Generation Interconnection
System Impact Study Report

For

PJM Generation Interconnection Request Queue
Position Z2-108

Meyersdale North 115kV

March 2015

Preface

The intent of the 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 System Impact 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), Meyersdale Windpower, L.L.C. is proposing to install 18 MW Energy (0 MW Capacity) of batteries at its existing 30MW wind farm for a total combined 48MW Energy located in Somerset County, PA interconnecting into the Penelec area. This means that the full 18 MW generated by the battery can be curtailed should a system reliability constraint occur. The IC has proposed in-service date is for December 30, 2015 and is currently under review. The IC has requested a backfeed date of August 31, 2015.

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

Z2-108 will interconnect with the Penelec transmission system at the existing Point of Interconnection for K23 Meyersdale Wind Farm.

Attachment Facilities

Since this is an uprate to an existing facility, no Attachment Facilities upgrades are required. 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.

The IC shall install a separate meter to measure the battery portion of generation for settlement purposes.

Direct Connection Cost Estimate

Since this is an uprate to an existing facility, no Direct Connection upgrades are required.

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 Direct Connection cost estimates:

Table 1. Non-Direct Connect Cost Estimate

Description	Total Cost	Tax	Total with Tax
Remote relaying setting changes (PJM Network Upgrade Number n**4479**)	$10,000	$3,200	$13,200
Total	**$10,000**	**$3,200**	**$13,200**

Revenue Metering and SCADA Requirements

For PJM: Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for Interconnection Customer'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

Interconnection Requirements

Interconnection Customer (IC) will be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

1. Installation of the Project on the generator side of the existing IC owned circuit breaker. The IC cannot use multiple circuit breakers to protect the generator lead line between the IC and FE substations.

2. The purchase and installation of 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.

3. The purchase and installation of an 115kV interconnection metering instrument transformer. Ratio and accuracy specifications based on the customer load and generation levels will be provided.

4. The purchase and installation of a revenue class meter for each unit to measure the power delivered.

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.

6. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

7. A compliance with the FE and PJM generator power factor and voltage control requirements.

8. The execution of a back-up service agreement to serve the customer load supplied from the Z2-108 115kV interconnection substation when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The above requirements are in addition to any metering required by PJM.

