Revised
Generation Interconnection
Combined Feasibility/System Impact
Study Report

For

PJM Generation Interconnection Request
Queue Position V3-044

Glendon 34.5kV

May 2010

Preface

This report supersedes and expands on the report sent on January 9, 2010. 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

PPL Renewable Energy, LLC, the Interconnection Customer (IC), has proposed a 4.8 MW (4.8 MW capacity) methane fueled generating facility. The facility will be located in Glendon, New Jersey.

Attachment facilities and local upgrades (if required) along with terms and conditions to interconnect V3-044 will be specified in a separate two party Interconnection Agreement (IA) between the Transmission Owner and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT). From the transmission system perspective, no network impacts were identified as detailed below.

Results of PJM Analysis

Point of Interconnection

V3-044 will interconnect with the MetEd distribution system as a tap of an existing 34.5 kV distribution circuit from the Glendon substation.

Network Impacts

The queue V3-044 project was studied as a 4.8MW capacity injection into MetEd's system at the Glendon#4 34.5kV substation. The project was studied on a combined feasibility-impact basis which utilizes an AC analysis, and incorporates all contingency types. Project V3-044 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential network impacts were as follows:

Generator Deliverability

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

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line, Line with Failed Breaker and, Bus Fault contingencies for the Full energy output.

No problems identified.

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)

No problems identified.

Short Circuit

Not required.

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.

None

Stability Analysis

Not required.

Results of First Energy Analysis

Connection Facilities

PPL Renewable Energy, LLC has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM that identifies its plan to construct a Glendon (V3-044) Generation Project that will be comprised of three methane fired units totaling 4.8 MW at their facilities on Hilton St. West, Glendon, Northampton County, Pennsylvania (shown on Attachment 1). This generation has a proposed in-service date of December 31, 2010. The project was studied as an injection of 4.8 MW on Met-Ed's 34.5 kV 00805-3 circuit (805 line) near Met-Ed's pole number 69825-49608, which is fed from Glendon Substation.

Attachment 2 shows a conceptual one-line diagram of the Direct Connection facilities that will be required for the Glendon (V3-044) Project. As shown, the 34.5 kV interconnection point will require the installation of a breaker on the generator side of the interconnection and three GOAB switches (to be installed by Met-Ed at PPL Renewable Energy's cost) at or near the tap point of the existing 805 line. PPL Renewable Energy is also responsible for constructing all of the facilities on its side of the point of interconnection. In addition, PPL Renewable Energy will be responsible for obtaining any needed right-of-way between the plant site and the FirstEnergy's facilities. A summary of the facilities required for the Glendon (V3-044) Project Direct Connection and their cost estimate is shown on Attachment 3.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Glendon (V3-044) Project on the FE Transmission System. This study was completed using a 2012 summer peak load power flow that contained a detailed representation of the Met-Ed transmission networks in the area of the proposed Glendon (V3-044) Project. The findings and the recommendations from this study are based on a contingency analysis that was performed to identify the facility loadings and/or voltage conditions that violate the ReliabilityFirst, PJM or FE Planning Criteria and are attributable to this project.

The results of the FE analysis show that there are **no network upgrades required** for the deliverability of the Glendon (V3-044) Project generation to the PJM system.

Short Circuit and Dynamics Analysis

A short circuit analysis was conducted by the FE Protection staff. This analysis showed that no FE circuit breaker will exceed its interrupting capability with the implementation of the Glendon (V3-044) Project. Therefore **no reinforcements will be required**.

System Protection Analysis

An analysis was conducted to assess the impact of the Glendon (V3-044) Project on the system protection requirements in the area. The results of this review have identified the following minimum requirements:

Direct Transfer Trip (DTT) using a developer provided communications channel is required from the 805 line breaker at Glendon Substation. The type of communication channel shall be specified and/or approved by FirstEnergy. Currently, the generator would be fed from the Glendon Substation and the cost estimates provided assume that DTT will be from Glendon substation. The generator must be disconnected from the 34.5 kV system while 805 line is fed from an alternate source.

The 805 line breaker (at Glendon Substation) overcurrent relays must be changed to directional.

The cost estimate for the required FE facilities is included on Attachment 3.

Metering

PPL Renewable Energy, LLC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 4 to this report.

Compliance Issues

PPL Renewable Energy, LLC will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. This includes the provision of a reactive power capability sufficient to maintain a composite power delivery for the facility at the interconnection point at a power factor between .95 leading (absorbing MVARs) and .90 lagging (producing MVARs). However, the generator will be required to operate at approximately 100% power factor under normal conditions.

