Generation Interconnection Feasibility Study Report Web Version

For

PJM Generation Interconnection Request Queue Position W4-012

Ridgway-Whetstone 115kV Project

April, 2011

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by PJM Interconnection LLC, (PJM), and FirstEnergy (FE) in response to a request made by the Interconnection Customer (IC) for the connection of a 120 MW (15.6 MW Capacity) Ridgway – Whetstone 115kV (W4-012) Wind Farm Generation Project to the Penelec Transmission System. IC has proposed commercial operation date of December 2014 for the proposed Ridgway – Whetstone 115kV (W4-012) facility. As per the PJM Generation Interconnection study process, the Ridgway – Whetstone 115kV (W4-012) Project assessment was accomplished by: 1. Evaluating the reliability impact of the proposed facilities and connection on the interconnected transmission system by the performance of a power flow study; 2. Ensuring compliance with the NERC, ReliabilityFirst, PJM and FE Reliability Standards by identifying the system reinforcements that will need to be installed for an interconnection of the proposed project; 3. Coordinating and cooperating with the PJM staff and IC by participating in project meetings and issuing this report as a part of the study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting all studies in accordance with the PJM Manuals, the "FE Requirements for Transmission Connected Facilities", and the "FE Study Guide".

Connection Facilities

In compliance with the PJM Generation Interconnection Planning protocol, IC has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram that identifies its plan to construct a 60 x 2.0 MW Wind Turbine Generation Project with a total capability of 120 MW (15.6 MW Capacity) in Pennsylvania. For purposes of this report, it has therefore been designated as the Ridgway – Whetstone 115kV (W4-012) Project to reflect its interconnection voltage and its proximity to the Ridgway – Whetstone 115kV line. IC has requested the study of both a Primary and Secondary Point of Interconnection (POI) for the Ridgway – Whetstone 115kV (W4-012) Project. This report contains detailed connection requirements, direct connection costs and schedule, power flow analysis, short circuit analysis, and a cost and schedule for any associated system reinforcements for the Primary POI. For the Secondary POI, this report only provides the results of the power flow analysis and short circuit analysis. It does not contain a cost/schedule associated with direct connection or any identified system reinforcements pertaining to the analysis performed.

Primary Point of Interconnection: Ridgway – Whetstone 115kV Line

The Primary POI for this project will be accomplished by the construction of a new 115kV 3 breaker ring bus and the looping of the Ridgway – Whetstone 115kV line to it. The new 115kV 3 breaker ring bus will be approximately 0.5 miles from Whetstone substation. IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 115kV 3 breaker ring bus interconnection substation and the associated attachment facilities. IC will also be responsible for the rough grade of the property and an access road to the proposed 3 breaker ring bus site. A summary of the Ridgway – Whetstone 115kV (W4-012)

Project direct connection facilities that will be required for the Primary POI and their estimated costs are shown on Attachment 3. The one-line for the Primary POI is shown in Attachment 2a.

Secondary Point of Interconnection: Shawville - Elko 230kV Line

The Ridgway – Whetstone 115kV (W4-012) Project is located 4.3 miles from the Shawville – Elko 230kV line. The Secondary POI for this project will be a new 230kV 3 breaker ring bus and the looping of the Shawville – Elko 230kV line to it. The new 230kV 3 breaker ring bus will be approximately 9.8 miles from Elko substation. IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 230kV 3 breaker ring bus interconnection substation and the associated attachment facilities. IC will also be responsible for the rough grade of the property and an access road to the proposed 3 breaker ring bus site. As mentioned previously, there is not an estimated cost or schedule provided for the Secondary POI. The one-line for the Secondary POI is shown in Attachment 2b.

PJM Report on the Transmission System

This portion of the report addresses the impacts on and the required reinforcements to that part of the transmission system under PJM jurisdiction.