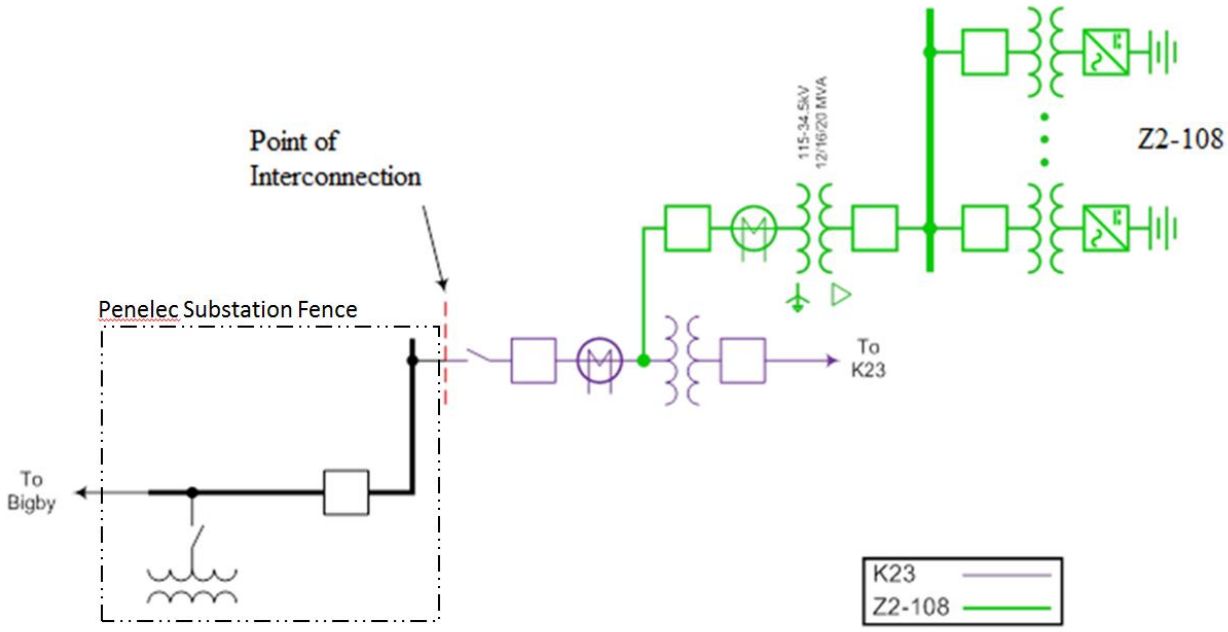

Figure 1. Single Line Diagram

Network Impacts

The Queue Project Z2-108 was studied as an 18.0 MW (0.0 MW Capacity) injection at the Meyersdale North 115 kV substation in the Penelec area. Project Z2-108 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z2-108 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis – 2018

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 Z2-108 queue project **Meyersdale North 115kV**. One option was considered during this study: the primary option was a direct connection to the Meyersdale N 115kV 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 - 2018

(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, the following violations were identified:

Item 1a. (PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 126.04% to 138.36% (AC power flow) of its emergency rating (166 MVA) for the single line contingency outage of 'B_PN115-XF-#95A'. This project contributes approximately 19.99 MW to the thermal violation.

```
CONTINGENCY 'B_PN115-XF-#95A'                    /* GARRETT 138-115 KV XF
  DISCONNECT BRANCH FROM BUS 235469 TO BUS 235470 CKT 1
  DISCONNECT BRANCH FROM BUS 235470 TO BUS 200762 CKT 1
  END
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Item 1b. (PENELEC - AP) The 26GARRETT-01GARRET 115 kV line (from bus 200762 to bus 235470 ckt 1) loads from 131.17% to 144.98% (AC power flow) of its emergency rating (160 MVA) for the single line contingency outage of 'B_PN115-LX-#198_A'. This project contributes approximately 19.99 MW to the thermal violation.

CONTINGENCY 'B_PN115-LX-#198_A' /* SOMERSET-ROCKWOOD & ROCKWOOD #1 XF
DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1
DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1
END

Item 1c. (AP - AP) The 01GARRET-01ALBRIG 138 kV line (from bus 235469 to bus 235120 ckt 1) loads from 98.64% to 106.41% (AC power flow) of its emergency rating (191 MVA) for the single line contingency outage of 'B_PN115-LX-#198_A'. This project contributes approximately 14.04 MW to the thermal violation.

CONTINGENCY 'B_PN115-LX-#198_A' /* SOMERSET-ROCKWOOD & ROCKWOOD #1 XF
DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1
DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1
END

Item 1d. (AP - AP) The 01GARRET 138/115 kV transformer (from bus 235470 to bus 235469 ckt 1) loads from 110.94% to 121.3% (AC power flow) of its emergency rating (196 MVA) for the single line contingency outage of 'B_PN115-LX-#198_A'. This project contributes approximately 19.99 MW to the thermal violation.

CONTINGENCY 'B_PN115-LX-#198_A' /* SOMERSET-ROCKWOOD & ROCKWOOD #1 XF
DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1
DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1
END

Item 1e. (PENELEC - PENELEC) The Y1-003 TAP-26GARRETT 115 kV line (from bus 913000 to bus 200762 ckt 1) loads from 115.38% to 128.94% (AC power flow) of its emergency rating (167 MVA) for the single line contingency outage of 'B_PN115-LX-#198_A'. This project contributes approximately 20.0 MW to the thermal violation.

CONTINGENCY 'B_PN115-LX-#198_A' /* SOMERSET-ROCKWOOD & ROCKWOOD #1 XF
DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1
DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1
END