

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

***For***

***PJM Generation Interconnection Request  
Queue Position V4-070***

***Frenchtown 34.5kV***

**May 2010**

## **Preface**

The intent of the Combined Feasibility/System Impact Study is to determine a plan, with approximate cost and construction times 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 construction 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 specification (on the 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 action 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**

The Interconnection Customer (IC), has proposed a 3.0 MW (1.14 MW capacity) solar generating facility. The facility will be located at 873 Rt. 12 West in Frenchtown, New Jersey.

### **Point of Interconnection**

V4-070 will interconnect with the Jersey Central Power & Light distribution system fed from the A729-3 34.5kV line between the East Flemington and Frenchtown substations.

## **Network Impacts**

The queue V4-070 project was studied as a 3MW (1.14 MW capacity) injection into JCPL's system at the W FLM TP 34.5kV substation. The project was studied on a combined feasibility-impact basis which utilizes an AC analysis, and incorporates all contingency types. Project V4-070 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential network impacts were as follows:

### **Generator Deliverability**

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

No problems identified.

### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and, Bus Fault contingencies for the Full energy output.*

No problems 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 problems identified.

### **Short Circuit**

No problems identified.

### **New System Reinforcements**

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

None.

### **Contribution to Previously Identified System Reinforcements**

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.*

None.

### **Potential Congestion due to Local Energy Deliverability**

*(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 below. There is no guarantee of full deliverability 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 identified overloaded element(s). . As a result of the aggregate energy resources in the area, the following violations were identified:*

No problems identified.

## **System Protection Analysis**

An analysis was conducted to assess the impact of the Slacktown Road (V4-070) Project on the system protection requirements in the area. The results of this review have identified the following:

Under the assumption that the Slacktown Road (V4-070) Project generation will not supply fault current to the Jersey Central transmission system, there will be no protection upgrades needed for the East Flemington - Frenchtown (A729) 34.5 kV line path. However, the Slacktown Road (V4-070) Project will be required to have two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.

Fault current on the radial attachment line .85 miles from the Baptistown 34.5 kV substation toward East Flemington are listed below:

Three phase: 2,829 amperes

Line-to Ground: 1,486 amperes

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

Based on the information provided, an S&C SMD-1A, 50E fuse, either standard or slow speed, will be required.

The cost estimate for the required FE system protection facilities is included 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 Interconnection Customer will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. 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 MVARs) and .90 lagging (producing MVARs). If this capability cannot be provided, a 1.5 MVAR capacitor must be installed at the Slacktown Road (V4-070) Project substation at the Interconnection Customer's cost.

The Interconnection Customer will also 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 Slacktown Road (V4-070) Project for the conditions studied. Therefore the conclusion is that no transmission or distribution reinforcements will be required to provide the requested service.

## **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 including:

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. The purchase and installation of a 34.5 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.
3. The purchase and installation of a revenue class meter for the Slacktown Road (V4-070) interconnection to measure the power delivered in compliance with the FE standards.
4. A compliance with the FE and PJM generator power factor and voltage control requirements. However, the generators will need to supply their output at a unity power factor at the point of interconnection during normal conditions.
5. The execution of a back-up service agreement to serve the customer load supplied from the Slacktown Road 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.
6. 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.
7. 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.

8. The following status and metering points will be required:
  - a. Interconnection breaker position.
  - 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.
9. An installation of two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.

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 Slacktown Road (V4-070) 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

