Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AD1-033

Fentress - Landstown 230kV
42 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 the Interconnection Customer (IC) and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

The IC has proposed a solar generating facility located in City of Chesapeake County, Virginia. The installed facilities will have a total capability of 70 MW with 42 MW of this output being recognized by PJM as Capacity Interconnection Rights. The proposed in-service date for this project is December 1, 2021. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AD1-033 will interconnect with the ITO transmission system will connect via a new three breaker ring bus switching station that connects the Fentress – Landstown 230kV line.

Cost Summary

The AD1-033 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$641,857
Direct Connection Network Upgrades	$6,817,447
Non Direct Connection Network Upgrades	$1,352,320
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$8,811,624**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AD1-033 is a request to interconnect a 70 MW solar generating facility located in City of Chesapeake County, Virginia. The scope of the project AD1-033 includes necessary network upgrades and attachment facilities to connect the generation to the Dominion transmission network. 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 Submitted Milestone Schedule

- Plan to break ground July 1, 2020
- Permits – state level Permit By Rule and county level Final Site Plan approval complete July 1, 2020
- Substantial site work completed January 1, 2021
- Delivery of major electrical equipment March 1, 2021
- Back Feed Power May 31, 2021
- Commercial Operation December 1, 2021

4. Scope of Customer's Work

The generating facility (Bedford Solar Center) will be comprised of 30 2.5 MW TMEIC PVH-L2700GR solar inverters (additional 2 inverters used to mitigate a project reactive deficiency). The 28 solar inverters are connected to 28 34.5/0.60 kV generator step up (GSU) transformers each with a rating of 2.70 MVA and a 34.5kV capacitor bank of 6 MVAR. The generating facility will connect to the Point of Interconnection (POI) via a 230/34.5/13.8 kV station transformer with a rating of 50/66.7/83.3 MVA.

5. Description of Facilities Included in the Facilities Study

The project will build a 230kV, 3-breaker ring bus to support the new 70 MW solar farm. The site is located along the ITO's existing 230kV, 271 Line from Fentress substation to Landstown substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 230kV feed from the new 70 MW solar farm. The new 230kV 3-breaker ring bus substation will share a common footprint and fence line with the collector station. The demarcation point between the two stations will be the 230kV breaker disconnect switch 4-hole pad in the 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.

Due to the short line segment between the 3-breaker ring bus substation and Fentress substation (approximately 1.7 miles), a fiber optic cable will be required between the 2 substations for line protection.

Transmission lines to renumber the existing line segment between the new 3-breaker ring bus substation and Fentress substation. The existing line segment between the new 3-breaker ring bus substation and Landstown substation shall remain line 271.

Additional Work to be required at Fentress and Landstown substations.

The substation general arrangement drawing (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	$346,674	$221,491	$49,454	$24,238	$641,857
Total Attachment Facilities Cost					
New AD1-033 230kV substation (n6695)	$3,187,128	$2,873,577	$417,571	$339,171	$6,817,447
Transmission line work to cut in the new AD1-033 substation (n6696)	$719,784	$286,082	$110,985	$37,540	$1,154,391
Remote-end relay work at Fentress and Landstown substations (n6697)	$125,252	$41,381	$24,151	$7,145	$197,929
Total Network Upgrades	$4,032,164	$3,201,040	$552,707	$383,856	$8,169,767
Total Project Costs	$4,378,838	$3,422,531	$602,161	$408,094	$8,811,624

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

Facilities are estimated to take 8 – 9 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 – 9 months
- Permitting: 6 – 9 months (runs concurrent with design)
- Construction 8 – 9 months

ITO requires the site to be fully graded and permitted site so they can start construction by August 2020.

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

The Attachment Facilities include that portion of the interconnecting switching station which is associated solely with the single feed to the generating facilities. The project's Attachment Facilities include bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, protection and metering equipment. The demarcation point between the two stations will be the 230kV breaker disconnect switch 4-hole pad in the collector station by the common fence. The ITO will bring its bus to the demarcation point.

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

The equipment associated with the Attachment Facilities includes the following:

Purchase and install substation and line material:

Purchase and install substation material at Colonial Trail substation:

1. One (1), 230kV, 3000A center break switch
2. Three (3), 230kV metering accuracy CCVT's
3. Three (3), 230kV metering accuracy CT's
4. Three (3), 180 kV, station class arresters
5. Conductors, connectors, conduits, control cables, foundations, steel structures and grounding.

