Customer to engage DEP to ensure the remote end relay scope of work is completed.

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	$283,458	$195,714	$52,030	$21,252	$552,454
Total Attachment Facilities Cost					
AC2-100 230 kV Switching Station (n6651)	$2,478,523	$2,989,203	$431,219	$351,107	$6,250,052
Line #296 Transmission work (n6652)	$643,388	$302,077	$109,333	$41,012	$1,095,810
Sedge Hill remote relay (n6632)	$69,116	$33,378	$12,759	$5,735	$120,988
Total Network Upgrades	$3,191,027	$3,324,658	$553,311	$397,854	$7,466,850
Total Project Costs	$3,474,485	$3,520,372	$605,341	$419,106	$8,019,304

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 October 2021.

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) 230 kV, 2000A, 3-phase center break gang operated switch
2. Three (3) 230 kV metering accuracy CCVT's
3. Three (3) 230 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), 4506 – 3 Phase CCVT Potential M.U. Box w/ Metering (P4)
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 #n6652 - Re-arrange line #296 to loop into and out of the new three breaker AC2-100 230 kV switching station between existing Person and Sedge Hill 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:

Structure Installations:

1. Install (1) 230KV galvanized steel backbone structure with 38' spacing inside the switching station.
2. Install (2) galvanized static pole structures inside switching station.
3. Install (1) DOM Type H-frame anchor structure

Conductor/shield wire installations:

1. Install three spans of 1-7#7 ALWD shield wire (approximately 0.10 miles) from proposed backbone to each proposed static pole and between the two proposed static poles.
2. Transfer existing three-phase 2-571 ACSS/TW/HS-285 and 3#6 ALWD to proposed backbone.
3. Transfer existing three-phase 2-571 ACSS/TW/HS-285 and 2-3#6 ALWD to proposed H-frame structure.
4. String new 2-571 ACSS/TW/HS-285 and 2-3#6 ALWD from proposed H-frame to proposed backbone structure.

Removals:

1. Remove existing 2-pole Wood suspension H-frame Str. # 296/169.
2. Remove existing 2-pole Wood suspension H-frame Str. # 296/170.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6651 - Build a three breaker AC2-100 230 kV switching station. The site is located along the 230kV line #296 from Person and Sedge Hill substations.

The position of the switching station will be adjacent to the right of way of the existing 230 kV transmission line #296. The station will be positioned in such a way that the new backbone will align with the line near structure 296/169. The cut lines will be attached to the new backbone and risers will be dropped from both sides of the backbone 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 230 kV feed from the collector station for the solar farm. 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 ground grid for two 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 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 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. Three (3), 230 kV CCVTs, relay accuracy
8. Three (3), 230 kV CCVTs, meter accuracy
9. Three (3), 230 kV, 2000:5, CTs, meter accuracy
10. Two (2), 230 kV, 3000 Amps Wave Traps and Line Tuners
11. One (1) 24’ X 40’ control enclosure
12. One (1) 125 VDC, 200 Ah station battery and 50 amp charger (size to be verified during detail engineering)
13. Approximately 240 FT of cable trough, with a 20 FT road crossing section
14. Four (4) 100 KVA power potential transformers for station service
15. Oil containment system for the 230 kV PVTs.
16. Two (2) 230 kV, 3000A, 2-phase center break gang operated switches
17. Two (2), 2” conduits from the substation backbone to the cable trough
18. Conduit Tracer Wire, 1/C #10, Green

19. 1-1/4” Orange Polyethylene conduits for fiber in the cable trough
20. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
21. Foundations as required including control house, equipment and bus support stands
22. 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. One (1), 1424 – 28” SEL-735 Gen. Check/Revenue/ Delivery Point Metering Panel
7. One (1), 4524 – Revenue Metering C.T. M.U. Box
8. Two (2), 4000 – Station Service Potential M.U. Box
9. Two (2), 4018 – 500A Station Service AC Distribution Panel
10. Two (2), 4007 – 225A Outdoor Transmission Yard AC NQOD
11. Two (2), 4019 – 225A Three Phase Throwover Switch
12. Two (2), 4016 – 600A PVT Disconnect Switch
13. One (1), 4153 – Wall Mount Station Battery Monitor
14. One (1), 5612 - SEL-3530 Data Concentrator Panel
15. One (1), 1255 – Station Annunciator Panel
16. One (1), 5021 – SEL-2411 RTU Panel
17. One (1), 5609 – Fiber Optic Management Panel
18. Three (3), 4526_A – Circuit Breaker Fiber Optic M.U. Box
19. One (1), 5202 – 26” APP 601 Digital Fault Recorder
20. One (1), 5603 – Station Network Panel 1
21. One (1), 5603 – Station Network Panel 2
22. One (1), 5616 – Station Security Panel

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6653 - 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 Person and Sedge Hill 230kV substations.

