Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-042

Altavista – Mt Airy 69kV
15.96 MW Capacity / 42 MW Energy

February, 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 Sycamore Solar I, LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). IC has proposed a solar generating facility located in Pittsylvania County, VA. The installed facilities will have a total capability of 42 MW with 15.96 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 1/31/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-042 will interconnect with the ITO transmission system via a new single breaker tap switching station that connects on the Altavista – Mt Airy 69kV line #35.

Cost Summary

The AC1-042 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 3,007,125
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 1,087,876
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 4,095,001**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC1-042 is a request to interconnect a 42 MW new solar generating facility to be located in Pittsylvania County, Virginia. The proposed generating facility will interconnect with the ITO's new AC1-042 69kV Switching Station via a new breaker terminal station. The requested in-service date is January 31, 2022. 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 March 31, 2021
- Permits – state level Permit By Rule and county level Final Site Plan approval complete by December 31, 2020
- Substantial site work completed September 1, 2021
- Delivery of major electrical equipment June 1, 2021
- Back Feed Power October 31, 2021
- Commercial Operation January 31, 2022

4. Scope of Customer's Work

IC will build a solar generating facility in Pittsylvania County, Virginia. The generating facility (Sycamore Solar I) will be comprised of solar arrays. AC1-042 consists of 21 x 2.09 MW SMA Sunny Central inverters. The 21 x 34.5/0.39 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 69/34.5 kV wye grounded wye grounded main power transformer with a rating of 27/36/44 MVA. The AC1-042 POI will be at a tap of the Altavista – Mt Airy 69kV line #35.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC1-042 69kV one breaker terminal switching station adjacent to the transmission right of way. The site is located along the ITO's 69kV Line #35 near the Mt Airy DP substation. The switching station will be positioned at the transmission structure 35/788 in such a way that the 69kV tap line can be taken directly rolled onto the Substation Backbone structure. The switching station will consist of one 69kV Circuit Breaker will be installed at this terminal along with disconnect switches, arresters, & PT's. Metering equipment, including metering accuracy CT's and metering accuracy CCVT's. The demarcation point between the switching station and the collector station will be the 4-hole pads on the ITO's disconnect switch. The IC will bring its bus over the common fence to the demarcation point. The IC will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the IC. The ITO requires transmission line protection and anti-islanding work

required at the remote lines terminals in Altavista, Gretna, and Bearskin. 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	$1,281,245	$1,376,179	$212,130	$137,571	$3,007,125
Total Attachment Facilities Cost	$1,281,245	$1,376,179	$212,130	$137,571	$3,007,125
Line #35 Transmission work (n6325)	$447,729	$278,352	$83,868	$29,089	$839,038
Remote relay (n6326)	$97,577	$112,793	$20,840	$17,628	$248,838
Total Network Upgrades	$545,306	$391,145	$104,708	$46,717	$1,087,876
Total Project Costs	$1,826,551	$1,767,324	$316,838	$184,288	$4,095,001

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 to 12 months

ITO requires the site to be fully graded and permitted site so they can start construction by January 2021.

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

Build a one breaker AC1-042 115 kV terminal switching station. The site is located adjacent to the transmission right of way along the ITO's 115kV Line #35 near Mt Airy DP Substation. The switching station will be positioned at the transmission structure 35/788 in such a way that the 69kV tap line can be taken directly rolled onto the Substation Backbone structure. The switching station will consist of one 69kV Circuit Breaker will be installed at this terminal along with disconnect switches, arresters, & PT's. Metering equipment, including metering accuracy CT's and metering accuracy CCVT's. The demarcation point between the switching station and the collector station will be the 4-hole pads on the ITO's disconnect switch. The IC will bring its bus over the common fence to the demarcation point. The IC will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the IC.

