

***Generation Interconnection
Combined Feasibility and System
Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position AB2-003***

Halfway – Milnor 34.5 kV

September 2016

Preface

The intent of the Combined Feasibility and System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation, if any, is included in the System Impact Study.

The Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. Interconnection Customer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs associated with them will be addressed when seeking an Interconnection Agreement as outlined below. Interconnection Customer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Interconnected Transmission Owner standards.

General

Paradigm Power LLC (“Interconnection Customer”) has proposed a solar generating facility located at 13300 Greencastle Pike, Hagerstown, Washington County, MD. The installed facilities will have a total capability of 4.4 MW with 1.7 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 31, 2017. **This study does not imply a Potomac Edison (“Interconnected Transmission Owner”) commitment to this in-service date.**

Point of Interconnection

AB2-003 generating facility will interconnect with the Potomac Edison distribution system by tapping onto the Halfway – Milnor 34.5 kV line. Refer to the one-line diagram in Appendix 2 for system configuration.

Costs Summary

Interconnected Transmission Owner facilities, network upgrades and related costs required for this interconnection project are listed below.

- (a.) Attachment Facilities:
 - Estimated total time to complete: 12 Months
 - Estimated total costs: **\$ 204,000** (Total with Tax: **\$ 275,500**), detailed as follows:
 - (a.1) Install 2-34.5 kV, 1200A, loadbreak air switches on the Halfway-Milnor (HFW) 34.5 kV line. Install 34.5 kV metering in customer's facilities and build single span of 336 ACSR to point of interconnection with customer.
 - Cost estimate: \$ 204,000 (Total with Tax: \$ 275,500)
 - Network Upgrade Number: Not Required
- (b.) Direct Connection Network Upgrades, \$ 0 (None)
- (c.) Non-Direct Connection Network Upgrades:
 - Estimated total time to complete: 12 Months
 - Estimated total costs: **\$ 56,400** (Total with Tax: **\$ 65,800**), detailed as follows:
 - (c.1) Revise relay settings on the Milnor 34.5 kV line for AB2-003 interconnection at halfway substation.
 - Estimated costs: \$ 18,900 (Total with Tax: \$ 22,600)
 - Network Upgrade Number: n5096
 - (c.2) Revise relay settings on the Halfway 34.5 kV line for AB2-003 interconnection at Huyetts substation.
 - Estimated costs: \$ 18,900 (Total with Tax: \$ 22,600)
 - Network Upgrade Number: n5097
 - (c.3) Revise relay settings on the Halfway 34.5 kV line for AB2-003 interconnection at Milnor substation.
 - Estimated costs: \$ 18,600 (Total with Tax: \$ 20,600)
 - Network Upgrade Number: n5098
- (d.) Direct Connection Local Upgrades: \$ 0 (None)
- (e.) Non-Direct Connection Local Upgrades: \$ 0 (None)
- (f.) Contributions for Previously Identified Upgrades: \$ 0 (None)
- (g.) Baseline Upgrades: \$ 0 (None)
- (h.) Option to Build: \$ 0 (None)

Net total costs (a.) to (h.): \$ 260,400

Gross total costs (a.) to (h.): \$ 341,300

Interconnection Customer Requirements

In addition to the Potomac Edison facilities, AB2-003 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 interrupting device on the high side of the AB2-003 step-up transformer.
2. The purchase and installation of the minimum required FirstEnergy 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 FirstEnergy Transmission System Control Center.
4. The establishment of dedicated communication circuits for SCADA to the FirstEnergy Transmission System Control Center.
5. A compliance with the FE and PJM generator power factor and voltage control requirements of 0.95 leading to 0.95 lagging measured at the generator's terminals.
6. The execution of a back-up retail service agreement with the electric distribution company to serve the customer load supplied from the (AB2-003) generation project interconnection point when the units are out-of-service.

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.

