Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-110

Englishtown-Millhurst 34.5kV

August 2016

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, 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 will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC), has proposed a solar generating facility located in Monmouth County, NJ. The installed facilities will have a total capability of 11.1 MW with 4.2 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is April 2017. **This study does not imply a Jersey Central Power & Light Company (JCPL) commitment to this in-service date.**

Point of Interconnection

AB2-110 will interconnect with the JCPL system along the Millhurst-Route 33 Switch Point 34.5kV line.

Cost Summary

The AB2-110 project will be responsible for the following costs:

Description	Total Cost
Transmission Owner facilities	$ 590,500
Transmission Upgrades	$ 0
Total Costs	**$ 590,500**

Transmission Owner Scope of Work

The primary direct connection of this project will be accomplished by tapping the Millhurst – Route 33 Switch Point (I-87) 34.5 kV line, and installing an overhead 34.5 kV line to the point of interconnection ("POI"), 3-34.5 kV gang-operated SCADA controlled switches at the tap location, and 34.5 kV interconnection metering. The Interconnection Customer will be responsible for constructing all of the facilities on its side of the POI including the attachment line. The Interconnection Customer may not install above ground equipment within any JCP&L right-of-way unless permission to do so is expressly granted by JCP&L.

Activity	Estimate Cost	Tax (if Applicable)	Total Cost
Feasibility study for solar generation interconnection of AB2-110 to JCPL I87 line 34.5kV subtransmission system. Construct 34.5kV line tap/connection and install 3-34.5kV gang-operated SCADA controlled switches at tap location. Build one (1) span of 34.5KV line from tap to point of interconnection (poi). Pole at poi to be purchased and installed by customer. Revenue meter to be installed by JCPL.	$ 474,500	$ 76,400	$ 550,900
Adjust relay settings on Wyckoff Street line relaying @ Englishtown SS	$ 58,000	$ 7,900	$ 65,900
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Total Estimated Costs	**$ 590,500**	**$ 92,200**	**$ 682,700**

System Protection Analysis

An analysis was conducted to assess the impact of the (AB2-110) generation project on the system protection requirements in the area. The results of this review have identified that all current relaying and protection at Englishtown and Wyckoff Street substation is sufficient in protecting the transmission system. The Interconnection Customer will still be responsible for meeting the generator interconnection requirements in FE's "Requirements for Transmission Connected Facilities" document.

The fault currents on the Millhurst – Route 33 Switch Point (I-87) 34.5 kV are listed below.

Three phase fault current:	5669.9 Amps
Single line to ground fault current:	3489.7 Amps
Positive Sequence Thevenin (ohms):	1.17256 + j3.31160
Zero Sequence Thevenin (ohms):	2.57840 + j9.77688

These values are for the current system configuration. Any system changes in the area could have a significant impact on these values. It will be the responsibility of the Interconnection Customer to make any protection upgrades required should this occur. The proposed interconnection facilities must be designed in accordance with the "FirstEnergy Requirements for Transmission Connected Facilities" document.

Interconnection Customer Requirements

In addition to the JCP&L facilities, the Interconnection Customer is will also be responsible for meeting all criteria as specified in the applicable sections of the FE "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 (AB2-110) step-up transformer.

2. The purchase and installation of the minimum required FE 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 FE Transmission System Control Center.

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

5. A compliance with the FE 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 (AB2-110) 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.

Schedule

Based on the extent of the JCP&L primary direct connection and system upgrades required to support the (AB2-110) generation project, it is expected to take a minimum of 8 months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the Interconnection Customer to make a preliminary payment to FE 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.

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.

JCPL 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

The Queue Project AB2-110 was evaluated as a 11.1 MW (Capacity 4.2 MW) injection tapping the Englishtown-Millhurst 34.5kV line in the JCPL area. Project AB2-110 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-110 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

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

None.

Short Circuit

(Summary of impacted circuit breakers)

None.

JCPL Reactive Analysis

It will be mandatory for the (AB2 110) generation project to have a range of dynamic reactive capability that supports its operation from a 0.95 leading to 0.95 lagging power factor measured at the generator's terminals. The FE studies show that the addition of solar projects can cause voltage swings as their output oscillates with moving clouds without continuous regulation, and system voltages can exceed the established limits. Should the Interconnection Customer fail to provide dynamic reactive capability from the (AB2-110) generation project for any reason once interconnected, the FE and/or PJM Dispatchers may need to take action to curtail its output to prevent non-compliance with voltage criteria.

Affected System Analysis & Mitigation

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

None.

Attachment 1. Site Location

Attachment 2. Single Line Diagram