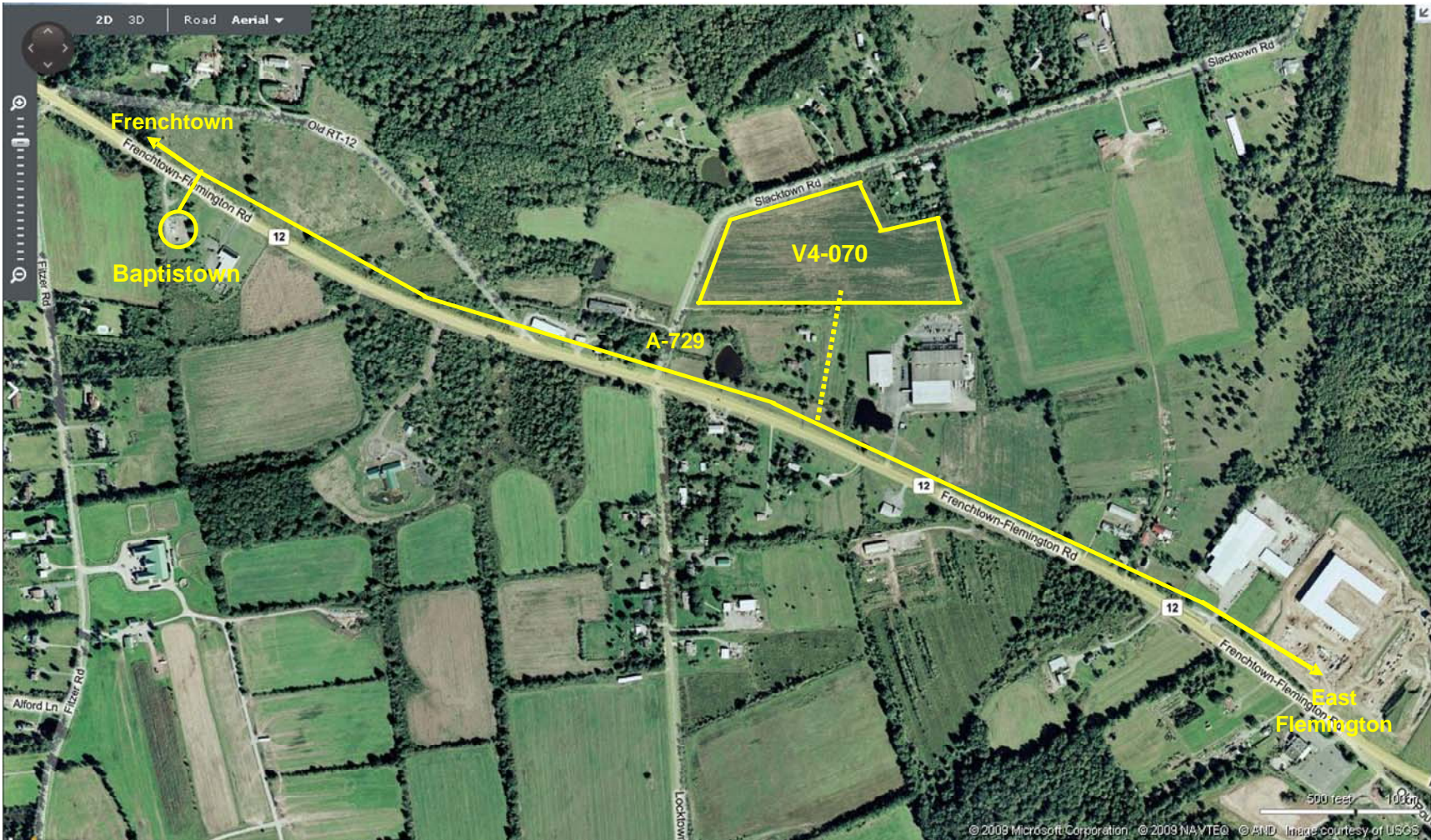
The connection of the Slacktown Road (V4-070) Project to the FE transmission system will require no network upgrades. Therefore the Interconnection Customer will only have a cost responsibility for the Direct Connection of the Slacktown Road (V4-070) Project to the Jersey Central transmission system. As shown on Attachment 4, the estimated cost of these facilities is \$183,000.

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 Slacktown Road (V4-070) Project. This includes the requirement for the Interconnection Customer to make a preliminary payment to FE that funds the first three months of engineering design that is related to the construction of the Direct Connection facilities. 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 PJM will allow all 34.5 kV transmission system outages when requested.

