Generation Interconnection Combined Feasibility/System Impact Study Report

For

PJM Generation Interconnection Request Queue Position Y2-018

Pequest River 34.5kV

March 2013

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

WC Landfill Energy, LLC (WCLE), the Interconnection Customer (IC), has proposed a solar generating facility located in Oxford, New Jersey. The installed facilities will have a total capability of 1.9 MW with 0.7 MW of this output being recognized by PJM as capacity. This means that the remaining 1.2 MW will be curtailable should a system reliability constraint occur. The proposed in-service date for this project is November 2012. **This study does not imply a FirstEnergy commitment to this in-service date.**

This solar facility will be using Capacity Interconnection Rights from a 1.9 MW unit associated with N27.

Point of Interconnection

Y2-018 will interconnect with the Jersey Central Power & Light Company system along the 34kV line C705 from the Pequest River substation at the existing POI from N27.

Cost Summary

The Y2-018 project will be responsible for the following costs:

Description	Total Cost
Transmission Owner facilities	$ 0
Transmission Upgrades	$ 0
Total Costs	**$ 0**

Non-Direct Connection Cost Estimate

As defined by the Interconnection Customer and shown on Attachment 1, the tapped connection point for the Y2-018 Generation Project will be the existing connection located at pole 190362A72560 about 1.8 miles west of the Furnace Brook Substation. FE owns one radial span from that tap point to the Point of Interconnection (POI) at pole 190362A72574. The Interconnection Customer -owned section of the radial tap extends approximately 1500 feet northwest from the POI pole to the customer substation.

No upgrades to the existing connection facilities will be required by FE. The Interconnection Customer will be responsible for constructing all of the facilities on its side of the point of interconnection including the attachment line, and will be responsible for acquiring all easements, properties and permits that will be required. Attachment 2 shows a conceptual one-line diagram of the Y2-018 Generation Project. As indicated, it will be studied as a 1.9 MW injection at pole 190362A72560 of the Furnace Brook – Hazen Switch Point (C705-2) section of the Pequest - Washington (C705) 34.5 kV path.

Interconnection Customer Requirements

The Interconnection Customer is required to:

- Provide two independent high-speed zones of protection to sense and clear faults on the interconnection transformer. Fault current at the Y2-051 Project 34.5 kV tap of the Great Adventure Tap - Great Adventure (T146) 34.5 kV line point, 0.2 miles from the Brick School substation, are listed below:

	Three Phase	Line-Ground
X/R Ratio	9.8	5.4
Fault Current (Amps)	6,706	3,674

  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 Interconnection Customer's responsibility to make any protection upgrades required should this occur.

- Install the minimum required generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

- Install the necessary generator protection, synchronization controls, and fault detection to initiate a trip to protect the Y2-018 Project equipment from faults on the Jersey Central System.

- Install intertie relays at the Point of Interconnection that either trip the breaker at the point of interconnection or the individual generators beyond the point of interconnection. The function of the intertie relays must include over/under voltage and over/under frequency protection. Note that these intertie relays are in addition to and must be separate from the two relays that provide the independent high speed zone of protection

to sense and clear faults. They include the installation of an SEL-351-7 (Version 7) relay or its equivalent for power elements, a potential transformer or CCVT's on the high side of the transformer, and current transformers on the high side of the transformer.

- Install supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center. The RTU, the communications channel and all related equipment will be furnished and maintained by the Brick Standard, LLC. The RTU must communicate with the FirstEnergy EMS via DNP 3.0 protocol.

  The following status, control and metering points will be required:

  - Interconnection breaker position status and trip control.
  - Generator real and reactive power output measured at the high-side of the generator step-up transformer.
  - Generator voltage at the point of interconnection.

- Comply with FirstEnergy "Technical Requirements for the Interconnection of Parallel-Operated Generation to the FirstEnergy Distribution System" posted on both the PJM and FirstEnergy websites at:

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

- Execute a back-up service agreement to serve the customer load supplied from the Interconnection Customer 34.5 kV substation when the units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the station load.

- Comply with the inverter standard UL1741 and IEEE 1547, "Standard for Interconnecting Distributed resources with Electrical Power Systems", in addition to the power quality standards defined by ReliabilityFirst and PJM.

The Interconnection Customer will not excavate, construct facilities, or locate solar panels under the existing FE transmission facilities or on FE rights-of-way without the express permission of FE.

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 #Y2-018 was studied as a 1.9MW (Capacity 0.7MW) injection at the N-027 34.5 kV substation in the JCPL area. Project #Y2-018 was evaluated for compliance with reliability criteria for summer peak conditions in 2016. 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 contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None.

Short Circuit

(Summary of impacted circuit breakers)

No circuit breakers were found to be overdutied. An assumption of this study was that solar generation projects will contribute no appreciable fault current to the breakers on the FE transmission system. As defined 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."[1] Based on this fact, the results of the analysis showed that no circuit breaker will exceed its interrupting capability with the implementation of the Y2-018 Project.

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

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

The FirstEnergy analysis found that it will be mandatory for the Y2-018 Generation Project to have a range of dynamic reactive capability that supports its operation from a .95 lead to .95 lag power factor. Without a continuous regulation, the FE studies show that the addition of solar projects can cause voltage swings as their output oscillates with moving clouds and system

[1] EPRI Document TR-111490 "Integration of Distributed Resources in Electric Utility Distribution Systems: Distribution System Behavior Analysis for Suburban Feeder", published November 1998, page 62

voltages can exceed the established limits. Should the Interconnection Customer fail to provide a dynamic reactive capability from the Y2-018 Generation Project for any reason once interconnected, the Jersey Central and/or PJM Dispatchers may need to take action to curtail both the energy and capacity portion of its output to prevent a non-compliance with voltage criteria.

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

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.

Potential Congestion due to Local Energy Deliverability

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. Aerial View

Attachment 2. Single Line Diagram