

***Generation Interconnection  
Feasibility Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position W4-067***

***Vernon 12kV***

**June 2011**

## 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 Vernon Township, New Jersey. The installed facilities will have a total capability of 8.0 MW with 3.04 MW of this output being recognized by PJM as capacity. This means that the remaining 4.96 MW will be curtailable should a system reliability constraint occur. The proposed in-service date for this project is December 31, 2012. **This study does not imply a First Energy commitment to this in-service date.**

## Point of Interconnection

W4-067 will interconnect at one of two options. Option 1 is to connect with the Jersey Central Power & Light system at the 12kV circuit #17802 from the Vernon substation at or near pole NJ6121VR. Option 2 is to connect with the Sussex Rural Electric Cooperative. The Point of Interconnection for Option 2 will be a tap of the 34.5kV bus at the Vernon substation.

## **First Energy Analysis**

During the initial review of the Primary Point of Interconnection, First Energy determined that the 12kV circuit #17802 only has 3.0 MW of available capacity. In order to support the full output requested, the Interconnection Customer would need to upgrade the existing circuit to a higher voltage at a significant cost or connect to a Secondary Point of Interconnection. It is PJM's and First Energy's opinion that a connection to the Secondary Point of Interconnection would be the least-cost option to interconnect this facility. As a result, the analysis below addresses the Secondary Point of Interconnection.

In order to connect the full 8.0 MW of proposed generation, a secondary point of connection for the W4-067 Project, will be a tap of the 34.5 kV bus at the Vernon Substation. From this point Jersey Central will build a new 34.5 kV line extension over the existing 17802, 12.47 kV distribution circuit out of Vernon Substation 3.4 miles (approximately 18,000') to a point adjacent to the W4-067 Generation Project for its Direct Connection. Note that this will require new breaker positions and underground egress with riser pole at Vernon Substation and a re-build of this section of the existing #17802, 12.47 kV distribution circuit in order to accommodate the new 34.5 kV circuit. Since Jersey Central will own, operate, and maintain this new radial attachment line, the point of interconnection will be adjacent to the W4-067 project boundary as identified on Attachment 2.

In summary, Attachment 3 shows a conceptual one-line diagram of the Direct Connection facilities that will be required for the W4-067 Project. As indicated, it will be studied as an 8 MW injection to the Jersey Central 34.5 kV system on the B-704 line at the bus of the Vernon Substation. New breakers and egress at the substation and an in-line disconnect near the point of interconnection will be needed 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 radial tap and line extension and constructing all facilities on its side of the point of interconnection. A summary of the FE facilities required for the W4-067 Project Direct Connection and their cost estimate is shown on Attachment 4.

### **Metering**

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 5 to this report.

### **Compliance Issues**

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" located at:

<http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx>

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 and .90 lagging. If this capability cannot be provided by the solar units, a dynamic device such as

a STATCOM or SVC must be installed at the W4-067 Project substation at the Interconnection Customer's cost.

The Interconnection Customer will be responsible for following the requirements of the "FirstEnergy Wholesale Generation Interconnection (WGI) Manual" and the "FE Approved Vendors and Contractors" documents, which are also located at the above link. In addition, the Interconnection Customer will 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 W4-067 Project for the conditions studied. Therefore, the conclusion is that no transmission or distribution system reinforcements will be required to provide the requested service.

## **Network Impacts**

Queue project W4-067 was studied as a(n) 8.0 MW (3.0 MW of which was Capacity) injection into JCPL's system. Project W4-067 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

### **Option 1: VERNON 34.5 kV substation**

Potential transmission network impacts are as follows:

#### **Generator Deliverability**

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

No violations identified.

#### **Multiple Facility Contingency**

*(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)*

No violations 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 violations identified.

#### **New System Reinforcements**

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

None required.

#### **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 required.

#### **Short Circuit**

*(Report over-dutied breakers.)*

None required.

#### **Energy Portion of Interconnection Request**

*PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

*Note: Only the most severely overloaded conditions are listed. 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.*

No violations identified.

## **Option 2: SUSSEX B 34.5 kV substation**

Potential transmission network impacts are as follows:

### **Generator Deliverability**

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

No violations identified.

### **Multiple Facility Contingency**

*(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)*

No violations 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 violations identified.