Sedge Hill 230 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #296 destination from Person substation to AC2-100 substation. Also install line #296 islanding and breaker failure transfer trip schemes to now work with the new AC2-100 Substation (replace the existing CT-51C breaker failure transmitter with a CS-51C to send/receive breaker failure transfer trip to/from AC2-100).

The revenue metering between Dominion and Duke Energy is located at Sedge Hill Substation on line 296. The metering CT's will be removed as this function will be moved to the AC2-100 substation.

Purchase and install Substation material:

1. Remove- Three (3), 230 kV metering CT's and install jumper conductors.

Purchase and install relay material:

2. One (1), CT-51C transfer trip set
3. One (1), SEL-2411 maintenance switch
4. One (1), CS-51C breaker failure transfer trip set
5. One (1), panel retirement (panel 44)

Person 230 kV Substation

The IC will need to engage Duke Energy/Progress to install islanding transfer trip transmit and breaker failure transfer trip transmit at Person substation to work with the new AC2-100 substation. Breaker failure receive transfer trip currently exists between Person and Sedge Hill and can now be used with AC2-100. Line #296 relay resets at Person substation will also be required.

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

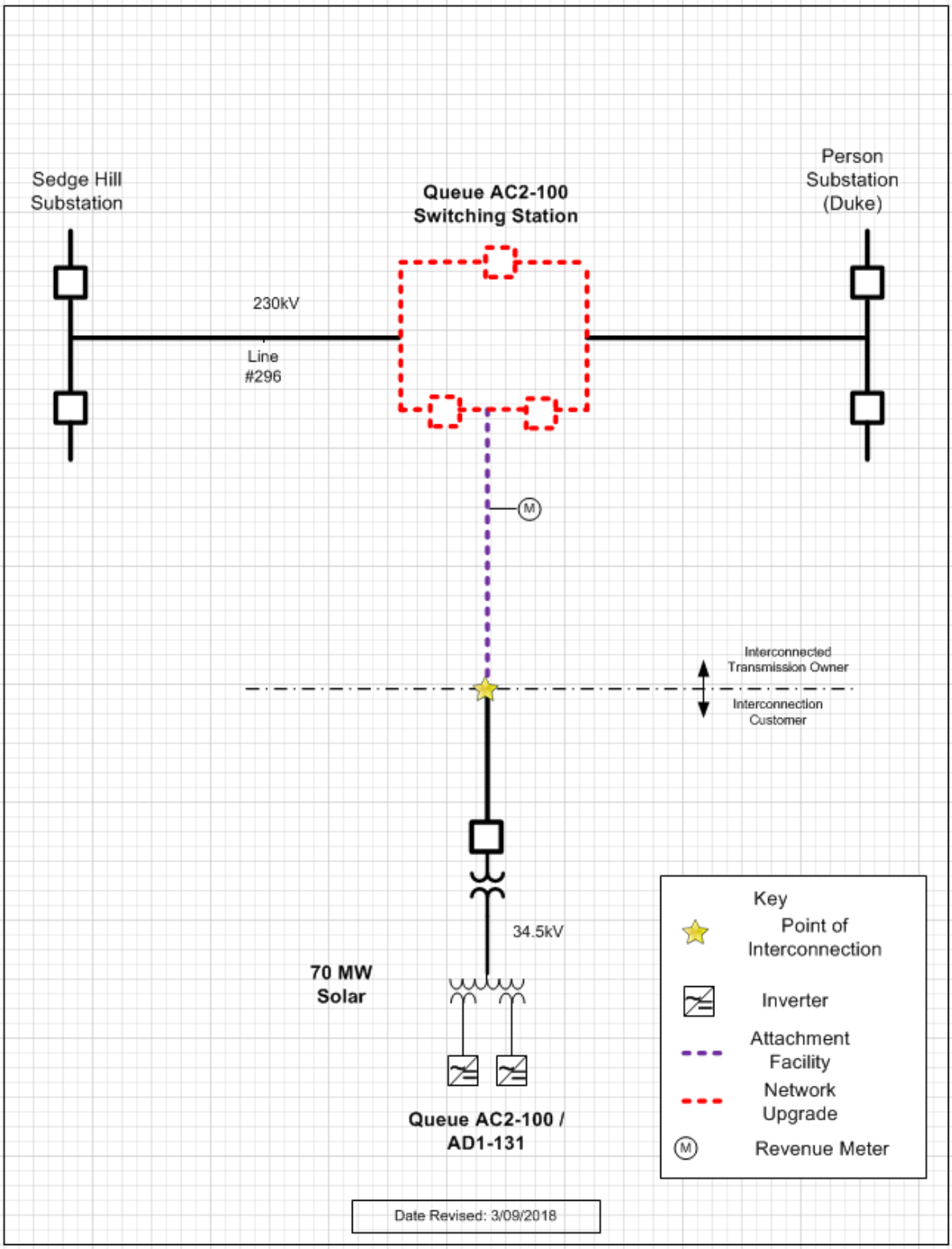
The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

- 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 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 October 2021.
    - 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.
AC2-100/AD1-131 Switching Station General Arrangement