Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position Y1-055

Brick Mills Lane 34.5kV

July 2012

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 Brick, New Jersey. The installed facilities will have a total capability of 5.0 MW with 1.9 MW of this output being recognized by PJM as capacity. This means that the remaining 3.1 MW will be curtailable should a system reliability constraint occur.

Point of Interconnection

Y1-055 will interconnect with the Jersey Central Power & Light system at the 34.5kV line between the Brick School and Lanes Mill substations.

Cost Summary

The Y1-055 project will be responsible for the following costs:

Description	Total Cost	
Connection Facilities	$	285,264
Transmission Upgrades	$	0
Total Costs	**$**	**285,264**

Transmission Owner Scope of Work

As defined by the Interconnection Customer and shown on Attachment 1, the connection point for the Y1-055 Project will be from a tap of the Brick School - Lanes Mill section of the Larrabee - Brick School - Lanes Mill - Point Pleasant (T146) 34.5 kV path. From this point Jersey Central will construct a new 34.5 kV line extension that will be overbuilt on an existing 12.5 kV single phase Distribution circuit. Since Jersey Central will own, operate and maintain the new radial 34.5 kV attachment line to the end of its existing 12.5 kV Distribution circuit, the Point of Interconnection will be at the edge of the FE right of way, as identified on Attachment 1 and Attachment 2. Disconnect switches will be needed on two poles as well as the radial tap pole in addition to a circuit breaker and switch on the system side of the generator step-up transformer.

The scope of work includes:

- Install new tap at pole in a three way dead end configuration. Rebuild and install two SCADA controlled 1200 pole-mounted load break switches on adjacent poles.
- Construct a new 425 foot 34.5kV line from new pole on Brick School –Lanes Mill (T146) 34.5kV line that is overbuilt on a 12.5kV single phase Distribution circuit with all new poles
- Construct a new pole on the new overbuilt Distribution Line from the Brick School (T-146) 34.5kV line in a dead end configuration with a disconnect switch (single blade disconnects)
- Construct an approximate 200 foot span of overhead 34.5kV wire from the new pole to a new customer owned pole
- Review of environmental map shows no need for environmental permitting at the preliminary service point indicated on applicant's submitted sketch. If permitting is needed, and additional $50K will be added to estimate.
- Estimate includes $20,000 for metering to be installed in customers cubicle.
- Install overhead transmission metering equipment provided by the Interconnection Customer to be mounted on the Interconnection Customer owned pole. (Optional to Collector Substation)
- Miscellaneous Protection, Fuses, Metering, RTU, SCADA.

Total cost estimate for this work is **$285,264**. The does not include the CIAC (Contribution in Aid of Construction) Tax Gross-up charge of $92,510.

Interconnection Customer Scope of Work

The Interconnection Customer will construct a 0.1 mile 34.5 kV line on a new right of way between the Point of Interconnection and the Interconnection Customer substation. A separate agreement will be required for the section of this line that traverses under the Jersey Central circuits and right of way that extend nearby. The Interconnection Customer will own, operate and maintain this line extension

Requirements

The Interconnection Customer will be responsible for the following:

- 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 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 two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.

  FirstEnergy has calculated the fault currents at the tap to be:

	Three Phase	Line-Ground
X/R Ratio	3.84	4.38
Fault Current (Amps)	8,888	3,028

- Install a 100E, S&C SMD-2C, standard fuse must be installed on the tapped connection

- Ensure the necessary generator protection, synchronization controls, and fault detection are in place to initiate a trip to protect the Y1-055 Project equipment from faults on the Jersey Central System.

- Install standard voice grade (analog) telephone line and associated conduit between the telephone company source and the meter socket or enclosure.

- 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 Interconnection Customer. 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.

- 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 the Interconnection Customer is to net the generation with the station load.

- Meet all criteria specified in the applicable FirstEnergy standards:

  - FE Requirements for Transmission Connected Facilities
  - Technical Requirements for the Interconnection of Parallel-Operated Generation to the FirstEnergy Distribution System
  - FirstEnergy Wholesale Generation Interconnection (WGI) Manual
  - FE Approved Vendors and Contractors

  These documents can be found on the FirstEnergy or PJM websites:

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

- Acquiring all permits and right of way that may be needed.

- Comply with the inverter standard UL1741 and IEEE 1547, "Standard for Interconnecting Distributed resources with Electrical Power Systems"

Notes:

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

Schedule

Based on the extent of the FE direct connection and system upgrades required to support this project, it is estimated that it will take one (1) year from the date of a fully executed Interconnection Agreement (IA) to complete the upgrades required for the Y1-055 Project.

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 #Y1-055 was studied as a 5.0MW (Capacity 1.9MW) injection as a tap of the BRICK SC - LANES MI 34.5 kV line in the JCPL area. Project #Y1-055 was evaluated for compliance with reliability criteria for summer peak conditions in 2015. 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)

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

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

None.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

For the Y1-055 Project, 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 1.64 MVAR) and .95 lagging (producing 1.64 MVAR) at the point of connection. If this capability cannot be provided by the solar units, a dynamic device such as a STATCOM or SVC must be installed at the Y1-055 Project substation at the Interconnection Customer's cost. Note that if the proposed 0.1 mile radial connection from the point of interconnection is constructed as an underground cable, additional reactor compensation from the project may be needed to offset the resultant line charging.

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.

The results of the FE analysis show that there are numerous other solar generation projects proposed in the vicinity of the Y1-055 project that will contribute to system constraints. In addition, there is the potential for high voltage during light load periods and voltage criteria violations due to swings in the MW output of the cumulative attached solar generation. A conclusion of this analysis is therefore that the curtailment of the Y1-055 project output can be expected at times to maintain the Jersey Central system reliability within the NERC, Regional and FE operations and planning standards.

Attachment 1. Aerial View

Attachment 2. Single Line Diagram