Purchase and install substation material:

1. Approximately 130' X 125' site preparation and grading as required for installation of the switching station (by the IC)
2. Approximately 510 linear FT of 5/8" Chain Link, 12 FT tall, perimeter fence around the station along with the security cameras and integrators (Design 4 Standard).
3. Full substation ground grid as per engineering standards
4. One (1), 72kV, 3000A, 40 kA, SF6 Circuit Breaker
5. One (1), 69 kV, 2000A, Vertically Mounted, Center Break Switch
6. One (1), 69 kV, 2000A, Horizontally Mounted, Center Break Switch
7. One (1), 69 kV, CCVT, Relay Accuracy
8. One (1), 1600 A, Vertically Mounted, Wave Trap along with Line Tuner
9. Six (6), 90 kV MO, 74 kV MCOV Station Class Arresters
10. One (1), 115kV, 50 KVA Power PT for Station Service
11. One (1), 24' x 30' Control Enclosure (w/ provisions for backup generator connection for secondary Station Service)
12. One (1), 135 VDC, 300 Ah Batteries and 50A Charger
13. Three (3), 69 kV, Metering Accuracy CCVT's
14. Three (3), 69 kV, Metering Accuracy CT's
15. Oil Containment system for the 69kV PVT.
16. Steel structures as required including switch stands, bus supports, station service transformer, CCVT and wave trap supports
17. Foundations as required including control house, equipment and bus support stands
18. Conductors, connectors, conduits, control cables and grounding materials
19. One (1) 115 kV Backbone Structure (by Transmission)

Purchase and install relay material:

1. One (1), 1510 – 28" Dual SEL-351-7 Transmission Breaker w/ Reclosing Panel
2. One (1), 4510 - SEL-2411 Breaker Annunciator
3. One (1), 4000 – Station Service Potential M.U. Box
4. One (1), 4007 – 225A Outdoor Transmission Yard AC NQOD
5. One (1), 4019 – 225A Three Phase Throw Over Switch

6. Three (3), 200A Disconnect Switch
7. One (1), 4153 – Wall Mount Station Battery Monitor
8. One (1), 5613 – Annunciator / RTU / Communications Panel
9. One (1), 5610 – Wall Mounted Fiber Optic Management Housing
10. One (1), 4526_A – Circuit Breaker Fiber Optic M.U. Box
11. One (1), 5603 – Station Network no. 1 Panel
12. One (1), 5603 – Station Network no. 2 Panel
13. One (1), 5616 – Station Security Panel
14. One (1), Telephone Interface Box
15. One (1), 1109 – 28" Dual SEL-587Z Transmission Bus Panel
16. One (1), 1425 – Generation/NUG/PJM/IPP Metering Panel
17. One (1), 4524 – Revenue Metering C.T. M.U. Box
18. One (1), 4531 – Generator Interconnect CCVT Potential M.U. Box
19. One (1), 1323 – 28" SEL-451 PMU Panel w/SEL 735/735
20. Two (2), 4541 - Control Cable M.U. Box
21. One (1), 1604 – 28" Transmission Transfer Trip Panel
22. One (1), 1605 – 28" Carrier Blocking & Transfer Trip Panel
23. One (1), 4507 - Single Phase CCVT Potential M.U. Box
24. One (1), 1603 – 28" SEL-451 Islanding Control Scheme Panel
25. One (1), 5202 – 26" APP 601 Digital Fault Recorder

2. Transmission Line – Upgrades

PJM Network Upgrade #n6326 – Rebuild the Mt. Airy 69kV tap of Line #35 to accommodate the interconnection of the new one breaker Queue AC1-042 substation.
Constructed in 2012 on Weathering Steel Dom-pole structures, the Mt. Airy tap of the 35 line is an existing 69 kV line that runs from the main 35 line to Mt. Airy D.P. Queue AC1-042 will require the installation of a new one-breaker substation near Mt. Airy D.P. The transmission work scope is for the construction of a new substation connection on Transmission Line #35 between the 35 line main-line and Mt. Airy D.P. The line connection will require the installation of (1) backbone structure, one (1) Double-Dead-End H-Frame Structure, and three spans of new conductor and static wire.