### **New System Reinforcements**

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

None required.

### **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 required.

### **Short Circuit**

*(Report over-dutied breakers.)*

None required.

### **Energy Portion of Interconnection Request**

*PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.*

*Note: Only the most severely overloaded conditions are listed. 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.*

No violations identified.

## Interconnection Customer Requirements

In addition to the FE facilities, the Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document. Since the W4-067 Project will be connected to the 34.5 kV network, the Interconnection Customer will also be responsible for compliance with the FirstEnergy "Technical Requirements for the Interconnection of Parallel-Operated Generation to the FirstEnergy Distribution System". This includes but is not limited to the following:

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. A compliance with the FE and PJM generator power factor and voltage control requirements. Note that the W4-067 Project may need to absorb reactive power at the point of interconnection to minimize the voltage change should the units rapidly reduce their output or trip off line.
3. The execution of a back-up service agreement to serve the customer load supplied from the 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.
4. Any complaints from other customers (e.g. flicker complaints) will have to be corrected by the Interconnection Customer. Correction may include changing operation, reducing generation, disconnecting the generators from the Jersey Central system, or other measures.
5. 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, 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.
6. The following status, control, and metering points will be required:
  - a. Interconnection breaker position status and trip control.
  - 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.
7. An installation of two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.
8. A compliance 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 Reliability *First* and PJM.

9. A provision of the necessary generator protection, synchronization controls, and fault detection to initiate a trip to protect the W4-067 Project equipment from faults on the Jersey Central System.
10. A compliance with the PJM Manuals and Operating instructions to have a plant operator on call 24/7 to respond within a minute to reduce the output of W4-067 Project when network constraints occur.
11. 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.
12. The purchase and installation of the standard voice grade (analog) telephone line and associated conduit between the telephone company source and the meter socket or enclosure.

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

Note that an assumption of this study is that the W4-067 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.

## Summary

The connection of the W4-067 Project to the FE transmission system will require no network upgrades. Therefore, the Interconnection Customer will only have a cost responsibility for the Direct Connection of the W4-067 Project to the Jersey Central transmission system. As shown on Attachment 4, the estimated cost of these facilities is \$4,388,259. The above cost of \$4,388,259 does not include a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge. This charge is approximately 32.43% of the above cost or \$1,423,112. This tax may or may not be charged based on Rules and Regulations relating to Renewable Energy Sources.

