Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position Z2-026

North Temple 230kV

August 2014

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 natural gas generating facility located Berks County, Pennsylvania. The installed facilities will have a total capability of 800 MW with 800 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 1, 2018. **This study does not imply a Metropolitan Edison (MetEd)/FirstEnergy commitment to this in-service date.**

Point of Interconnection

Z2-026 will interconnect with the MetEd transmission system to the North Temple 230kV substation.

Cost Summary

The Z2-026 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 14,914,100
Total Costs	**$ 14,914,100**

In addition, the Z2-026 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 10,791,300
Previously Identified Upgrades	$ 0
Total Costs	**$ 0**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

There are no new Attachment Facilities required for construction by MetEd.

Direct Connection Cost Estimate

There are no new Direct Connection Facilities required for construction by MetEd.

Non-Direct Connection Cost Estimate

The North Temple 230 kV substation must be expanded to a breaker and a half bus configuration and several line terminations will be relocated to accommodate the Z2-026 connection. The double circuit dead end structure for the Ironwood Tap (1001) and Northkill (1071) 230 kV lines will be relocated and the lines re-terminated to new positions. The North Temple – Lyons (1031) 230 kV line termination will be relocated and the Z2-026 Project will connect in its place. The North Temple – Ontelaunee (1014) 230 kV line will be terminated on an adjacent bay to avoid a common breaker with the Z2-026 Project and to accommodate the north main bus of the breaker and a half design. A motor operated SCADA control switch will be installed at the North Temple Substation in series with the Z2-026 Project attachment line to promptly isolate the circuit and restore the network through path of the North Temple bus in the event of a permanent line fault.

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Expand North Temple 230kV substation to a breaker and a half configuration: • Expand existing substation footprint on an angle to avoid neighboring gas pipeline • Extend and reconfigure bus work to accommodate the breaker and a half bus configuration • Add five (5) new circuit breakers (4000 amp with 60 kA interrupting capability) • Add ten (10) new breaker disconnect switches (4000 amp) • Relocate line terminations for the (1014), (1031), (1001), and (1071) 230 kV line (associated substation work) • Add new substation termination structures required for new line terminations • Add new substation termination structure for the Z2-026 generator • All new substation bus conductor to be bundled 1590 ACSR wire • Expand existing or add new control building for substation expansion facilities (see protection requirements) • Install/Replace system protection facilities • Relocate two storage buildings to accommodate the breaker and a half bus expansion • Install metering and reroute fiber communications as necessary • Attachment Line Fiber, Protection, Metering, SCADA etc.	$ 13,003,400
Transmission work: • Relocate the existing Ironwood Tap (1001) and N. Lebanon (1071) double circuit tower line dead-end structure • Relocate line terminations for the (1014), (1031), (1001), and (1071) 230 kV line (associated line work) • Relocate two single-circuit 69 kV lines to reroute around expanded substation	$ 1,910,700
Total Non-Direct Connection Facility Costs	**$ 14,914,100**

Schedule

Based on the extent and number of FE direct connection and system upgrades required to support this project, it is expected to take a minimum of two (2) years of continuous construction from the signing of an Interconnection Construction Service Agreement to complete the upgrades required for the Z2-026 project. This assumes that the Interconnection Customer will construct all facilities to the point of interconnection at the North Temple 230 kV substation. 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 transmission system outages when requested. The construction timeline will be examined in greater detail in the System Facility Study. A preliminary payment is required for the first three months of the engineering design work that is related to the expansion of the North Temple 230 kV and 69 kV substations and the required attachment facilities.

Interconnection Customer Requirements

The Interconnection Customer will be responsible to acquire Right Of Way (independent from FE's ROW), construct, own and operate its radial 230 kV attachment line to the North Temple substation. The Point of Interconnection will be located on the Z2-026 Project attachment line one span from the North Temple dead end structure. The Interconnection Customer will also be responsible for acquiring all easements, properties and permits that may be required to expand the North Temple substation for the construction of the project connection facilities. When the final Right Of Way is disclosed for the Z2-026 Project FE will finalize the connection design.

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 230 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 each unit 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.

5. The execution of a back-up service agreement to serve the customer load supplied from the North Temple 230 kV substation when the Z2-026 Project units are out-of-service.

6. 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.

7. 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.

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

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

Network Impacts

The Queue Project Z2-026 was studied as an 800.0 MW (Capacity 800.0 MW) injection at the North Temple 230 kV substation in the MetEd area. Project Z2-026 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z2-026 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
PL100139	CONTINGENCY 'PL100139' /* HOSE-NTEM 230KV & NTEM T4 DISCONNECT BRANCH FROM BUS 204508 TO BUS 204607 CKT 4 DISCONNECT BRANCH FROM BUS 204686 TO BUS 204508 CKT 1 END

Generator Deliverability

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
1	N-1	PL100139	MetEd	27N.TEMPLE 230/69 kV transformer	204508	204607	6	DC	85.83	112.89	ER	297	80.37	1

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

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.

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.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without Z2-026	Duty Percent With Z2-026	Duty Percent Difference
2	PECO	213906	PLYMTG 1 230kV	265	S	99.93	100.01	0.08

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.

FirstEnergy Network Impacts

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

#	Type	Name	Outage Description	Facility Description	Final Loading %	Rating Type	Rating MVA
3	MetEd	C2_ME230-SB-#9	Northkill-N. Temple & N. Temple-Hosensck 230kV lines	North Temple-Lyons (1031) 230kV line	106.9	Norm 4hr	709 869
4	MetEd	b-ME230-LS-14	North Temple 230/69kV #4	North Temple 230/69kV #6 bank	100.1	Norm 4hr	249 297
5	MetEd	b-ME230-LS-15	North Temple 230/69kV #6	North Temple 230/69kV #4 bank	112.3	Norm 4hr	249 261

#	Type	Name	Outage Description	Facility Description	Final Loading %	Rating Type	Rating MVA
6	MetEd	B_ME230-SX-#33	Northkill-N. Temple 230kV & N. Temple 230/69kV #6	North Temple 230/69kV #4 bank	123.0	Norm 4hr	249 261

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1, 4 5, 6	North Temple 230/69kV Transformer #6 North Temple 230/69kV Transformer #4	Install a new 230/69 kV transformer and add 69 kV bus and associated equipment at North Temple. Estimated Cost with tax: $10,291,300; Tax: $2,436,000; Estimated Time: 18 months	Pending	**$ 10,291,300**
2	Plymouth 265 230kV circuit breaker	Replace circuit breaker with a 63kA breaker. This work is expected to take 2 years to complete	Pending	**$ 500,000**
3	North Temple-Lyons (1031) 230kV line	This overload will be mitigated by the substation rearrangement required to connect Z2-026	N/A	**$ 0**
			Total New Network Upgrades	**$ 10,791,300**

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.

Attachment 1. Project Location

Attachment 2. Single Line Diagram

Attachment 3. Flowgate Details

The following tables contain additional information about each flowgate presented in the body of the report. For each table, a description of the flowgate and its contingency was included for convenience. However, the intent of the table section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the table are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Table 1

(METED - METED) The 27N.TEMPLE 230/69 kV transformer (from bus 204508 to bus 204607 ckt 6) loads from 85.83% to 112.89% (DC power flow) of its emergency rating (297 MVA) for the single line contingency outage of 'PL100139'. This project contributes approximately 80.37 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
204665	27ONTELCT1	1.22
204666	27ONTELCT2	1.22
204667	27ONTELST1	0.87
917111	Z2-026	80.37