

***Generation Interconnection
Combined Feasibility/System
Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position Y2-051***

Brick-Lanes Mill 34.5kV

January 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

Brick Standard, LLC, the Interconnection Customer (IC), has proposed a solar generating facility located along Sally Ike Road 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. The proposed in-service date for this project is September 30, 2015. **This study does not imply a FirstEnergy commitment to this in-service date.**

Point of Interconnection

Y2-051 will interconnect with the Jersey Central Power & Light system to the T146 34kV line between the Brick School and Lanes Mill substations.

Cost Summary

The Y2-051 project will be responsible for the following costs:

Description	Total Cost
Transmission Owner facilities	\$ 291,077
Allocation for Transmission Upgrades	\$ 0
Total Costs	\$ 291,077

Note: These costs do not include CIAC Tax Gross-up.

Transmission Owner Scope of Work

As defined by the Interconnection Customer and shown on Attachment 1, the connection point for the Y2-051 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 at or near pole JC122BT146 about 400 feet from the Brick School substation along Lanes Mill Road. 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 that crosses Lanes Mill Road and follows about a 425 foot path to a dead end pole JC7277BK within the Brick High School Athletic complex. As an extension from this pole, the Interconnection Customer will then construct a further 0.1 mile 34.5 kV line on a new right of way that spans to and crosses Sally Ike Road to the project collector substation. Note that 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 along Sally Ike Road. 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 from pole JC7277BK as identified on Attachment 1 and Attachment 2. The Interconnection Customer will construct, own, operate and maintain the line extension from the point of interconnection to its collector substation at the Y2-051 Project site.

In summary, Attachment 2 shows a conceptual one-line diagram of the Direct Connection facilities that will be required for the Y2-051 Project. As indicated, it will be studied as a 5.0 MW injection to the Jersey Central 34.5 kV system at pole JC122BT146 of the Brick School - Lanes Mill (T146-2) 34.5 kV line. Disconnect switches will be needed on poles JC121BT146 and JC125BT146 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 Interconnection Customer will be responsible for acquiring all permits that may be required for the 34.5 kV tap and radial line extension, and any new ROW (right of way) needed. The Interconnection Customer will also be responsible all permits and constructing, owning, operating and maintaining all facilities on its side of the point of interconnection including the line extension to the project site.

The total estimated cost for the interconnection costs are **\$291,077**. These costs do not include CIAC Tax Gross-up of \$94,396. The scope of work includes:

- Install new tap at pole JC122BKT146 in a three way dead end configuration. Rebuild and install two SCADA controlled 1200 pole-mounted load break switches on adjacent poles JC125BKT146 and JC121BKT146.
- Construct a new 425 foot 34.5kV line from new pole JC122BT146 on Brick School – Lanes Mill (T146) 34.5kV line that is overbuilt on a 12.5kV single phase Distribution circuit that crosses Lanes Mill Road and terminates at pole JC7277BK on the Brick School Athletic Complex with all new poles
- Construct a new pole JC7277BK 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 JC7277Bk 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 mounted on the customer owned pole. (Optional to Collector Substation)
- Miscellaneous Protection, Fuses, Metering, RTU, SCADA.
- Estimate includes cost of vegetation clearing.
- Estimate includes cost of traffic control for Sally Ike Rd.
- Estimate includes cost of poles and hardware, distribution transfers, guying, and labor.

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	3.79	4.34
Fault Current (Amps)	8,671	3,003

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 Y2-051 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 a 100E, S&C SMD-2C, standard fuse on the tapped connection.
- 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.
- Install standard voice grade (analog) telephone line and associated conduit between the telephone company source and the meter socket or enclosure.
- 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>

- Provide metering to be installed by Jersey Central Power & Light.
- Obtain any and all third party rights of way (ROW) required to extend the electric facilities to their sites. This includes vegetation management, environmental compliance, wetland preservation, and any other state or local permitting required to extend facilities to the site.
- Obtain any permits and right of way necessary for the Jersey Central 34.5 kV tap and radial overbuild line and the line extension to the pole JC7277BK on the Brick School Athletic Complex.
- Obtain any necessary third party rights of way required to extend the transmission facilities to the Sally Ike Road (Y2-051) Project site beyond the tap pole JC7277BK on the Brick School Athletic Complex
- 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.

Note: An assumption of this study is that the Y2-051 Project generation will automatically be disconnected whenever the local area network is islanded. If this assumption is not correct, a direct transfer trip scheme will need to be implemented for such situations at the Interconnection Customer’s cost.

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>

Schedule

Based on the extent of the Transmission Owner scope of work 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 Construction Service Agreement to complete the upgrades required for the Y2-051 Project. The Interconnection Construction Service Agreement will be a two-party agreement issued by FirstEnergy.