PERMANENT FACILITIES TO BE INSTALLED:

1. Install one (1) SC Heavy-Duty Steel DDE Backbone structures (no switches) with foundations (Str. 35/786). NOTE: Existing Survey data for this line is currently limited. Once Survey data is obtained, we will be able to determine whether a 55' or a 70' tall Backbone is needed. A 70' Backbone was used for the purposes of this estimate.
2. Install one (1) Dom-pole H-Frame DDE anchor structure (Str. 35/787).
3. Install approximately 0.24 miles of new 3-phase 336 ACSR 26/7 "Linnet" conductor from Ex. Str. 35/785 to the existing Mt. Airy Backbone.
4. Install two (2) new 7#7 ALWD static wires (approximately 0.24 miles each) from Ex. Str. 35/785 to the existing Mt. Airy Backbone.

PERMANENT FACILITIES TO BE REMOVED:

1. Remove one 3#6 ALWD Static wire (approximately 0.24 miles) from Ex. Str. 35/785 to the existing Mt. Airy Backbone.

2. Remove one 3#6 ALWD Static wire (approximately 0.07 miles) from Ex. Str. 35/787 to the existing Mt. Airy Backbone.
3. Remove approximately 0.24 miles of 3-phase 336 ACSR 26/7 "Linnet" conductor from Ex. Str. 35/785 to the existing Mt. Airy Backbone.
4. Remove two (2) direct-embed Dom-pole monopole suspension structures.
5. Remove one (1) direct-embed Dom-pole H-Frame anchor structure.

CONCEPTUAL DESIGN NOTES:

1. The existing 35 line needs to remain in service to Mt. Airy D.P. until the new permanent facilities are built. The new structures will be built adjacent to the existing R/W, in new R/W that must be granted to the ITO by the IC. This will allow Mt. Airy D.P. to remain in service during construction, and avoids the need for a temporary line for this project.

2. Mecklenburg Electric Cooperative has confirmed that Mt. Airy D.P. can be taken out of service for a short duration of time (1-2 days) in low-load, mild-weather conditions (spring and fall). During this short outage, conductor and static wire would be installed from Ex. Str. 35/785 – new Backbone Str. 35/786 and from new H-Frame anchor Str. 35/787 to the Existing Mecklenburg Backbone Structure.

3. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #6325 - 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 Altavista, Gretna, and Bearskin 69kV substations. These costs include the following:

Altavista 69 kV Substation

Project Summary
Drawing work, relay resets, and field support at Altavista Substation to accommodate the new AC1-042 interconnection substation which is to be tapped from Line # 35 between Altavista and Gretna Substations. Also, install Line 35 Islanding & Breaker Failure Transfer Trip schemes to work with the new AC1-042 Substation. Include AC1-042 Substation in the existing Line/Breaker Failure Transfer Trip and Carrier Blocking schemes.

Purchase and install relay material:

1. One (1), CR-51C Islanding Transfer Trip Set
2. One (1), 1604 – 24" Transmission Transfer Trip Panel

Bearskin 69 kV Substation

Project Summary
Drawing work, relay resets, and field support at Bearskin Substation to accommodate the new AC1-042 interconnection substation which is to be tapped from Line # 35 between Altavista and Gretna Substations. Also, install Islanding Transfer Trip at Bearskin to the AC1-042 Substation via Gretna Substation. Since Gretna is only a Line Tie Breaker station, Bearskin Sub will also be required to be included in the Islanding Transfer Trip boundaries.

Purchase and install relay material:

1. One (1), 1604 – 28" Transmission Transfer Trip Panel (Islanding Transfer Trip Send to Gretna Substation (CT-51C), Line/Breaker Failure Transfer Trip Receive from AEP's Smith Mountain Substation (CR-51C), and Line/Breaker Failure Transfer Trip Receive from AEP's East Danville Substation (CR-51C))

Gretna 69 kV Substation

Project includes drawing work, relay resets, and field support at Gretna Substation to accommodate the new AC1-042 interconnection substation which is to be tapped from line # 35 between Altavista and Gretna Substations. Also, install line # 35 islanding & breaker failure transfer trip schemes to now work with the new AC1-042 Substation.

Purchase and install relay material:

1. One (1), 1604 – 28" transmission transfer trip panel (islanding transfer trip receive from bearskin, islanding transfer trip send to AC1-042, and breaker failure transfer trip from AC1-042.