Purchase and install relay material at the Colonial Trail substation:

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 – Dual SEL-735 Transmission & G. I. Metering
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4506 – 3 phase CCVT Potential M.U. Box
6. One (1), 1323 – Dual SEL-487E/735 PMU & PQ
7. Two (2), 4541 - Control Cable M.U. Box

2. Transmission Line – Upgrades

PJM Network Upgrade #n6696 - Re-arrange line #271 to loop into and out of the new three breaker AD1-033 230 kV switching station between existing Fentress and Landstown 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:

Scope of work:

1. Install one (1) 230 kV SC Steel DDE Backbone structure (no switches) with foundations (Str. 274/9).
2. Install one (1) 230 kV SC Steel DDE Monopole structure with foundations (Str. 274/10).
3. Install two (2) Static poles with foundations.
4. Modify seven existing suspension towers for the installation of one fiber.
5. Modify two existing dead-end towers for the installation of one fiber.
6. Modify one existing backbone in Fentress substation for the installation of one fiber. This will include the installation of a splice on the backbone.
7. Cut the existing 3-Phase conductor between Strs. 274/11 and 274/10 and transfer the existing 3-Phase 2-721 ACAR conductor to the new backbone structure.
8. Cut the existing 3#6 shield wire between Strs 274/11 and 274/10. Transfer the 3#6 to new Backbone Str.
9. Install two (2) OPGW cables, of approximately 230' each, from modified Str. 22/2870 to new Str. 22/2871.
10. Install approximately 1.80 miles of 1-DNO 10585 OPGW from the new Backbone Structure to the existing backbone at Fentress Substation.
11. Install 3 spans of 7#7 wire between the proposed backbone and the proposed static poles.
12. Renumber approximately 10 structures with new line number 2XXX between Bedford Substation and Fentress Substation.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6695 - Build a three breaker AD1-033 230 kV switching station. The site is located along the 230kV line #271 from Fentress and Landstown substations.

The position of the switching station will be adjacent to the right of way of the existing 230 kV transmission line #271. The station will be positioned in such a way that the new backbone will align with the line between structures 271/10 and 271/9. 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 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.

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

The work required is as follows:

Purchase and install substation material:

1. Approximately 310' x 275' 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), 230kV, relay accuracy CCVTs
8. One (1), 230 kV, 3000 A wave trap
9. One (1), line tuner
10. Two (2), 230kV, 3000A, single-phase center break gang operated switches (for PVT's)
11. Four (2), 230kV, 100KVA power PT's for station service
12. Oil containment for 230kV PVT's
13. Two (2), 2" conduits from the substation backbone to the cable trough along with tracer wire.
14. One (1) 24' X 40' control enclosure
15. One (1) 125 VDC, 200 Ah station battery and 50 amp charger (size to be verified during detail engineering)
16. Approximately 240 FT of cable trough, with a 20 FT road crossing section
17. Station stone as required
18. Station lighting as required
19. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
20. Foundations as required including control house, equipment and bus support stands
21. 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. 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 – 600A PVT Disconnect Switch
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

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade # n6697 - 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 Fentress and Landstown 230kV substations.

Fentress 230 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #271 destination from Landstown substation to the new AD1-033 substation. Also replace line #271 relays with SEL-311L fiber relaying, install line #271 islanding transfer trip, and remove line #271 wave trap.

Purchase and install:

1. One (1), Remove Line 271 Wave Trap

Purchase and install relay material:

1. One (1), 1809 – 28" Dual SEL-311L Line Diff. w/ Reclosing Panel

Landstown 230 kV Substation

Project Summary:

Drawing work, relay resets, and field support necessary to change line #271 destination from Fentress substation to AD1-033 substation. Also install line #271 islanding transfer trip.