Network Impacts
Queue project W4-012 was studied as a(n) 120.0 MW (15.6 MW of which was Capacity) injection into the Penelec (FirstEnergy) system. Project W4-012 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Primary POI: 50.0% tap between Whetstone and Ridgway115.0 kV line

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*.

1. (PENELEC) The P47_OPT1-South Troy 115 kV line (from bus 290058 to bus 200673 ckt 1) loads from 121.31% to 122.48% (DC power flow) of its emergency rating (127 MVA) for the operational contingency 'B_PN230-SX-#28'. This project contributes approximately 9.20 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-SX-#28'      /* GLADE - WARREN 230 KV & WARREN 230/115 BK 4 - (PJM-PN28)
  DISCONNECT BRANCH FROM BUS 200811 TO BUS 200593 CKT 1
  DISCONNECT BRANCH FROM BUS 200818 TO BUS 200811 CKT 4
END
```

2. (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 95.84% to 98.82% (DC power flow) of its normal rating (478 MVA) for non contingency condition. This project contributes approximately 14.26 MW to the thermal violation.

3. (PENELEC) The R92-Rockton Mountain 115 kV line (from bus 296916 to bus 200713 ckt 1) loads from 63.07% to 102.56% (DC power flow) of its emergency rating (184 MVA) for the operational contingency 'B_PN115-LS-#85'. This project contributes approximately 72.66 MW to the thermal violation.

```
CONTINGENCY 'B_PN115-LS-#85'    /* FOREST - RIDGWAY (FR) 115 KV
  DISCONNECT BRANCH FROM BUS 200647 TO BUS 200582 CKT 1
END
```

4. (PENELEC/NYISO) The Warren-FALCONER 115 kV line (from bus 200579 to bus 135277 ckt 1) loads from 111.18% to 122.05% (DC power flow) of its emergency rating (118 MVA) for the operational contingency 'B_PN230-SX-#19'. This project contributes approximately 12.83 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-SX-#19'    /* ERIE SOUTH - WARREN (GES) 230 KV - (PJM-PN28)
  DISCONNECT BRANCH FROM BUS 200568 TO BUS 200811 CKT 1
END
```

5. (PENELEC/NYISO) The Warren-FALCONER 115 kV line (from bus 200579 to bus 135277 ckt 1) loads from 120.17% to 121.65% (DC power flow) of its normal rating (80 MVA) for non contingency condition. This project contributes approximately 7.35 MW to the thermal violation.

6. (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 95.62% to 99.41% (DC power flow) of its emergency rating (617 MVA) for the operational contingency 'KEYSTONE_JACKMTN1_1'. This project contributes approximately 23.34 MW to the thermal violation.

```
CONTINGENCY 'KEYSTONE_JACKMTN1_1'     /* 500/500KV, AREA 225/225.
  DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
END
```

7. (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 99.12% to 103.88% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 23.21 MW to the thermal violation.

8. (PENELEC) The -Shawville 1 1/230 kV transformer (from bus B$0067 to bus 200710 ckt 1A) loads from 109.22% to 110.41% (DC power flow) of its normal rating (138 MVA) for non contingency condition. This project contributes approximately 10.16 MW to the thermal violation.

9. (PENELEC) The Homer City-Shelocta 230 kV line (from bus 200767 to bus 200795 ckt 1) loads from 110.88% to 111.16% (DC power flow) of its emergency rating (841 MVA) for the operational contingency 'B_PN345-SX-#6'. This project contributes approximately 14.74 MW to the thermal violation.

```
CONTINGENCY 'B_PN345-SX-#6'     /* HANDSOME LAKE - WAYNE (WHL) 345 KV - (PJM-PN33A)
  DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1
END
```

10. (PENELEC) The -Shawville 2 1/230 kV transformer (from bus B$0082 to bus 200726 ckt 2A) loads from 98.81% to 99.84% (DC power flow) of its normal rating (155 MVA) for non contingency condition. This project contributes approximately 9.92 MW to the thermal violation.