PPL Renewable Energy, LLC will also be required to meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures for standards compliance. For example, the Developer will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

FE Facility Upgrades and Costs

The results of the FE analysis shows that no planning criteria violations are attributable to the addition of the Glendon (V3-044) Project for the conditions studied. Therefore the conclusion is that **no transmission or distribution reinforcements will be required** to provide the requested service.

PPL Renewable Energy, LLC Requirements

In addition to the FE facilities, PPL Renewable Energy 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 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.

2. The purchase and installation of a 34.5 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

3. The purchase and installation of a revenue class meter for the Glendon (V3-044) unit to measure the power delivered in compliance with the FE standards.

4. A compliance with the FE and PJM generator power factor and voltage control requirements. However, the generators will need to supply their output at a unity power factor at the point of interconnection during normal conditions.

5. The execution of a back-up service agreement to serve the customer load supplied from the Glendon 34.5 kV substation when the units are out-of-service. This assumes the intent of PPL Renewable Energy is to net the generation with the load.

6. Any complaints from other customers (e.g. flicker complaints) will have to be corrected by PPL Renewable Energy. Correction may include changing operation, reducing generation, disconnecting the generators from the Met-Ed system, or other measures.

7. The number of generator starts per day should be limited to help prevent flicker complaints.

8. It is recommended that the generators ramp up and down as slowly as possible to prevent rapid voltage swings.

9. Under emergency conditions on the Met-Ed system (e.g. a substation transformer outage) or during planned equipment maintenance, the generator may not be allowed to export to the Met-Ed system, with no penalty to Met-Ed.

10. A Direct Transfer Trip scheme will be required to trip the generator breaker if the 805 line breaker opens. The communications medium is the choice of the generator but must be approved by Met-Ed. Equipment and installation costs are the generator's responsibility. If, in the future, upstream protection is added by Met-Ed, the PPL Renewable Energy will be responsible for the cost to add Direct Transfer Trip on any new devices.

11. The generator is required to furnish a SCADA RTU which will interface with the FirstEnergy EMS system. The RTU, the communications channel and all related equipment will be furnished and maintained by the generator owner.

12. 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. The RTU must communicate with the FirstEnergy EMS via DNP 3.0 protocol.

13. The following status and metering points will be required:

    a. Interconnection breaker position.

    b. Generator real and reactive power output measured at the high-side of the generator step-up transformer.

    c. Generator voltage at the point of interconnection.

    d. Indication that a transfer trip has occurred.

14. The installation must comply with the attached Technical Requirements for the Interconnection of Parallel-Operated Generation to the FirstEnergy Distribution System (attached).

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

Summary

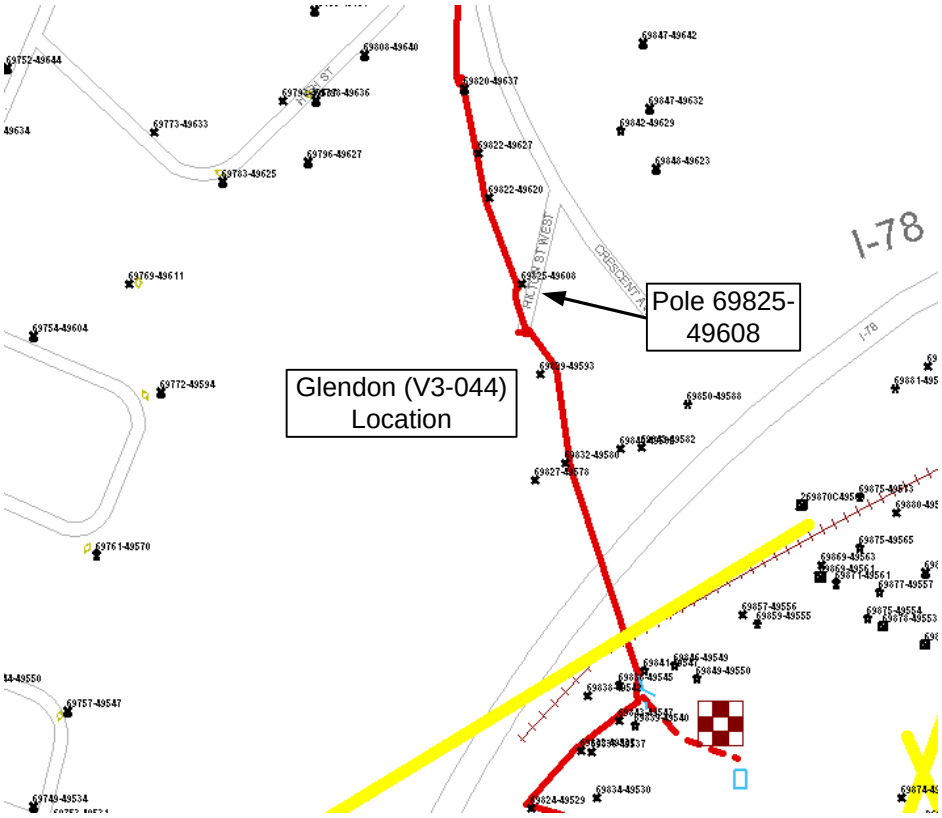
The connection of the Glendon (V3-044) Project to the FE transmission system will require no network upgrades. Therefore PPL Renewable Energy, LLC will only have a cost responsibility for the Direct Connection of the Glendon (V3-044) Project. As shown on Attachment 3, their estimated cost is $333,100.