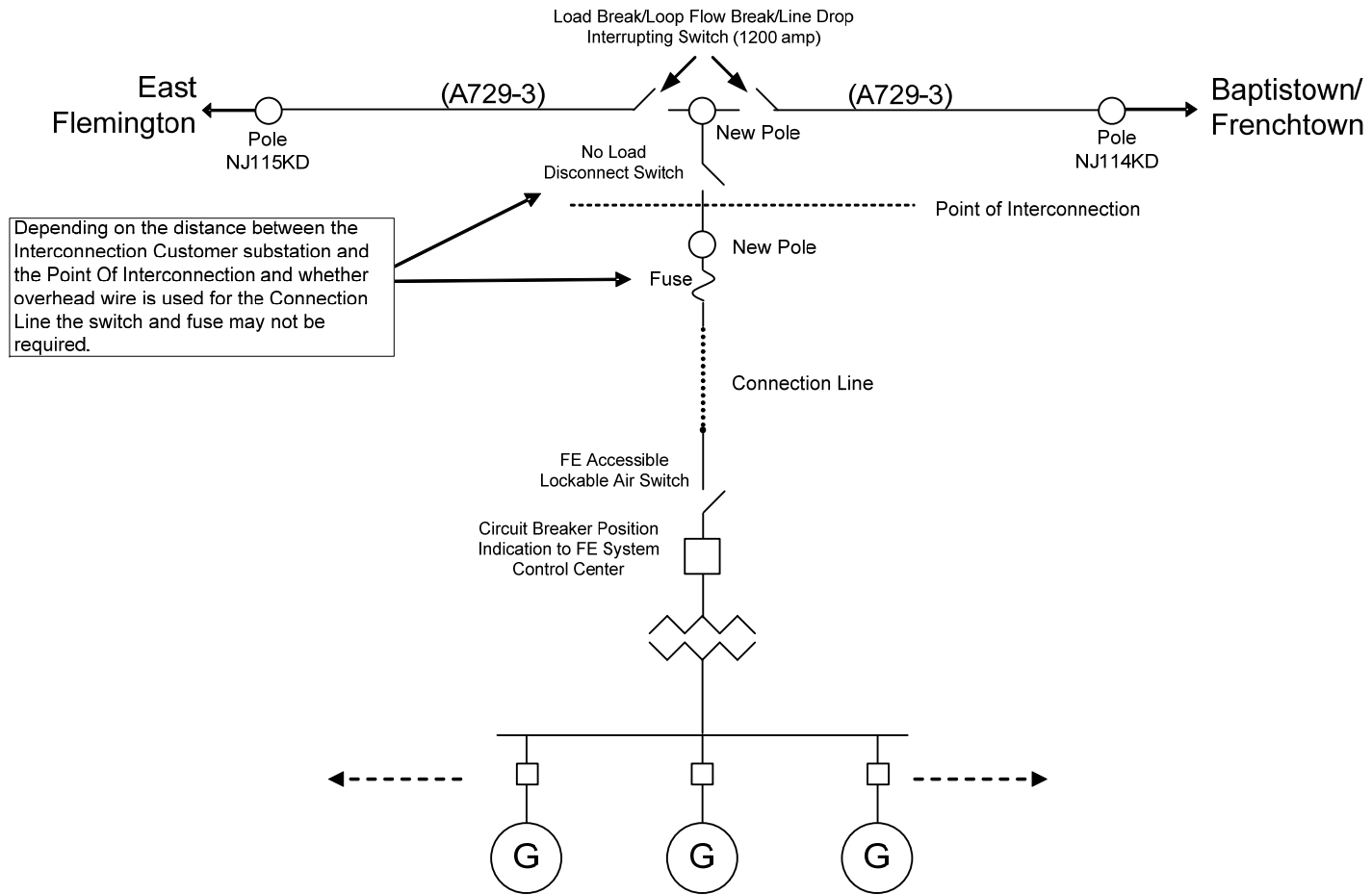
Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the Facilities Study. Further note that the cost estimate data contained in this document should be considered as only ballpark since it was produced without a detailed engineering review. The applicant 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 – Aerial View



### Attachment 3 – Single Line Diagram



Depending on the distance between the Interconnection Customer substation and the Point Of Interconnection and whether overhead wire is used for the Connection Line the switch and fuse may not be required.