11. (PENELEC) The V3-018 TAP-Towanda East 115 kV line (from bus 293419 to bus 200674 ckt 1) loads from 127.36% to 128.49% (DC power flow) of its emergency rating (119 MVA) for the operational contingency 'B_PN230-SX-#7B'. This project contributes approximately 8.32 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-SX-#7B'    /* EAST TOWANDA-GROVER-LAUREL HILL
  DISCONNECT BRANCH FROM BUS 292303 TO BUS 200675 CKT 1
END
```

12. (PENELEC) The V3-018 TAP-Towanda East 115 kV line (from bus 293419 to bus 200674 ckt 1) loads from 103.83% to 104.86% (DC power flow) of its normal rating (94 MVA) for non contingency condition. This project contributes approximately 5.98 MW to the thermal violation.

13. (PENELEC) The Rockton Mountain-Shawville 1 115 kV line (from bus 200713 to bus 200714 ckt 1) loads from 97.19% to 158.25% (DC power flow) of its emergency rating (119 MVA) for the operational contingency 'B_PN115-LS-#85'. This project contributes approximately 72.66 MW to the thermal violation.

```
CONTINGENCY 'B_PN115-LS-#85'    /* FOREST - RIDGWAY (FR) 115 KV
  DISCONNECT BRANCH FROM BUS 200647 TO BUS 200582 CKT 1
END
```

14. (PENELEC) The South Troy-V3-018 TAP 115 kV line (from bus 200673 to bus 293419 ckt 1) loads from 127.39% to 128.52% (DC power flow) of its emergency rating (119 MVA) for the operational contingency 'B_PN230-SX-#7B'. This project contributes approximately 8.32 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-SX-#7B'    /* EAST TOWANDA-GROVER-LAUREL HILL
  DISCONNECT BRANCH FROM BUS 292303 TO BUS 200675 CKT 1
END
```

15. (PENELEC) The South Troy-V3-018 TAP 115 kV line (from bus 200673 to bus 293419 ckt 1) loads from 103.87% to 104.9% (DC power flow) of its normal rating (94 MVA) for non contingency condition. This project contributes approximately 5.98 MW to the thermal violation.

16. (PENELEC) The Shelocta-Keystone 230 kV line (from bus 200795 to bus 200810 ckt 1) loads from 108.15% to 108.51% (DC power flow) of its emergency rating (841 MVA) for the operational contingency 'B_PN345-SX-#6'. This project contributes approximately 19.26 MW to the thermal violation.

```
CONTINGENCY 'B_PN345-SX-#6'    /* HANDSOME LAKE - WAYNE (WHL) 345 KV - (PJM-PN33A)
  DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1
END
```

Secondary POI: 50.0% tap between Shawville 2 and Elko230.0 kV line

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.*

1. (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 95.83% to 98.71% (DC power flow) of its normal rating (478 MVA) for non

contingency condition. This project contributes approximately 13.77 MW to the thermal violation.

2. (PENELEC/NYISO) The Warren-FALCONER 115 kV line (from bus 200579 to bus 135277 ckt 1) loads from 111.18% to 112.49% (DC power flow) of its emergency rating (118 MVA) for the operational contingency 'B_PN230-SX-#19'. This project contributes approximately 9.59 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-SX-#19'    /* ERIE SOUTH - WARREN (GES) 230 KV - (PJM-PN28)
  DISCONNECT BRANCH FROM BUS 200568 TO BUS 200811 CKT 1
END
```

3. (PENELEC/NYISO) The Warren-FALCONER 115 kV line (from bus 200579 to bus 135277 ckt 1) loads from 120.17% to 121.27% (DC power flow) of its normal rating (80 MVA) for non contingency condition. This project contributes approximately 5.45 MW to the thermal violation.

4. (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 95.64% to 100.11% (DC power flow) of its emergency rating (617 MVA) for the operational contingency 'KEYSTONE_JACKMTN1_1'. This project contributes approximately 27.59 MW to the thermal violation.

