

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

***For***

***PJM Generation Interconnection Request Queue  
Position Z1-105***

***Emlenton 34.5kV***

**December 2014**

## **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 will be deferred until the System Impact Study is performed.

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 may be included in the study.

## General

The Interconnection Customer (IC) is proposing to install a 19MW (14MW Capacity) natural gas facility to be located in Clarion County, PA interconnecting into the Penelec area. This means that the remaining 5MW can be curtailed should a system reliability constraint occur. The IC has a proposed in-service date is for December 31, 2016.

The intent of the System Impact Study is to determine system reinforcements and associated costs and construction time estimates required to facilitate the addition of the new generating plant to the transmission system. The reinforcements include the direct connection of the generator to the system and any network upgrades necessary to maintain the reliability of the transmission system.

## Point of Interconnection

Z1-105 will interconnect with the Penelec distribution system to the Emlenton 34.5kV line, which connects to the Piney 34.5kV substation.

The single line is shown below in **Figure 1**.

The IC is required to construct all connection facilities in accordance with the Penelec published standards.

Total cost of Direct Connection, Non-Direct Connection and Attachment Facilities is **\$265,900** (add **\$80,400** tax if applicable for a total of **\$346,300**) to interconnect and will take a minimum of 12 months after the receipt of an executed Construction Service Agreement to complete this work (See **Table 1** and **Table 2** below for cost breakdown and details). These costs do not include costs listed in the Network Upgrades section of this report.

## Direct Connection/Attachment Facilities Cost Estimate

To accommodate this interconnection, a 34.5kV tap, radio controlled switch and associated equipment must be installed.

The total preliminary cost estimate for Direct Connection work is given in the following tables below.

For Penelec building Direct Connection cost estimates:

<b>Description</b>	<b>Total Cost</b>	<b>Tax</b>	<b>Total with Tax</b>
Install 34.5kV tap, radio controlled switch and associated equipment(PJM Network Upgrade Number n4281)	\$45,800	\$13,700	\$59,500
Engineering Oversight and Commissioning	\$65,200	\$19,700	\$84,900
<b>Total</b>	<b>\$111,000</b>	<b>\$33,400</b>	<b>\$144,400</b>

## Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following tables below:

For Penelec building Non-Direct Connection cost estimates:

<b>Table 2. Non-Direct Connect Cost Estimate</b>			
<b>Description</b>	<b>Total Cost</b>	<b>Tax</b>	<b>Total with Tax</b>
Install sync check relaying and anti-islanding DTT transmitter on Emlenton 34.5kV line at Piney substation (PJM Network Upgrade Number n4282).	\$147,400	\$44,500	\$191,900
RTU programming for connection to FirstEnergy SCADA and relay support for generation installation (PJM Network Upgrade Number n4283).	\$7,500	\$2,500	\$10,000
<b>Total</b>	<b>\$154,900</b>	<b>\$47,000</b>	<b>\$201,900</b>

In addition to the FE facilities, 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 installation of a Penelec provided 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 installation of a Penelec provided revenue class meter for each unit to measure the power delivered in compliance with the FE standards.
4. 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.
5. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.
6. A compliance with the FE and PJM generator power factor and voltage control requirements.
7. The execution of a back-up service agreement to serve the customer load when the units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the load.

8. The rough grade of the property for the Z1-105 Interconnection 34.5 kV tap pole and an access road for the delivery of equipment to this site. The above requirements are in addition to any metering and telecommunications required by PJM as specified in PJM Manuals M-01 and M-14D

Also, meeting the protection requirements (for anti-island protection) will involve installation of a Direct Transfer Trip (DTT) system. Interconnection Customer shall pay for and provide overall system equipment design, and installation (except for the connection to Penelec equipment as covered below). The DTT system type and design shall be subject to FirstEnergy's approval. Due to the significant size of the proposed generation vs. Penelec's circuit loading, a fiber optic communication DTT system is strongly preferred.

The DTT system shall include transmitter/receiver equipment. The transmitter equipment, so as to receive CB status (from Penelec's 34.5kV Emlenton CB at Piney Substation) will be located in local proximity to this Penelec equipment. Hardware, which will provide CB status to the DTT transmitter, will be designed, provided by, and installed by FirstEnergy, at Interconnection Customer's expense.

A receiver shall be located at Interconnection Customer's generation facility to receive the tripping signal. Tripping of the Interconnection Customer's generator would be required (via the DTT) for an open, or trip out, condition of Penelec's Emlenton CB mentioned above.

Tripping of the Interconnection Customer's generator would be required for a loss of DTT communication channel between the transmitters and receiver, as well as for times of nonfunctional DTT transmitter/receiver terminals. Interconnection Customer's generator will not re-connect to the Penelec system until full integrity of the DTT system is restored.

Interconnection Customer shall provide RTU normal/alarm operational status of the DTT system to the Penelec Load Dispatch Office. This monitoring shall be a continuous monitoring of the communication channel and operational readiness of the transmitter/receiver terminals, i.e., overall system integrity.

Maintenance and upkeep of the DTT system will be at Interconnection Customer's expense.

For any abnormal 34.5kV operation of the Penelec system which would cause Interconnection Customer's generation facility to be electrically isolated from Penelec's Piney Substation via the normal 34.5kV circuit, Interconnection Customer's generator will disconnect, and remain disconnected, from the Penelec system until the normal 34.5kV circuit is restored.

