Generation Interconnection Combined Feasibility/System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AB2-094

Warren Glen Switch Point 34.5kV

(Revised)

October 2016

Preface

The intent of the Combined Feasibility/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. 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 associated with them will be addressed when seeking an Interconnection Agreement as outlined below. . Developer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

General

NJ Battery Energy Storage Project 1, LLC, the Interconnection Customer (IC), has proposed a battery storage facility located in Hunterdon County, NJ. The installed facilities will have a total capability of 20 MW with 0 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 2017. **This study does not imply a Jersey Central Power & Light Company (JCPL) commitment to this in-service date.**

Point of Interconnection

AB2-094 will interconnect with the JCPL system from the Warren Glen Switch Point 34kV substation.

Cost Summary

The AB2-094 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 93,900
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 189,500
Transmission System Upgrades	$ 0
Total Costs	**$ 283,400**

Overview

The proposed POI for the AB2-094 generation project will be located on the Warren Glenn 34.5 kV substation bus. Attachment 1 provides an aerial view of the proposed location of the facility. The connection of AB2-094 will be accomplished by installing SCADA controlled switches on the A27 line adjacent to Warren Glen substation, automating two sets of switches in Warren Glen substation with SCADA control and accepting termination of the Interconnection Customer's line. Attachment 2 shows a conceptual one-line diagram of the proposed connection of AB2-094 to the JCP&L transmission system. 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. The JCP&L facilities required to be upgraded for the connection of the generation project and the associated cost estimates are listed below:

Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Cost	Tax (if applicable)	Total Cost
Proposed 20MW battery: Tap the A27 line at Warren Glen SW Station at the Riegel Paper Musconetcong River plant. Install 1 SCADA switch on the tap. Partial cost of the secondary power feed from the distribution supply to the SCADA switch is included.	$ 93,900	$ 15,100	$ 109,000
Total Estimated Cost	**$ 93,900**	**$ 15,100**	**$ 109,000**

Direct Connection Cost Estimate

No Direct Connection facilities are required to support this request.

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Cost	Tax (if applicable)	Total Cost
Install 2 new SCADA switches on new poles adjacent to Warren Glen Switch facility. Re-insulate the 3 feeds. Partial cost of the secondary power feed from distribution supply to the SCADA switches is included in the cost.	$ 189,500	$ 30,500	$ 220,000
Total Estimated Cost	**$ 189,500**	**$ 30,500**	**$ 220,000**

Interconnection Customer Requirements

PJM Requirements

1. 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.

In addition to the JCP&L facilities, the Interconnection Customer 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 interrupting device on the high side of the AB2-094 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 a 34.5 KV interconnection metering package. FE will provide the ratio and accuracy specifications.
4. 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.
5. The establishment of dedicated communication circuits for SCADA to the FE Transmission System Control Center.
6. A compliance with the FE and PJM generator power factor and voltage control requirements.

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

Schedule

Based on the extent of the scope required to support the AB2-094 generation project, it is expected to take a minimum of eight months from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. It 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 scope, 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.

FirstEnergy 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 AB2-094 was evaluated as a 20.0 MW (Capacity 0.0 MW) injection at the Warren Glen 34.5kV substation in the JCPL area. Project AB2-094 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-094 was studied with a commercial probability of 53%. 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.

FirstEnergy Analysis

Power Flow

The open ended line contingency, loss of the Morris Park source to the X24 line, causes a voltage violation when the generator's power factor is held at unity and the generator is supplying energy into the system. This facility shall be designed with the ability to dynamically maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals. This requirement serves to resolve the identified voltage violation.

Short Circuit Analysis

This project, modeled per the filed Attachment N as grounded wye on the 34.5 kV side, has a significant impact on the ground currents (nearly doubling the fault current) for faults on the tapped line. To avoid creating possible miscoordination, which could trigger the need for a substation ring bus connection rather than a tap connection, this project should have the 34.5 kV connection ungrounded (either ungrounded wye or delta on the step up transformers).

Evaluating the connection of the AB2-094 generation project to the 34.5 kV system as an ungrounded connection indicated there were no overdutied breakers.

The X/R ratio and the fault currents on the Warren Glenn 34.5 kV Substation bus are shown below.

	Three-Phase	Single-Line
X/R Ratio	3.1672	5.0407
Fault Current (Amps)	6,834	2,935

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 FE "Requirements for Transmission Connected Facilities" document.

System Protection Analysis

An analysis was conducted to assess the impact of the generation project on the system protection requirements in the area. The results of this review have identified the following:

- Standard 34.5 kV line protection for the A27/X24 Gilbert to Morris Park 34.5 kV line and the Interconnection Customer 34.5 kV line.