```
CONTINGENCY 'KEYSTONE_JACKMTN1_1'    /* 500/500KV, AREA 225/225.
  DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
END
```

5. (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 99.14% to 104.78% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 27.53 MW to the thermal violation.

6. (PENELEC) The Homer City-Shelocta 230 kV line (from bus 200767 to bus 200795 ckt 1) loads from 110.89% to 111.16% (DC power flow) of its emergency rating (841 MVA) for the operational contingency 'B_PN345-SX-#6'. This project contributes approximately 14.05 MW to the thermal violation.

```
CONTINGENCY 'B_PN345-SX-#6'    /* HANDSOME LAKE - WAYNE (WHL) 345 KV - (PJM-PN33A)
  DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1
END
```

7. (PENELEC) The Shelocta-Keystone 230 kV line (from bus 200795 to bus 200810 ckt 1) loads from 108.15% to 108.5% (DC power flow) of its emergency rating (841 MVA) for the operational contingency 'B_PN345-SX-#6'. This project contributes approximately 18.13 MW to the thermal violation.

```
CONTINGENCY 'B_PN345-SX-#6'     /* HANDSOME LAKE - WAYNE (WHL) 345 KV - (PJM-PN33A)
  DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1
END
```

Penelec (FirstEnergy) Feasibility Analysis Report

This portion of this Feasibility Study Report has been prepared for this PJM queue project by Penelec (FirstEnergy). It addresses the impacts on and required reinforcements to the transmission system in Penelec and to the distribution level system. It also includes the attachment and direct connection facilities.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Ridgway – Whetstone 115kV (W4-012) Project on the FE Transmission System. This included the performance of a contingency analysis to identify any facility overload or voltage condition that violates the FE Planning Criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them.

The Ridgway – Whetstone 115kV (W4-012) Project Power Flow Analysis was performed using a 2014 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of the Ridgway – Whetstone 115kV line. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Ridgway – Whetstone 115kV (W4-012) Project was conducted to test for criteria compliance. The direct connection of the Ridgway – Whetstone 115kV (W4-012) Project to the Penelec transmission system was studied at both the Primary and Secondary POI.

The results from the study Power Flow Analysis showing a comparison of the FE and PJM contingency study results are detailed on Attachment 4. Please note that the Attachment displays the Power Flow Analysis results for both the Primary and Secondary POI. As shown, the conclusion from this analysis is that there are no new upgrades required for the Ridgway – Whetstone 115kV (W4-012) Project. However, the PJM and FE findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability. IC will therefore be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

For both the Primary and Secondary POI, a short circuit analysis has been performed by PJM and the findings were confirmed by FE. The findings show that no circuit breakers are newly over dutied with the addition of the Ridgway – Whetstone 115kV (W4-012) Project. The study also showed no significant fault current contribution to the breakers which are near the over-duty limit.

System Protection Analysis

An analysis was conducted to assess the impact of the Ridgway – Whetstone 115kV (W4-012) Project on the system protection requirements in this area. This study assumes no dual pilot relaying is required for stability on the Ridgway – W4-012 interconnection substation 115kV line. The results of this review show that the following relay additions and upgrades will be required:

Whetstone – W4-012 line (0.5 miles) – install fiber for dual pilot protection and DTT to W4-012 Generation

Whetstone 115kV Substation