The Interconnection Customer must provide the property for the attachment and right-of-way facilities that will be needed at the project initiation. It is also assumed 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 all 34.5 kV transmission system outages can be scheduled when needed.

Network Impacts

The Queue Project #Y2-051 was studied as a 5.0MW (Capacity 1.9MW) injection as a tap of the Brick – Lanes Mill 34.5 kV line in the JCPL area. Project #Y2-051 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 Y2-051 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

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

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 Y2-051 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 Y2-051 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)

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

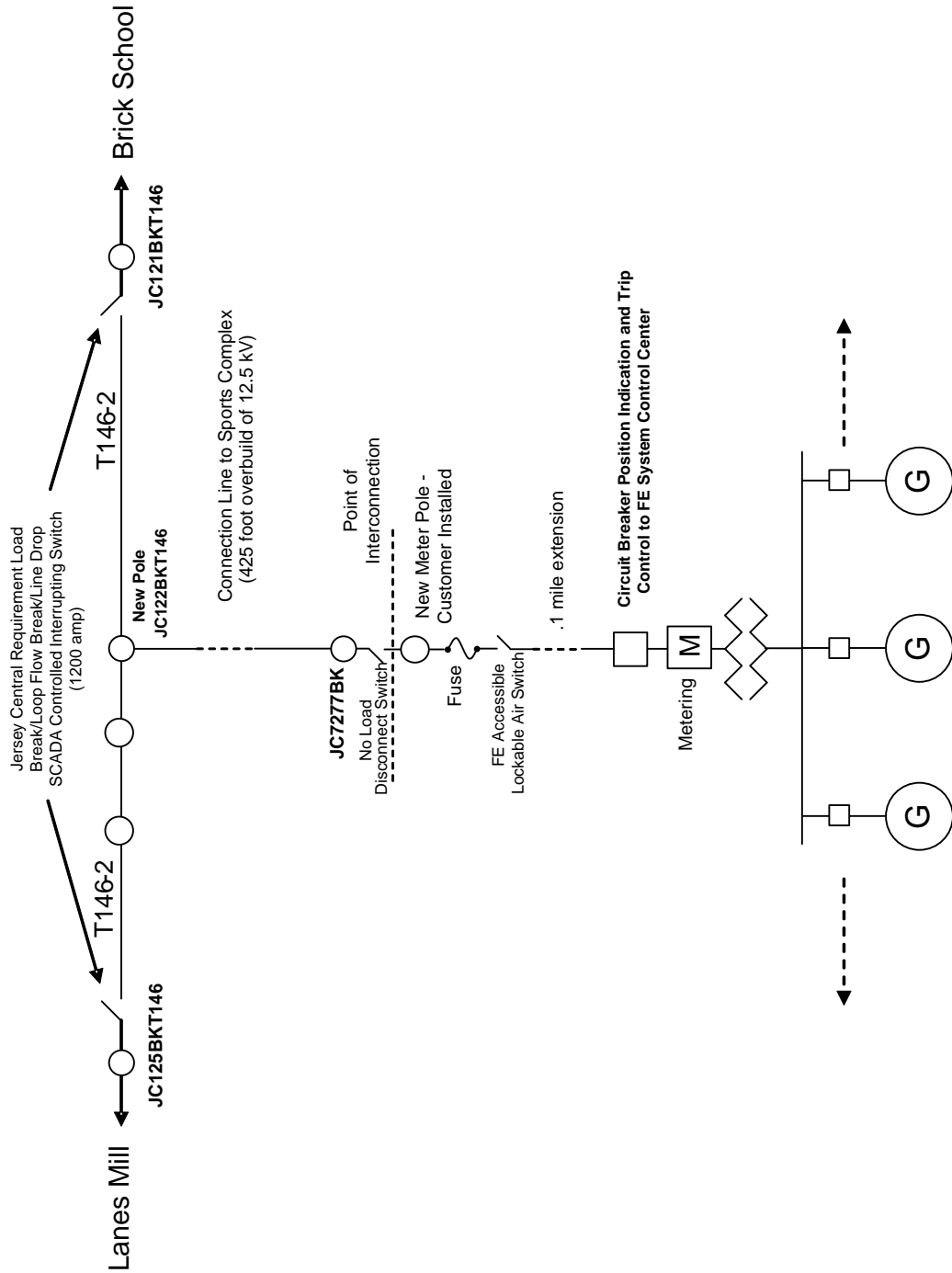
Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

None

Attachment 1. Aerial View



Attachment 2. Single Line Diagram



5.0 MW Total Solar Photo Voltaic Generation