Based on the extent of the FE direct connection and system upgrades required to support this project, it is estimated that it will take six (6) months from the date of a fully executed Interconnection Connection Service Agreement to complete the upgrades required for the Glendon (V3-044) Project. This includes the requirement for PPL Renewable Energy to make a preliminary payment to FE that funds the full cost of engineering design that is related to the construction of the Direct Connection facilities. It further assumes that PPL Renewable Energy will provide the property for the attachment facilities needed and any right-of-way properties 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 PJM will allow all transmission system outages when requested.

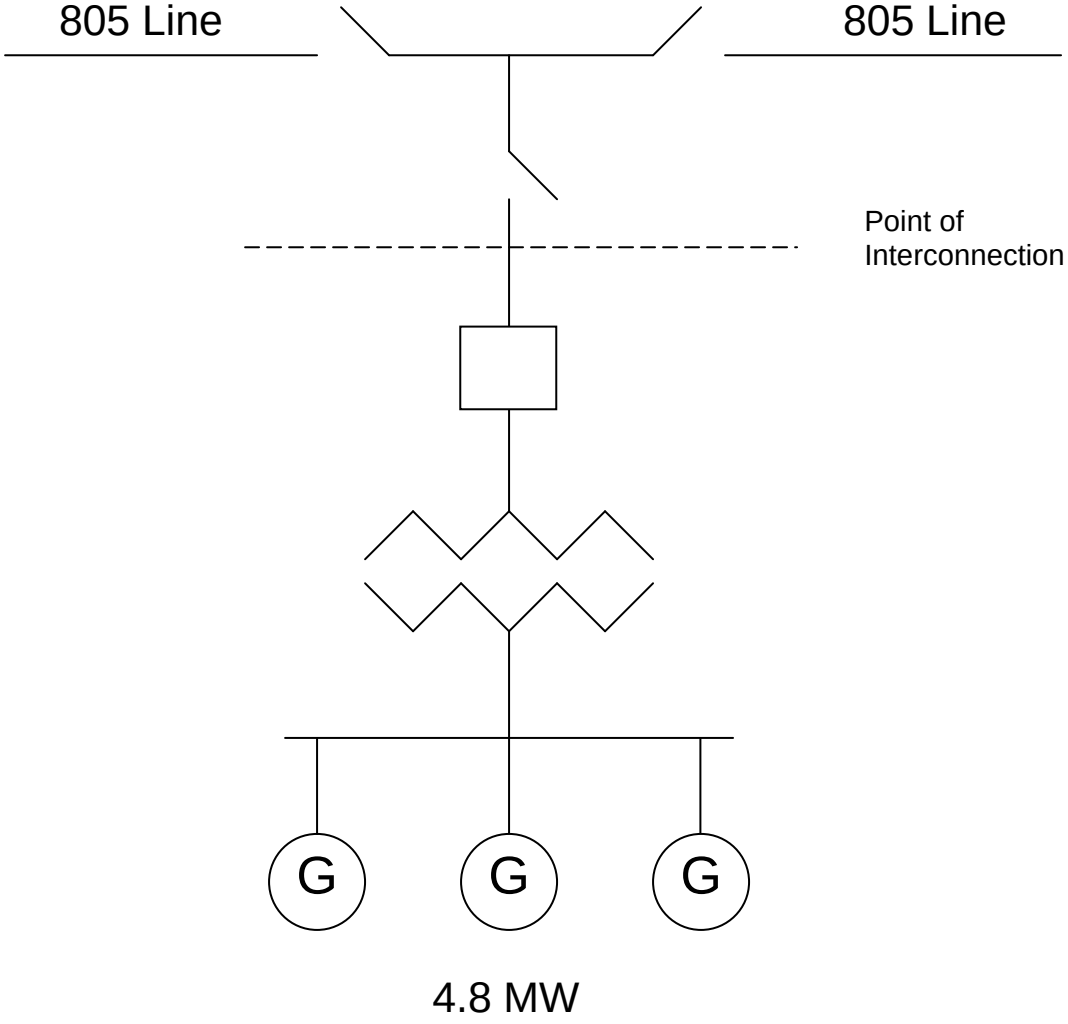
Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the Feasibility / System Impact Study. Further note that the cost estimate data contained in this document should also be considered as conceptual for budgetary purposes since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FirstEnergy herein reserves the right to return to any issues in this document and, upon