W4-012 115kV line exit (formerly Ridgway exit) - Line relays to use fiber optic communication. Remove the existing primary GCY primary relaying and install SEL311L line current differential relaying. Replace the existing line JBCG backup relaying with new SEL321 relay capable of interfacing with fiber and purchase fiber transceivers to interface with new fiber communication channel (DCB over mirrored bits). Remove Z phase wave trap and associated PLC equipment. Replace the existing BF relaying with new SEL352 BF relaying. Install SEL-279 reclosing relay. Install RFL9745 transmitter for DTT via fiber to W4-012 generation. Harvey Run exit breaker and W4-012 exit breaker 'b' contacts to be wired into RFL-9745 transmitter.

Ridgway – W4-012 line (15 miles)– retain existing on-off carrier scheme (DCB over PLC) utilizing new relaying and install DTT to W4-012 Generation

Ridgway 115kV Substation
W4-012 115kV line exit (formerly Whetstone exit) - Remove the existing primary GCY primary relaying and install SEL421 relays (DCB over PLC). Replace the existing Z phase wave trap if not possible to retune to dual frequency by replacing wave trap tuning device. Remove existing IRQ-8 backup and install SEL321 backup relaying. Install a RFL-9780 transmitter, new LTU, coax, hybrids, and filters for DTT to W4-012 generation. Replace the existing on-off carrier set with RFL9785. Replace the existing BF relaying with new SEL352 BF relaying. Install a new SEL279 reclosing relay.

W4-012 Interconnection Substation
Install 3 new ring bus breakers with SEL352 BF/SC relaying (one per breaker) and 3 sets of CCVTs. Add new SEL351A for reclosing. Add SEL2020, Satek metering, and GPS clock.

Ridgway 115kV exit - Install line relaying with SEL421 primary relaying (DCB over PLC) and Z phase wave trap and SEL321 backup relaying. Install RFL-9780 receiver, wave trap, LTU, for DTT to W4-012 generation for loss of FE source. On-off carrier to be implemented using RFL9785 on Z phase along with DTT.

Whetstone 115kV exit - Line relays to use fiber optic communication. Install SEL311L line current differential primary and SEL321 backup relays (DCB over mirrored bits). Install 9745 receiver for DTT scheme to trip W4-012 generation on loss of FE source.

W4-012 Generation Sub line exit (3.1 miles) - Install SEL311L line current differential relaying. Install SEL321 relay capable of interfacing with fiber and purchase fiber transceivers to interface with new fiber communication channel (DCB over mirrored bits). Install scheme for DTT to W4-012 generation for loss of FE source utilizing W4-012 Interconnection Sub breaker 'b' contacts and Ridgway and Whetstone exits DTT receiver's contacts.

Metering

IC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 7 of this report.

Compliance Issues

IC will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. While the voltage analysis is not performed for the feasibility study, any voltage criteria violations that would require the plant to provide reactive power, that determination of reactive power requirements will be determined in the system impact study, which will include the low voltage ride through analysis.

IC must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the IC 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 from the PJM and FE Power Flow Analysis (Attachment 4) show that there are no FE criteria violations that are directly attributable to the capacity of the Ridgway – Whetstone 115kV (W4-012) Project. Therefore in accordance with the procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, IC is not responsible for network upgrades. However, the PJM and FE findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability for both the Primary and Secondary POI. IC will therefore be subject to generation curtailment in order to mitigate these violations. Note that the FE and PJM study results differ due to the differences in the study process and power flow programs utilized. The Primary POI direct connection costs are detailed in Attachment 3. The Secondary POI costs are not provided.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to error. More accurate estimates will be determined as a part of the System Impact Study. IC will be responsible for the actual cost of the direct connection that is implemented. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission system.