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Altavista	$37,102	$38,657	$7,902	$6,042	$89,703
Bearskin	$27,748	$37,068	$6,055	$5,793	$76,664
Gretna	$32,727	$37,068	$6,883	$5,793	$82,471
Total Remote Relay Upgrades	$97,577	$112,793	$20,840	$17,628	$248,838

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 Sections 24.1 and 24.2.

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

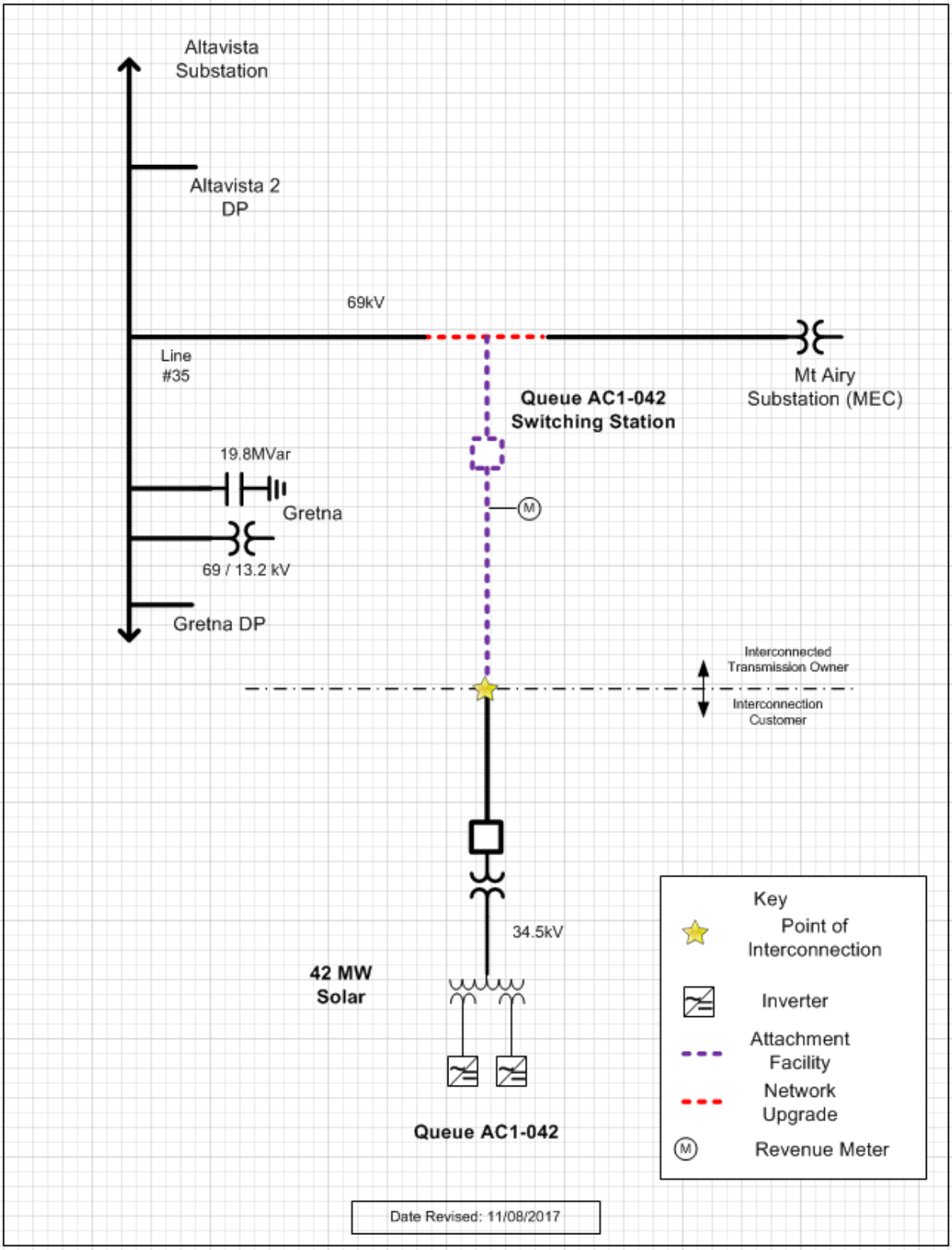
The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

- 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 130'x 125' 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 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 then 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.
AC1-042 Switching Station General Arrangement