Interconnected 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>

Schedule

Based on the extent of the FirstEnergy Attachment Facilities and Network Upgrades to support the AB2-003 generation project, it is expected to take a minimum of twelve (12) months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement for AB2-003 to make a preliminary payment to FirstEnergy which funds the first three months of engineering design that is related to the construction of the Attachment Facilities and Network Upgrades facilities. It further assumes that AB2-003 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 Attachment Facilities and Network Upgrades, and that all system outages will be allowed when requested.

Network Impacts

The Queue Project AB2-003 was evaluated as a 4.4 MW (Capacity 1.7 MW) injection at the Huyetts 34.5kV substation in the APS area. Project AB2-003 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-003 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

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

Not required.

Short Circuit

(Summary of impacted circuit breakers)

None

Affected System Analysis & Mitigation

NYISO Impacts:

None

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 - 2020

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

System Reinforcements

Short Circuit

None

Stability and Reactive Power Requirement

None

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Not Applicable

Light Load Load Flow Analysis Reinforcements

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements

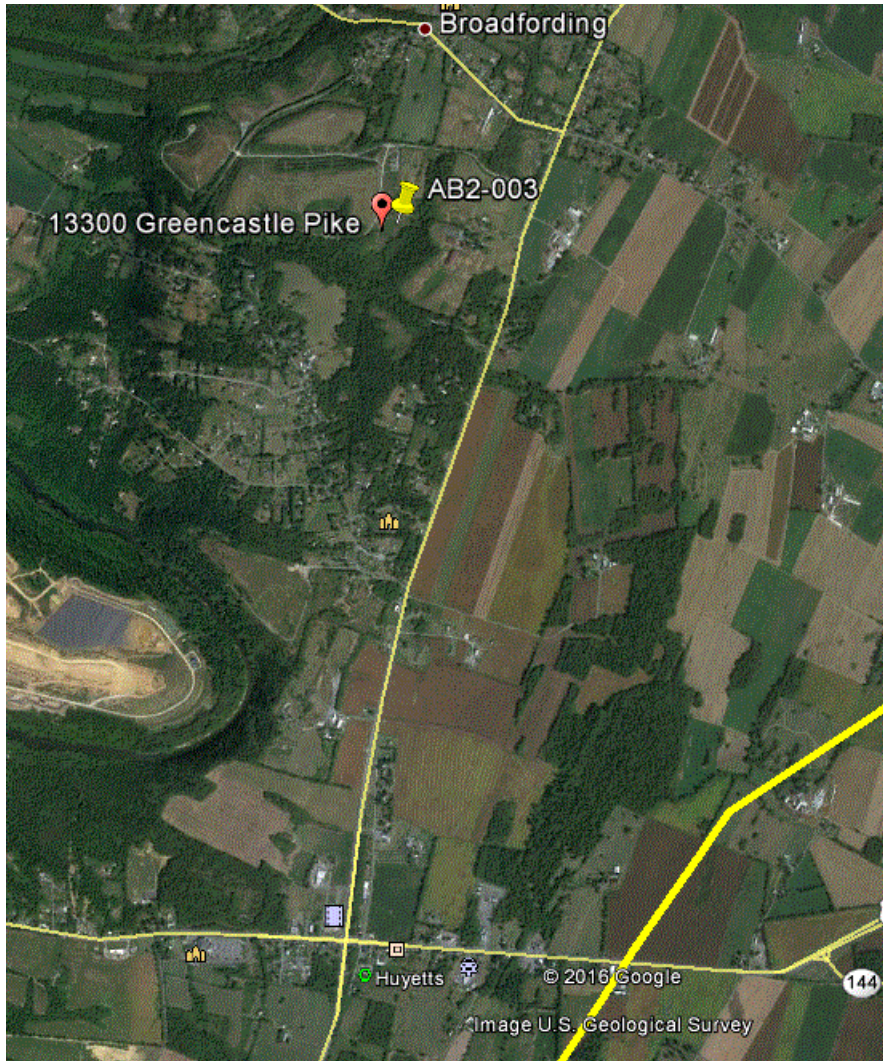
(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Not Applicable

Appendix 1

Facility Location

PJM Queue Project Number: AB2-003



Appendix 2

Interconnection Single Line Diagram

PJM Project Queue Number: AB2-003

