Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position Y1-038

Sparta

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 Sparta, 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

Y1-038 will interconnect with the Jersey Central Power & Light system at the 34.5kV line Y701 between the Woodruff' Gap and Sparta substations.

Cost Summary

The Y1-038 project will be responsible for the following costs:

Description	Total Cost
Connection Facilities	$ 220,300
Transmission Upgrades	$ 0
Total Costs	**$ 220,300**

Transmission Owner Scope of Work

As defined by the Interconnection Customer and shown on Attachment 1, the proposed tapped connection point for the Y1-038 Project will be located about 2.6 miles away from the Sparta substation. Attachment 2 shows a conceptual one-line diagram of the Direct Connection facilities that will be required for the Y1-038 Project. As indicated, it will be studied as a 5 MW injection at the Woodruff's Gap - Sparta (Y701-3) section of the Franklin – Sparta (Y701) 34.5 kV path. Both line and radial disconnect switches will be needed at the tap point in addition to a circuit breaker and switch on the system side of the generator step-up transformer. The point of interconnection (POI) will be at the first pole on the tap installed by the Interconnection Customer, and FirstEnergy will provide one span of conductor from that POI pole to the tap pole. 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.

The scope of work includes:

- Construct approximately 200 feet of new 34.5kV line from tap pole on the Y701-3 34.5kV line (Woodruffs Gap Switch-Sparta).

- Includes replacing and rebuilding existing pole, installation of a new stub pole across the nearby railroad right-of-way, a set of disconnect switches between the tap pole and the customer's meter pole, replacement of poles & installation of supervisory-controlled, group-operated, load-break switches on poles, all necessary distribution work, guying, etc., and a span of wire to a customer-owned pole beyond the switch pole.

- A review of this location in the NJDEP GeoWeb database shows that there is a Category 1 waterway that is near the proposed pole replacement and two ponds in the general vicinity as well. The proposed work in this area can be completed utilizing our 5-Year Multi-Permit as long as the conditions of the permit are followed. A U.S. Fish & Wildlife Service (USFWS) Threatened and Endangered (T&E) Species Section 7 Review of this work location will need to be conducted. It would require at least a 6 month lead-time prior to construction to obtain Section 7 Review as well as arrange Federal T&E survey(s), if applicable. The estimated cost for this review, etc., would be $25,000 (Assumes no protective mats or special vehicles needed to access pole(s) in wetlands. If matting or special vehicles are required additional costs will be incurred.)

- Estimate includes $25,000 for metering to be mounted in customer substation.

- Miscellaneous Protection, Fuses, Metering, RTU, SCADA

Total cost estimate for this work is **$220,300**. The does not include the CIAC (Contribution in Aid of Construction) Tax Gross-up charge of $70,700.

A prior Interconnection Queue Project is responsible to install an SEL-279 reclosing relay on the Y701 line at Franklin. However, if that project withdraws or the Y1-038 Project goes into service first, the Y1-038 Project will become responsible for this upgrade.

Interconnection Customer Scope of Work

The Interconnection Customer will be responsible for the following:

- Install minimum required FE generation interconnection relaying and control facilities. This includes the installation of 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

  Fault currents at the POI are listed below.

	THREE-PHASE	SINGLE-LINE
X/R		3.2 4.1
Fault Current (Amps)	3115	1958

- Install S&C SMD-1A 100E standard size fuses on the tapped connection

- Ensure the necessary generator protection, synchronization controls, and fault detection are in place to initiate a trip to protect the Y1-038 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 eighteen (18) months from the date of a fully executed Interconnection Agreement (IA) to complete the upgrades required for the Y1-038 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 #Y1-038 was studied as a 5.0MW (Capacity 1.9MW) injection as a tap of the X2-099 TAP - SPARTA Y 34.5 kV line in the JCPL area. Project #Y1-038 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)

The results of the FE analysis show that a network upgrade is required for the Capacity deliverability of the Y1-038 Project generation to the Jersey Central transmission systems. Specifically, the FE study results show that with all area solar projects at their Capacity output the Newton - Mohawk (Z702) 34.5 kV line section could load up to 122.7% of its emergency rating of 27 MVA upon loss of the Newton - Montville (N2214) 230 kV line.

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)

It will be mandatory for the Y1-038 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 voltages that can exceed the established limits. Should the Interconnection Customer fail to provide a dynamic reactive capability from the Y1-038

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.

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)

The violation on the Newton - Mohawk (Z702) 34.5 kV line section is a pre-existing violation. The Interconnection Customer does not have a financial responsibility for reinforcing this line. FE will assume all cost responsibility for the upgrade of this line section and plans to reconductor this limiting section by the summer of 2013.

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.

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The results of the FE analysis shows that the energy output of the Y1-038 Project may be curtailed. The Newton - Mohawk (Z702) 34.5 kV line section could load up to 134.4% of its emergency rating of 27 MVA upon loss of the Newton - Montville (N2214) 230 kV line.

Attachment 1. Aerial View

Attachment 2. Single Line Diagram