Generation facilities that comply with IEEE-1547 and are UL 1741 certified or provide documentation by a third party testing organization of successful testing of the proposed inverter equipment in accordance with IEEE-1547.1 that are connected to the FE Transmission System below 100 kV are required to have intertie relays installed as stated in Section 14.5 of the "Requirements for Transmission Connected Facilities."

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.

Light Load Analysis – 2020 Case

None.

New System Reinforcements

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

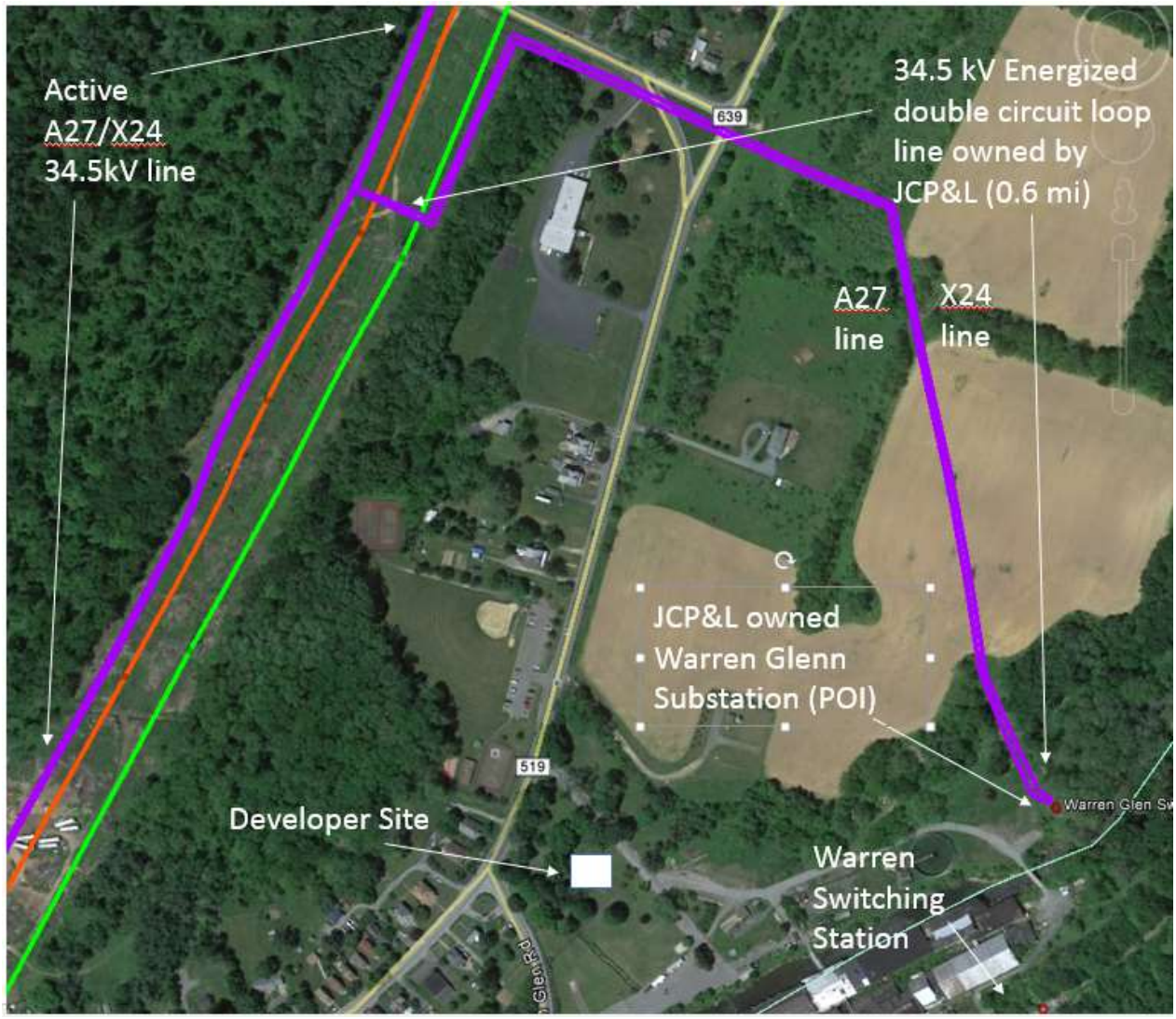
None.

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)

None.

Attachment 1. Aerial View



Attachment 2. Single Line Diagram