Interconnection Customer Requirements

In addition to the FE facilities, IC 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 a fully rated circuit breaker on the high side of the W4-012 115/34.5kV step-up transformer.

2. 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.

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

4. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

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 W4-012 115kV interconnection substation when the units are out-of-service. This assumes the intent of IC is to net the generation with the load.

9. The rough grade of the property for the W4-012 115kV interconnection substation and an access road for the delivery of equipment to this site.

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

Summary

The Ridgway – Whetstone 115kV (W4-012) Project direct connection for the Primary POI will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the 115kV three breaker ring bus substation is $5,016,000. The Ridgway – Whetstone 115kV (W4-012) Project does not have any required network upgrades.

Based on the scope of the direct connection for the Primary POI, it is expected to take a minimum of two (2) years from the signing of a Connection Service Agreement to complete the installation required for the Ridgway – Whetstone 115kV (W4-012) Project. This includes a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the W4-012 115kV interconnection substation. It also assumes that the IC will provide the property for the W4-012 115kV interconnection substation and all right-of-way, permits, easements, etc. 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 transmission system outages when requested.

Attachment 2a
Ridgway – Whetstone 115kV (W4-012) Project
Primary POI Interconnection Substation Configuration

Attachment 2b
Ridgway – Whetstone 115kV (W4-012) Project
Secondary POI Interconnection Substation Configuration

Attachment 3

Ridgeway - Whetstone 115kV (W4-012) Feasibility Study

Direct Connection Requirements

UpgradeID	Description	Total Cost
PN-T-133	Ridgeway-Whetstone 115kV, Loop to Wind Farm (PJM W4-012): Loop, approx. 200' in length, consists of two 3-way deadend structures and rebuild of adjacent H-frame structures (remove outside suspension assemblies and install 138kV horiz. post insulators). (ISD 12/31/2014)	$96,000
PN-S-467-1A	W4-012 Interconnect Sub: Install 115kV three position ring bus. (ISD 12/31/2014)	$4,140,600
PN-S-467-2	Whetstone Sub: Replace 115kV line relaying on existing Ridgway line. (ISD 12/31/2014)	$287,000
PN-S-467-3	Ridgway Sub: Replace 115kV line relaying on existing Whetstone line. (ISD 12/31/2014)	$303,300
	Engineering Oversight and Commissioning Support of the Interconnection Customer 34.5/115kV substation including support of protective relay installation	$62,200
	Whetstone – W4-012 line (0.5 miles)– install fiber for dual pilot protection and DTT to W4-012 Generation	$126,900
Total		$5,016,000

Attachment 4
(W4-012) Feasibility Study
FE Contingency Analysis Results
Primary POI: Ridgway - Whetstone 115kV Line

Identified New Project Upgrades

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	FirstEnergy Results		PJM Results		FirstEnergy Comments
					MVA Flow	% Rating	MVA Flow	% Rating	

Contributions To Previously Identified Overloads

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	MVA Flow	% Rating	MVA Flow	% Rating	

Potential Congestion due to Local Energy Deliverability

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	FirstEnergy Results		PJM Results		
					MVA Flow	% Rating	MVA Flow	% Rating	