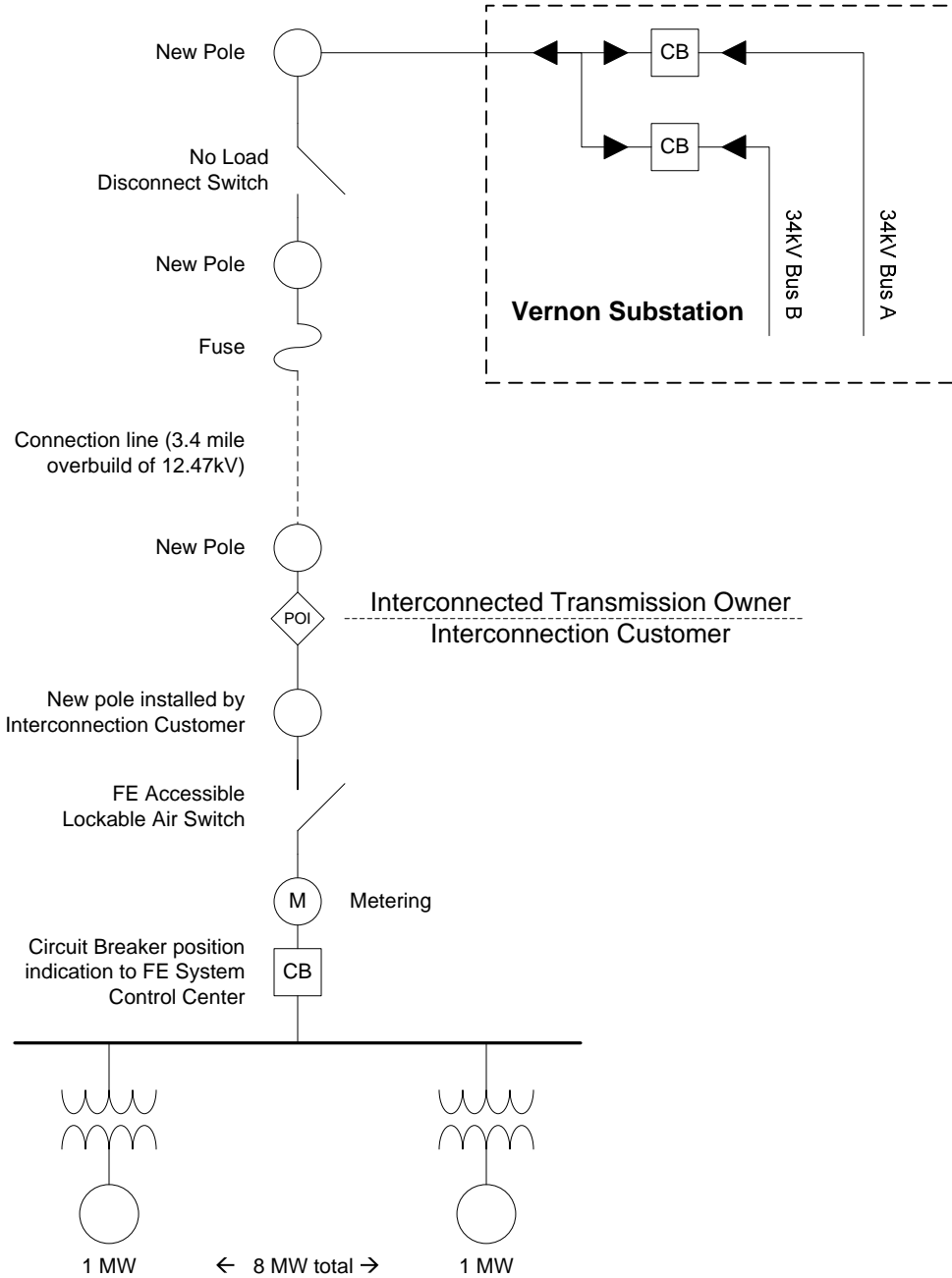
Based on the extent of the FE direct connection and system upgrades required to support this project, it is estimated that it will take one (1) year from the date of a fully executed Interconnection Construction Service Agreement to complete the upgrades required for the W4-067 Project. Full payment of the estimated cost of the project will be required upon execution of the Interconnection Service Agreement/Interconnection Construction Service Agreement (ISA/CSA). True up of the actual cost versus estimated cost of the project will be performed by FE at the end of the project. It further assumes that the Interconnection Customer will provide the property for the attachment and right-of-way facilities that will be 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 all 34.5 kV transmission system outages can be scheduled when needed.

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 System Impact Study. Further note that the cost estimate data contained in this document should be considered as only ballpark since it was produced without a detailed engineering review. The Interconnection Customer will be responsible for the actual cost of construction. FE 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**  
*Site View*

**Attachment 2**  
*Aerial View*

### Attachment 3 Single Line Diagram



**Attachment 4**  
**Estimated Costs**

<b>Item</b>	<b>Connection Facilities</b>
<b>1</b>	Construct approximately 3.4 miles (approximately 18,000') of new 34.5kV subtransmission line over the existing 17802 12.5 kV distribution circuit out of Vernon substation. The newly constructed line will extend from customer's point of connection at or near NJ198VR to a new line position on the 34.5 kV bus at Vernon Substation.
<b>2</b>	Estimate includes new breaker positions and underground egress with riser pole at Vernon Substation, and associated overhead line. In-line disconnect switches will be installed near the customer's point of connection on Sand Hill Road. Estimated cost of two new breakers at Vernon Substation is approximately \$1.4 million.
<b>3</b>	Estimate includes approximate cost of poles, conductor & cable, distribution transfers, hardware, guying, substation equipment and labor.
<b>4</b>	Estimate includes overhead subtransmission line work at the point of connection to JCP&L facilities up to the termination of the radial line extension.
<b>5</b>	Estimated cost to transfer existing distribution facilities onto new transmission replacement poles and estimated value of vegetation clearing is included in total cost.
<b>6</b>	As proposed additional ROW will be required to accommodate line construction, it is the applicant's responsibility to obtain a 50' wide ROW adjacent to FE's existing 115 kV ROW. If the new line is built on existing FE owned ROW, the applicant will be required to compensate FE for the diminished use of this ROW. Estimated cost to obtain new ROW or compensate FE for existing ROW is approximately \$910,000.
<b>7</b>	Estimate includes \$23K for metering to be mounted on the customer's pole.
<b>8</b>	Estimated value of vegetation clearing, at \$50,000.
<b>9</b>	No environmental review was conducted as part of this cost estimate. If environmental permitting is needed, an additional \$50K will be added to estimate.
<b>10</b>	Applicant is required to obtain any & all third party rights of way (ROW) required to extend electric facilities to their site. This includes vegetation management, environmental compliance, wetland preservation, and any other state or local permits required to extend facilities to their site.
<b>Total Estimated Costs: \$4,388,258.77 without CIAC tax</b>	

