Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC2-079

Ivor – Oak Ridge 115 kV
32.3 MW Capacity / 85 MW Energy

August, 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 RES America Developments, Inc., (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 Isle of Wight County, Virginia. The installed facilities will have a total capability of 85.0 MW with 32.3 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 1, 2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC2-079 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Ivor – Oak Ridge 115 kV line.

Cost Summary

The AC2-079 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$494,636
Direct Connection Network Upgrades	$5,270,526
Non Direct Connection Network Upgrades	$2,059,312
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$7,824,474**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC2-079 is a request to interconnect an 85 MW new solar generating facility to be located in Isle of Wight County, Virginia. AC2-079 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Ivor – Oak Ridge 115 kV line #23. 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

- Plan to break ground June 1, 2021
- Permits – state level Permit By Rule and county level final site plan approval complete June 1, 2021
- Substantial site work completed October 1, 2021
- Delivery of major electrical equipment August 1, 2021
- Back Feed Power January 1, 2022
- Commercial Operation June 1, 2022

4. Scope of Customer's Work

AC2-079 is a solar facility consisting of thirty-four 2.5 MW Power Electronics FS2800 inverters. The inverters of AC2-079 are connected to the POI via seventeen 34.5/0.645 kV, 5.6 MVA generator step-up transformers and a 115/34.5/13.8 kV, 60/80/100 MVA thee-winding collector transformer. The POI is located on a tap of the Ivor – Oak Ridge 115 kV circuit, in the Dominion Virginia Power (DVP) system, Isle of Wight County, Virginia.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC2-079 three-breaker ring bus switching station adjacent to the #23 line between the existing Ivor and Oak Ridge substations. The site is located along Dominion Energy's existing 115 kV, #23 Line from the Bell Avenue to Oak Ridge Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 115 kV feed Interconnection Customer (IC) collector station for the new 85 MW Solar Farm.

The new 115 kV three breaker ring substation will share a common footprint and fence line with Customer (IC) collector station. The demarcation point between the two stations will be the 115 kV breaker disconnect switch 4-hole pad in the Customer (IC) collector station by the common fence. Dominion 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.

Transmission lines to renumber the existing line segment between the new three breaker ring substation and Bell Avenue substation. The existing line segment between the new three breaker ring substation and Suffolk substation shall remain Line 23.

Non-Direct Connection Upgrades include installing islanding transfer trip schemes at Poe, Bell Avenue & Suffolk substations and drawing updates at Ivor & Oak Ridge substations.

There will be drawing updates, transmission line protection and anti-islanding work required at the remote line terminals at the Suffolk, Poe, Ivor, Oak Ridge, and Bell Ave 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	$277,635	$149,813	$48,554	$18,634	$494,636
Total Attachment Facilities Cost	$277,635	$149,813	$48,554	$18,634	$494,636
AC2-079 115 kV Switching Station (n6749)	$2,354,176	$2,320,951	$345,824	$249,575	$5,270,526
Trans Line #23 (n6750)	$1,015,955	$600,800	$165,297	$57,963	$1,840,015
Remote Station Work (n6751)	$100,139	$82,104	$22,783	$14,271	$219,297
Total Network Upgrades	$3,470,270	$3,003,855	$533,904	$321,809	$7,329,838
Total Project Costs	$3,747,905	$3,153,668	$582,458	$340,443	$7,824,474

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 March 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 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 Center Break Switch
2. Three (3), 115 kV, Metering Accuracy CCVT's
3. Three (3), 115 kV,1000:5 Metering Accuracy CT's
4. Tubular bus as required
5. Steel Structures as required
6. Conductor, connectors, conduit, control cable, foundations and grounding material as required 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 Panel
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4506 – 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 #n6750 - Re-arrange line #23 to loop into and out of the new three breaker AC2-079 115 kV switching station

This project will include a new solar generation interconnect on the 23 line between existing stations Ivor and Oak Ridge. The typical structure type for the Line 23 / Line 44 corridor is DC "AR" Towers. The substation and backbone will be nearly lined up with the existing alignment, though offset approx. 40 feet to ensure clearance to the adjacent circuit (44 Line).

The project work summary is described below:

EXISTING FACILITIES TO BE REMOVED

1. Remove (2) AR type Steel suspension tower structures 23/295, 44/295 and 23/296, 44/296

EXISTING FACILITIES TO BE TRANSFERRED

1. Transfer two (2) existing 3-phase 336.4 ACSR conductors and 2-3#6 static wire to new steel Engineered Pole DDE structures 23/295, 44/295 and 23/296, 44/296.
2. Transfer existing 3-phase 336.4 ACSR conductor and 1-3#6 static wire to new backbone 23/295A.