B_PN230-SX-#28	Single	Glade - Warren 230kV Line and Warren #4 230/115kV Transformer	Everts Drive - South Troy 115kV Line	173/225 MVA	170.4	75.7	155.6	69.1	PJM reported 127MVA rating for this facility.
B_PN115-LS-#85	Single	Forest - Ridgway 115kV Line	R92 - Rockton Mountain 115kV Line	142/183 MVA	184.6	100.8	188.7	103.1	PJM reported 184MVA rating for this facility.
Baseline	None	-	Warren - Falconer 115kV Line	80/118 MVA	97.1	121.4	97.3	121.7	
B_PN230-SX-#19	Single	Erie South - Warren 230kV Line	Warren - Falconer 115kV Line	80/118 MVA	137.5	116.5	144.1	122.1	
Baseline	None	-	Lewistown - Juniata 230kV Line	488/617 MVA	480.7	98.5	507.0	103.9	
Baseline	None	-	Shawville #1A 230/115/17.2kV Transformer	141/184 MVA	171.1	121.4	152.4	108.1	PJM reported 138MVA rating for this facility.
Baseline	None	-	Shawville #2A 230/115/17.2kV Transformer	147/191 MVA	-	-	154.8	105.3	PJM reported 155MVA rating for this facility.
B_PN345-SX-#6	Single	Handsome Lake - Wayne 345kV Line	Homer City - Shelocta 230kV Line	702/842 MVA	900.7	106.9	934.9	111.0	PJM reported 841MVA rating for this facility.
Baseline	None	-	V3-018 Tap - East Towanda 115kV Line	111/149 MVA	-	-	98.6	88.8	PJM reported 94MVA rating for this facility.
B_PN230-SX-#7B	Single	East Towanda - Laurel Hill 230kV Line	V3-018 Tap - East Towanda 115kV Line	111/149 MVA	171.5	115.1	152.9	102.6	PJM reported 119MVA rating for this facility.
B_PN115-LS-#85	Single	Forest - Ridgway 115kV Line	Shawville - Rockton Mountain 115kV Line	142/183 MVA	171.7	100.8	188.3	102.9	PJM reported 119MVA rating for this facility.
Baseline	None	-	V3-018 Tap - South Troy 115kV Line	111/149 MVA	-	-	98.6	88.8	PJM reported 94MVA rating for this facility.
B_PN230-SX-#7B	Single	East Towanda - Laurel Hill 230kV Line	V3-018 Tap - South Troy 115kV Line	111/149 MVA	171.7	115.2	152.9	102.6	PJM reported 119MVA rating for this facility.
B_PN345-SX-#6	Single	Handsome Lake - Wayne 345kV Line	Shelocta - Keystone 230kV Line	702/842 MVA	868.8	103.2	912.6	108.4	PJM reported 841MVA rating for this facility.
B_PN230-SX-#28	Single	Glade - Warren 230kV Line and Warren #4 230/115kV Transformer	Niles Valley - Sabinsville 115kV Line	135/158 MVA	166.4	105.3	-	-	
KEYSTONE_JACKMTN1_1	Single	Keystone - Juniata 500kV Line	Keystone - Conemaugh 500kV Line	2407/2983 MVA	5304.9	177.8	-	-	

Secondary POI: Shawville - Elko 230kV Line

Identified New Project Upgrades

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	FirstEnergy Results		PJM Results		FirstEnergy Comments
					MVA Flow	% Rating	MVA Flow	% Rating	

Contributions To Previously Identified Overloads

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	MVA Flow	% Rating	MVA Flow	% Rating	

Potential Congestion due to Local Energy Deliverability

Contingency	Type	Outage Description	Overloaded Element	N/A-Hr Rating	FirstEnergy Results		PJM Results		
					MVA Flow	% Rating	MVA Flow	% Rating	
Baseline	None	-	Warren - Falconer 115kV Line	80/118 MVA	-	-	97.0	121.3	
B_PN230-SX-#19	Single	Erie South - Warren 230kV Line	Warren - Falconer 115kV Line	80/118 MVA	134.3	113.8	132.7	112.5	
Baseline	None	-	Lewistown - Juniata 230kV Line	488/617 MVA	504.1	103.3	511.3	104.8	
KEYSTONE_JACKMTN1_1	Single	Keystone - Juniata 500kV Line	Lewistown - Juniata 230kV Line	488/617 MVA	572.6	92.8	617.8	100.1	
B_PN345-SX-#6	Single	Handsome Lake - Wayne 345kV Line	Homer City - Shelocta 230kV Line	702/842 MVA	900.7	106.9	934.9	111.0	PJM reported 841MVA rating for this facility.
B_PN345-SX-#6	Single	Handsome Lake - Wayne 345kV Line	Shelocta - Keystone 230kV Line	702/842 MVA	867.9	103.1	912.6	108.4	PJM reported 841MVA rating for this facility.

Attachment 5
Ridgway – Whetstone 115kV (W4-012) Project
FirstEnergy Network Facility Reinforcement Conceptual Cost Estimates

None Required

Attachment 6
Ridgway – Whetstone 115kV (W4-012) Project
FirstEnergy Network Facility Reinforcement Conceptual One Line Diagrams

None Required

Attachment 7

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.