## **Attachment 5**

### ***FirstEnergy Revenue Metering Requirements For Generation Facilities Connected 46 kV and Lower***

This document addresses the revenue metering requirements for new generation-only facilities connected to FirstEnergy (FE) system voltages 46 kV and lower. This document is not intended for existing retail or wholesale load facilities where behind-the-meter generation is being installed.

The FE operating company (FEOC) shall provide, own, operate, test, and maintain the revenue metering equipment at the Interconnection Customer's (IC) expense. FE reserves the right to review each proposed generation facility design and determine if the IC shall provide, own, operate, test, and maintain the revenue metering equipment at the IC's expense for engineering reasons.

The revenue metering equipment includes, but is not limited to, current transformers, voltage transformers, secondary wires, meter socket, bidirectional revenue meter, and associated devices.

The revenue metering equipment shall be located at the Point of Interconnection (POI) unless otherwise agreed to by FE and the IC. The revenue metering will be compensated for electrical energy losses if it is not located at the POI.

The IC must provide FE with a facility one line, the estimated bi-directional power flow at the revenue metering point, and any loss compensation data.

The IC shall provide and install the mounting structures (or enclosures) and conduits necessary for the metering installation unless otherwise agreed to by the FEOC. The conduit shall be 1-1/2 inch galvanized rigid steel conduit. Flexible galvanized steel (liquid tight) conduit may be used between instrument transformers. The FEOC will install the wiring in the conduit between the instrument transformers and the meter socket.

The IC shall mount the instrument transformers unless otherwise agreed to by the FEOC. The instrument transformers and meter socket shall be installed in a location that is readily accessible to authorized FEOC representatives. If for any reason the meter socket and/or associated devices must be mounted in a weatherproof enclosure, it shall be provided and installed by the IC. The meter socket shall be installed generally within 50 feet of the instrument transformers unless an alternate design has been approved by the FEOC. The meter socket shall be mounted such that the centerline of the meter is approximately five feet above final grade. Where vehicle traffic may interfere with or damage any revenue metering equipment, the IC must install concrete filled steel barrier posts to protect such equipment.

The bidirectional revenue meter provided and installed by the FEOC will record billing data in intervals typically fifteen minutes or thirty minutes. The IC shall provide, at its sole cost and expense, the installation, operation, and maintenance of the communication link required by the FE billing data collection system for access to the meter. The specifications for the typical telephone communication link are as follows:

- Standard voice grade (analog) with dial tone. No digital telephone lines are permitted.

- Two-pair or four-conductor with RJ-11 / Male termination. The FEOC will make final connection to the meter.
- Must be able to receive incoming calls.
- Must be a direct line to the meter with no operator interception or operation required.
- Install the telephone line and associated conduit between the telephone company source and the meter socket or enclosure.
- The telephone line must be tagged with a phone number, including the area code.
- The telephone line must be installed and operational prior to the IC's service being energized.

The IC shall, at its expense, install, own, operate, test, and maintain any metering and telemetry equipment that may be required to provide real-time meter data to FE or PJM.

The FEOC will provide the IC access to bidirectional kWh and kVARh pulses from the FEOC meter at the IC's expense if requested.

The IC shall provide FE with prior notification of any modifications at the facility that could affect the FEOC revenue meter measurements (substation reconfigurations, generator additions, etc).