Interconnection Customer is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'Re-synchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

Interconnection Customer's protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

### **Revenue Metering and SCADA Requirements**

**For PJM:** IC 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.

**For Penelec:** 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>

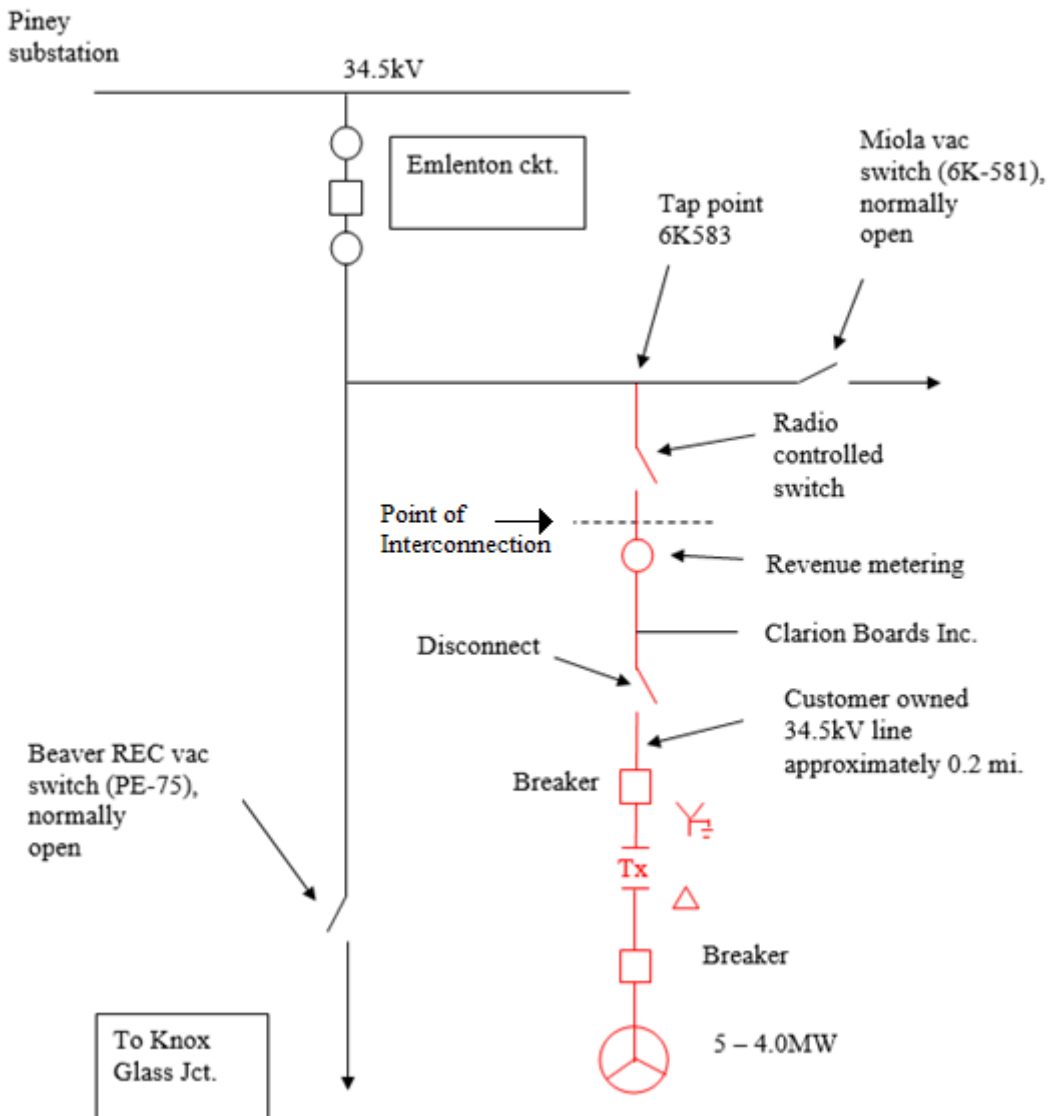


Figure 1. Single Line Diagram

## **Network Impacts**

The Queue Project Z1-105 was studied as a 14.0 MW (Capacity 14.0 MW) injection at the Piney 34.5 kV substation in the Penelec area. Project Z1-105 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z1-105 was studied with a commercial probability of 100%. Potential network impacts were as follows:

## **Summer Peak Analysis – 2017**

### **Generator Deliverability**

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

No violations were identified.

### **Multiple Facility Contingency**

*(Double Circuit Tower Line(DCTL), Line with Failed Breaker(LFFB) and Bus Fault(Bus) contingencies for the full energy output)*

No violations were 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 were identified.

### **Short Circuit**

*(Summary of impacted circuit breakers)*

PJM has completed the short circuit analysis of the Z1-105 queue project Emlenton 34kV. One option was considered during this study: the primary option was a direct connection to Piney 34.5kV substation. PJM analysis found **no breakers** to be over duty in the PENELEC transmission area.

### **Steady-State Voltage Requirements**

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

None.

### **Light Load Analysis - 2017**

*(Summary of any reinforcements required to mitigate system reliability issues during light load periods.)*

Not required.

### **Stability and Reactive Power Requirement**

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

Not required.

### **System Reinforcements**

#### **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.

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

*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.*

*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 will study all overload conditions associated with the overloaded element(s) identified.*

As a result of the aggregate energy resources in the area, no violations were identified.