3.0 MW Total Solar Photo-Voltaic Generation

## Attachment 4 – Direct Connection Facilities

Item	Connection Facilities
<b>1</b>	Construct approximate 300 feet of new 34.5kV line from a point between poles NJ114KD and NJ115KD on the A729-3 34.5kV line (West Flemington – Baptistown – Route 12 Switch) east of the Baptistown substation.
<b>2</b>	Installation will include a new tap pole, switch pole on tap (single blade disconnects included in estimate), load break switches on poles NJ114KD and NJ115KD, necessary guying, etc., and span of wire to a customer-owned meter pole beyond the switch pole.
<b>3</b>	Review of environmental maps shows no need for environmental permitting at the preliminary service point indicated on the Interconnection Customer submitted sketch. If permitting is needed, an additional \$50,000 will added to estimate.
<b>4</b>	Estimate includes \$20,000 for metering to be mounted on a customer-owned pole.
<b>5</b>	Miscellaneous Protection, Fuses, Metering, RTU, SCADA
	<b>Total Substation Costs: \$183,000</b>

## **Attachment 5 – FirstEnergy Revenue Metering Requirements for Generation Interconnection Customer**

Interconnection Customer shall install, own, operate, test and maintain the necessary revenue quality Metering Equipment. This includes current transformers, voltage transformers, mounting structures, wiring, meters, communication circuits, and associated devices. The Metering Equipment must meet the specifications listed in the FirstEnergy and regional transmission organization (RTO) connection documents. The FirstEnergy “Requirements for Transmission Connected Facilities” are located at: <http://www.firstenergycorp.com/feconnect>

The Metering Equipment shall be located at the generation facility on the high voltage side of the generator step-up transformers or facility main step-up transformer and/or station service power transformers. Power flows to and from the facility shall be compensated to the Point of Interconnection.

FirstEnergy will provide revenue quality Metering Equipment for a station service power supply at a generation facility if the supply is from the local FirstEnergy distribution system.

The revenue quality Metering Equipment shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by FirstEnergy, typically fifteen minutes or thirty minutes. The Interconnection Customer must provide FirstEnergy with remote access to the billing data in the Metering Equipment via a dedicated voice-grade analog telephone circuit. The Interconnection Customer shall provide FirstEnergy with contact information for the person or persons responsible for meter programming and Metering Equipment maintenance.

The Interconnection Customer shall consult with FirstEnergy regarding the revenue quality metering system design and provide the following information:

- Facility one line and revenue metering installation drawings (schematics, wiring diagrams, etc.)
- Estimated power flows to and from the facility at all revenue metering points
- Current transformer and voltage transformer specifications, including manufacturer, type, nameplate drawings, and certified accuracy test reports
- Revenue meter specifications including manufacturer, type, model number, and accuracy
- Revenue meter program information including but not limited to billing data recorder channel assignments, recorder pulse weights (Ke), and read-only password for access to interval data by the FirstEnergy billing data collection system (MV-90)
- Revenue meter telephone number

- Revenue meter loss compensation data (if applicable)

The Interconnection Customer shall provide FirstEnergy with prior notification of any modifications at the facility that will affect the revenue meter measurements, including substation reconfigurations and meter program changes.

The revenue metering system at each location shall be tested for accuracy by the Interconnection Customer once every two years. The Interconnection Customer shall give reasonable notice to FirstEnergy of the time when the testing is scheduled so that FirstEnergy may have representatives present. FirstEnergy and the RTO shall have the right to audit the revenue metering equipment and/or related documents. The Interconnection Customer shall be given a reasonable period of time to comply with any requests associated with an audit.

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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.

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