Generation Interconnection

Feasibility Study Report

Queue Position AB1-125

Interconnection Customer (IC) has proposed a solar photovoltaic generating facility located in Frederick County, MD. The installed facilities will have a total capability of 15.0 MW with 5.7 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is July 1, 2017. **This study does not imply a Potomac Edison commitment to this in-service date.**

Point of Interconnection (POI)

AB1-125 will interconnect with Potomac Edison electric system at either one of the following points of interconnection: Option 1 will be a tap onto the Monocacy-Carroll 34.5 kV line; or Option 2 will be a direct connect to existing 12.5kV bus at Walkersville substation. Note that Option 1 POI is FERC jurisdictional whereas Option 2 POI is Non-FERC or state jurisdictional.

Cost Summary

The AB1-125 project will be responsible for the following costs:

Description	Total Cost
Transmission Owner facilities	$ 50,000
Transmission Upgrades	$ 142,700
Non-Direct Network Upgrades	$ 12,300
Total Costs	**$ 205,000**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Transmission Owner Scope of Work

The primary direct connection requirements for the AB1-125 generation project to the Potomac Edison transmission system is detailed in the following table:

Description	Total Cost
Install two (2) 34.5 kV, 1200 A, air switches on Carroll-Monocacy 34.5 kV line. Install 34.5 kV metering in AB1-125 facilities and build single span of 336 ACSR to customer's Point of Interconnection.	$ 142,700
Install Line Tap from 34.5 kV line to POI	$ 50,000
Adjust remote relay settings at Carroll and Monocacy substations	$ 12,300
Total Attachment Facility Costs	**$ 205,000**

Note that the below costs do not include CIAC Tax Gross-up.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to change. More accurate estimates will be determined as a part of the System Impact Study. The Interconnection Customer will be responsible for the actual cost of the direct connection that is implemented. In addition, the Interconnection Customer is responsible to provide metering, disconnect switches and high-side breakers for each unit, as the Interconnection Customer will own this equipment. First Energy herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission system.

Schedule

Based on the extent of the Potomac Edison primary direct connection and system upgrades required to support the AB1-125 generation project, it is expected to take a minimum of 12 months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement for Interconnection Customer to make a preliminary payment to First Energy which funds the first three months of engineering design that is related to the construction of the Direct Connection facilities. It further assumes that the Interconnection Customer will provide all rights-of-way, permits, easements, etc. that will be needed. A further assumption is that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined Direct Connection and network upgrades, and that all system outages will be allowed when requested.

Note that the First Energy findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the System Impact Study. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. First Energy herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission system.

Interconnection Customer Requirements

In addition to the Potomac Edison facilities, the Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the First Energy “Requirements for Transmission Connected Facilities" document including:

1. The purchase and installation of fully rated 34.5 kV circuit breaker on the high side of the AB1-125 step-up transformer.

2. The purchase and installation of the minimum required First Energy generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition (“SCADA”) equipment to provide information in a compatible format to the First Energy Transmission System Control Center.

4. The establishment of dedicated communication circuits for SCADA to the First Energy Transmission System Control Center.

5. A compliance with the First Energy and PJM generator power factor and voltage control requirements.

6. The execution of a back-up service agreement to serve the customer load supplied from the AB1-125 generation project interconnection point when the units are out-of-service. This assumes the intent of the Interconnection Customer is to net the generation with the load.

The above requirements are in addition to any metering or other requirements imposed by PJM.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer 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.

Transmission Owner Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

http://www.firstenergycorp.com/feconnect
http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts - First Point of Interconnection

The following Network Impacts Analysis pertains to the first option point of interconnection (Option 1) which is considered to be the main or primary point of interconnection for the project. Please refer to the next section title "Alternate or Secondary Point of Interconnection" for Network Impacts regarding the secondary or alternate point of interconnection.

The Queue Project AB1-125 was evaluated as a 15.0 MW (Capacity 5.7 MW) injection tapping the Carroll-Monocacy 34.5kV line in the APS area. Project AB1-125 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). The Study is based on Summer Peak Analysis – 2019. Project AB1-125 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Generator Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads
(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

No Short Circuit study was required to be conducted by PJM for AB1-125 because the size of this project is less than 20 MW inverter based project connecting to a not monitored PJM facility.

First Energy conducted the Short Circuit and Dynamics Analysis Study and here are the findings:

In accordance with the RTEP process, a short circuit analysis was not conducted by PJM since the AB1-125 generation project connection is to the Potomac Edison transmission system less than 100 kV. Therefore, the FE Protection staff conducted a short circuit review of the project connection. An assumption of this study was that solar generation projects will contribute no appreciable fault current to the breakers on the PE transmission system. As stated by EPRI: "Inverters are generally designed to limit fault currents to 130% or less of rated current. Thus they can usually be disregarded when conducting fault studies." Based on this statement, the results of the FE analysis showed that no PE circuit breaker will exceed its interrupting capability with the implementation of the AB1-125 generation project. Therefore no circuit breaker reinforcements will be required.

No short circuit review was done for the secondary POI.

In accordance with the RTEP study process, if a dynamics study is needed the results for the AB1-125 generation project will be included in the System Impact Study stage of the RTEP process.

Affected System Analysis & Mitigation

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

None

Light Load Analysis - 2019

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements for Option 1 POI

None identified.

Network Impacts – Alternate or Secondary Point of Interconnection

The following Network Impacts Analysis pertains to the second point of interconnection (Option 2) which is considered to be the alternative option point of interconnection for AB1-125 project. Please refer to the previous section title "Network Impacts - First Point of Interconnection" for Network Impacts regarding the main or primary point of interconnection.

The alternate point of interconnection ("POI") for AB1-125 is to connect to the 12.5 kV bus at Walkersville substation.

Summer Peak Analysis - 2019

Generator Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads
(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

None.

Affected System Analysis & Mitigation

Delivery of Energy Portion of Interconnection Request
PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under

study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

None

Light Load Analysis - 2019

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

First Energy Load Flow Study Analysis:

For the secondary point of interconnection, the AB1-125 generation project chose to connect to the 12.5 kV bus at Walkersville substation. The results of the FE analysis for the secondary POI show that there are upgrades required for the deliverability of the AB1-125 Generation Project generation to the PE transmission system. The identified violations are as follows:

Study results indicate high voltage and voltage flicker violations on the 12.5 kV system at Walkersville substation.

System Reinforcements for Option 2 POI

None identified.

Additional Interconnection Customer Responsibilities:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.