appropriate justification, request additional monies to complete any connections to the transmission system.

Attachment 1
Glendon (V3-044) Project Location



Attachment 2
Glendon (V3-044) Project Connection



Attachment 3
Glendon (V3-044) Project Direct Connection Facilities

Project	Estimated Cost*
Direct Transfer Trip on the 805 Line breaker	$ 136,000
Change overcurrent relays on 805 line breaker to Directional	$ 42,900
Three GOAB switches at the point of interconnection	$ 60,000
Tap to generator interconnection point	$ 66,000
Miscellaneous labor cost (including witness testing and RTU interface)	$ 28,200
Total*	**$ 333,100**

Notes: The above costs are based on the assumption that the point of interconnection would be from the existing 34.5 kV 805 line at or near Met-Ed pole #69825-49608, and that the customer interconnection substation would be near this pole. Also, the above costs do not include taxes. If appropriate, this could add approximately an additional 34% to the Project cost.

Attachment 4
FirstEnergy Revenue Metering Requirements for Generation Interconnection Customer

Interconnection Customer shall install, own, operate, test, and maintain the necessary revenue quality Metering Equipment. This includes current transformers, voltage transformers, mounting structures, wiring, meters, communication circuits, and associated devices. The Metering Equipment must meet the specifications listed in the FirstEnergy and regional transmission organization (RTO) connection documents. The FirstEnergy "Requirements for Transmission Connected Facilities" are located at: http://www.firstenergycorp.com/feconnect

The Metering Equipment shall be located at the generation facility on the high voltage side of the generator step-up transformers or facility main step-up transformer and/or station service power transformers. Power flows to and from the facility shall be compensated to the Point of Interconnection.

FirstEnergy will provide revenue quality Metering Equipment for a station service power supply at a generation facility if the supply is from the local FirstEnergy distribution system.

The revenue quality Metering Equipment shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by FirstEnergy, typically fifteen minutes or thirty minutes. The Interconnection Customer must provide FirstEnergy with remote access to the billing data in the Metering Equipment via a dedicated voice-grade analog telephone circuit. The Interconnection Customer shall provide FirstEnergy with contact information for the person or persons responsible for meter programming and Metering Equipment maintenance.

The Interconnection Customer shall consult with FirstEnergy regarding the revenue quality metering system design and provide the following information:

- Facility one line and revenue metering installation drawings (schematics, wiring diagrams, etc.)
- Estimated power flows to and from the facility at all revenue metering points
- Current transformer and voltage transformer specifications, including manufacturer, type, nameplate drawings, and certified accuracy test reports
- Revenue meter specifications including manufacturer, type, model number, and accuracy
- Revenue meter program information including but not limited to billing data recorder channel assignments, recorder pulse weights (Ke), and read-only password for access to interval data by the FirstEnergy billing data collection system (MV-90)
- Revenue meter telephone number
- Revenue meter loss compensation data (if applicable)

The Interconnection Customer shall provide FirstEnergy with prior notification of any modifications at the facility that will affect the revenue meter measurements, including substation reconfigurations and meter program changes.

The revenue metering system at each location shall be tested for accuracy by the Interconnection Customer once every two years. The Interconnection Customer shall give reasonable notice to FirstEnergy of the time when the testing is scheduled so that FirstEnergy may have representatives present. FirstEnergy and the RTO shall have the right to audit the revenue metering equipment and/or related documents. The Interconnection Customer shall be given a reasonable period of time to comply with any requests associated with an audit.

Generation Interconnection Combined Feasibility/System Impact Study Report

For

PJM Generation Interconnection Request Queue Position V3-044

Glendon 34.5kV

January 2010

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Multiple Facility Contingency

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Contribution to Previously Identified Overloads

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Stability Analysis

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