PERMANENT FACILITIES TO BE INSTALLED

1. Install (2) Steel Engineered Pole DDE structures, 23/295, 44/295 and 23/296, 44/296
2. Install (1) 115KV Standard Backbone Structure 23/295A
3. Install (2) Engineered Static Poles 23/295B, 23/295C
4. Install approximately 0.12 miles of 7#7 ALWD static wire between the proposed backbone structures and the proposed static poles in a loop.
5. Renumber approximately 9.81 miles of existing 23 Line tower structures from Bell Avenue Substation to project site (approximately 72 structures).

ESTIMATE NOTES;

Additional Right-of-Way needs to be acquired for this project for clearance requirement purposes.

The contents of this estimate are valid for the geometric properties/relationships indicated in the general arrangement (footprint) provided by Substation Engineering. The final location and layout of Substation is subject to change; final foundation and structure costs and location may vary from estimate.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6749 - Build a three breaker AC2-079 115 kV switching station.

The facilities identified provides for the construction of a new 115 kV Three Breaker Ring Substation between Transmission Structures 15/74 and 15/75.

The objective of this project is to build a 115kV, 3-Breaker Ring Bus to support the new 85 MW Solar Farm built by Interconnection Customer (IC). The site is located along Dominion Energy's existing 115 kV, 23 Line from Bell Avenue to Oak Ridge Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 115 kV feed Interconnection Customer (IC) Collector Station for the new 85 MW Solar Farm.

The new 115 kV Three Breaker Ring Substation will share a common footprint and fence line with Customer (IC) Collector Station. The demarcation point between the two stations will be the 115 kV Breaker Disconnect Switch 4-hole pad in the Customer (IC) Collector Station by the common fence. Dominion 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.

Transmission Lines to renumber the existing line segment between the new Three Breaker Ring Substation and Bell Avenue Substation. The existing line segment between the new Three Breaker Ring Substation and Suffolk Substation shall remain Line 23.

Non-Direct Connection Upgrades include installing Islanding Transfer Trip schemes at Poe, Bell Avenue & Suffolk Substations and Drawing updates at Ivor & Oak Ridge substations.

Note: Currently, the scope and estimate assumes 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.

The work required is as follows:

Purchase and install substation material – Direct Network Upgrade:

1. Three (3), 115kV, 3000A, 40 kA, SF-6 Circuit Breakers
2. Six (6), 115kV, 2000A Center Break Switches
3. Two (2), 115kV, 2000A, 2-Pole Center Break Switches (for PVT's)
4. Six (6), 115kV, CCVT's relay accuracy
5. Two (2), 2000A, Vertically Mounted, Wave Traps
6. Two (2), Line Tuners
7. Six (6), 90kV MO, Station Class, 74kV MCOV Surge Arresters
8. Four (4), 115kV, 100KVA Power PT's for Station Service
9. One (1), 24' x 40' Control Enclosure, prewired by Trachte
10. One (1), 135VDC, 300Ah Batteries with Charger
11. Oil Containment as required for 115kV PVT's.
12. Cable Trough as required
13. Tubular bus as required
14. Ground Grid as required
15. Fence as required
16. Steel Structures as required
17. Conductor, connectors, conduit, control cable, foundations and grounding material as required 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 Throwover Switch
10. Two (2), 4016 – 600 A Disconnect Switch Fused @ 500A
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), 4523 – Security Camera Interface Box
21. One (1), 5616 – Station Security Panel
22. One (1), High Voltage Protection (HVP) Box
23. One (1), Telephone Interface Box

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6751 - Remote protection and communication work.

ITO protection requirements to reliably interconnect the proposed generating facility with the transmission system have been determined. As a result, drawing updates, transmission line protection and anti-islanding work required at the remote line terminals at the Suffolk, Poe, Ivor, Oak Ridge, and Bell Ave substations. These costs include the following:

Suffolk 115 kV Substation

Project Summary:
AC2-079 provides for the drawing updates, relay resets and installation of an Islanding Transfer Trip scheme necessary to support new GI on Line 23. This project is the Indirect Network Upgrade for the AC2079 Generator Interconnect project.

Purchase and install relay material:
1. One (1), 1604 – 28" Transmission Transfer Trip Panel

Poe 115 kV Substation

Project Summary:
AC2-079 provides for the installation of Islanding Transfer Trip scheme on line 106. This project is the Indirect Network Upgrade for the AC2079 Generator Interconnect project.

Purchase and install relay material:
1. One (1), 1604 – 28" Transmission Transfer Trip Panel

Ivor 115 kV Substation

Project Summary
AC2-079 provides for the Drawing Updates necessary to reflect the line 23 New Number and Destination Change to new GI. Substation.

Purchase and install relay material:
1. No Material

Oak Ridge 115 kV Substation

Project Summary
AC2-079 provides for the Drawing Updates necessary to reflect the line 23 New Destination Change to new GI. Substation.