Purchase and install relay material:

1. One (1), 1604 – 24" Transmission Transfer Trip Panel

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Fentress	$88,742	$23,925	$16,962	$4,131	$133,760
Landstown	$36,510	$17,456	$7,189	$3,014	$64,169
Total Remote End Upgrades	$125,252	$41,381	$24,151	$7,145	$197,929

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:

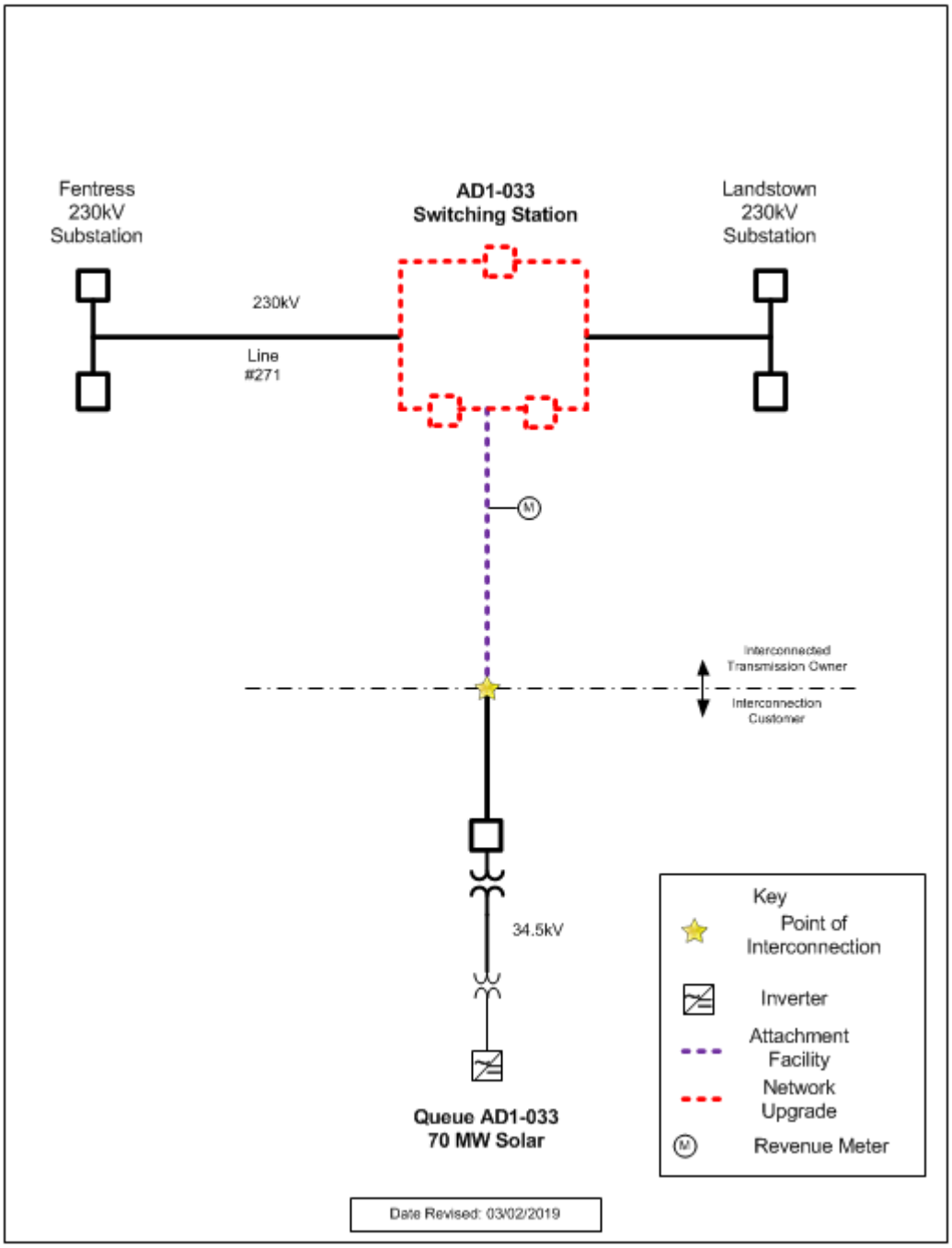
- Suitable Access Road from Substation to a Virginia State Maintained Roadway.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Conditional Use Permit for Substation.
- Any other Land/Permitting requirements required by the Substation.

ITO Real Estate Needs:

- The substation layout is complete and ITO requires a 310'x 275' 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 2020.

    - 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.
AD1-033 Substation General Arrangement