Purchase and install relay material:
1. No Material

Bell Ave 115 kV Substation

Project Summary
AC2-079 provides for the drawing work, relay resets, and field support necessary to change the Line 23 destination from Suffolk to the new AC2079 Generator Interconnect Substation. Install Islanding Transfer Trip scheme. This project is the Indirect Network Upgrade for the AC2079 Generator Interconnect project.

Purchase and install relay material:
1. One (1), 1604 – 28" Transmission Transfer Trip Panel

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Bell Station Protection	$32,275	$27,368	$7,079	$4,757	$71,479
Ivor Drawing Updates	$6,523	$0	$1,841	$0	$8,364
Oak Ridge Drawing Updates	$6,523	$0	$1,841	$0	$8,364
Suffolk Station Protection	$27,409	$27,368	$6,011	$4,757	$65,545
Poe Substation Protection	$27,409	$27,368	$6,011	$4,757	$65,545
Total Remote Relay Upgrades	$100,139	$82,104	$22,783	$14,271	$219,297

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

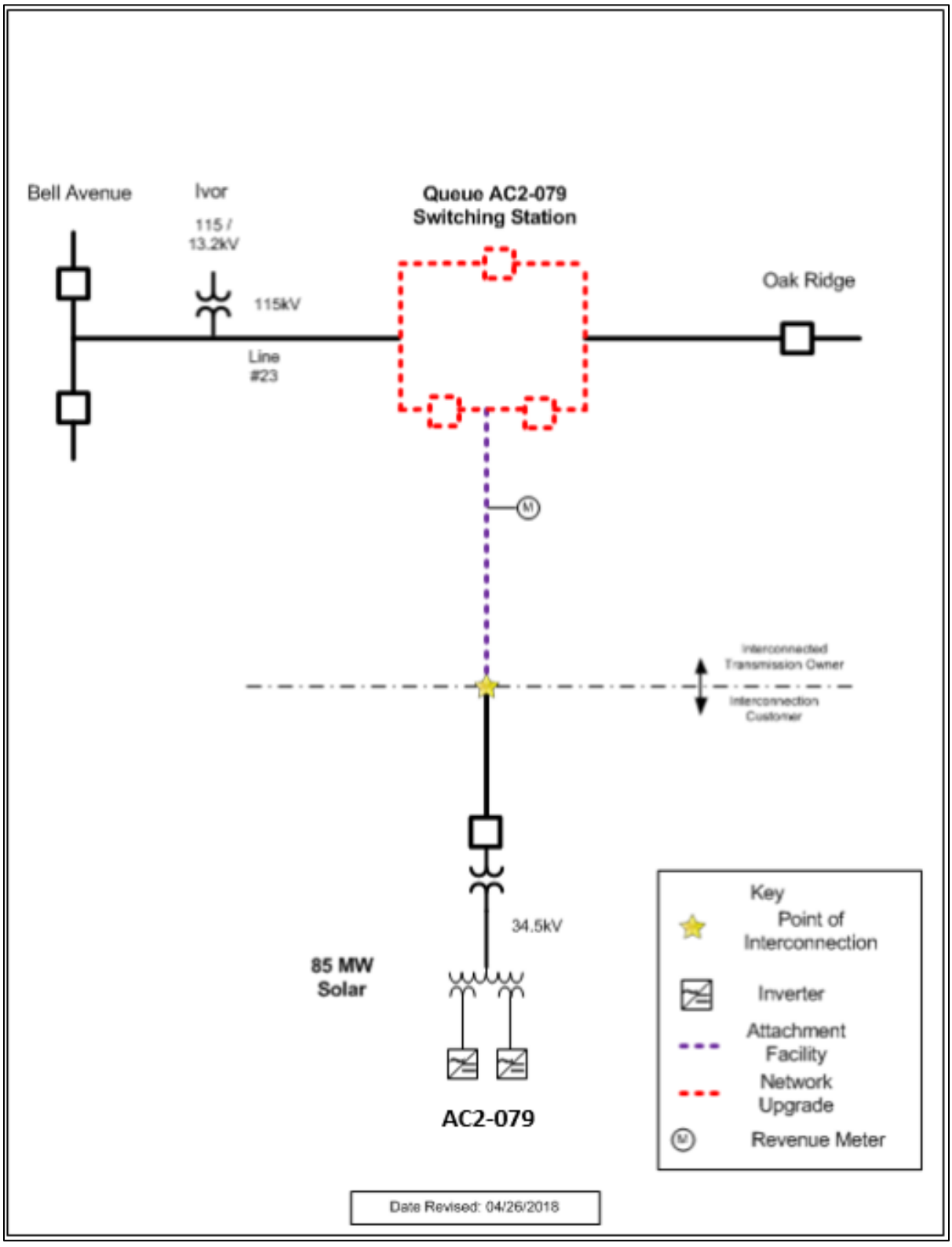
The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

- 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 260'x 175' 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 March 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.
AC2-079 Switching Station General Arrangement