Generation Interconnection
Web Version of the Feasibility Study Report

For

PJM Generation Interconnection Request
Queue Position X3-036

William 138 kV Project

February 2012

Feasibility Study Report

William 138 kV Generation Project

Introduction

This Feasibility Study report provides the documentation of an assessment performed by PJM Interconnection, L.L.C. (PJM) and FirstEnergy (FE) in response to a request made by Interconnection Customer (IC) for the interconnection of a 150 MW William Wind (X3-036) generation project to the Monongahela Power (MonPower) Transmission System. This 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 Interconnection Customer by participating in project meetings and issuing this report as a part of the PJM study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting all studies in accordance with the PJM Manuals and the "FE Requirements for Transmission Connected Facilities" documents that assure the assessment performed incorporates study assumptions, follows the documented system performance procedures, considers alternative connection and reinforcement plans, and jointly coordinates the study recommendations.

Connection Facilities

Interconnection Customer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM that identifies its plan to construct multiple 2–3 MW wind turbine generating units with a total energy resource output capability of 150 MW including a capacity resource of 19.5MW on property along a ridgeline approximately 7 miles East of the William substation owned by MonPower. Interconnection Customer will connect the generating units to the Henry Substation owned by Interconnection Customer and construct approximately 7 miles of 138kV line to the point of interconnection (POI) at the William substation. At the point of interconnection, adjacent to William substation, Interconnection Customer will install a three-phase gang operated disconnect. The proposed in-service date for the William Wind (X3-036) Project is December 31, 2012.

Attachment 1 shows a conceptual one-line diagram of the William substation and the reconfiguration of facilities to accept the Interconnection Customer owned line.

Interconnection Customer will be responsible to construct, own and operate the radial 138kV attachment line to the William 138kV substation. A summary of the William Wind (X3-036) project direct connection facilities and the system reinforcements that will be required with their cost estimate is shown on Attachment 2.

PJM Interconnection Study Results

The following is the report describing the results of the analysis performed by PJM engineers with respect to the transmission system impacts.

Network Impacts
Queue project X3-036 was studied as a(n) 150.0 MW (19.5 MW of which was Capacity) injection into APS's system at the WILLIAM 138.0 kV substation. Project X3-036 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

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

Short Circuit
(Report over-dutied breakers.)

None

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. (AP) The Lake Lynn-Lardin 138 kV line (from bus 235122 to bus 235207 ckt 2) loads from 100.95% to 102.23% (DC power flow) of its emergency rating (113 MVA) for the operational contingency 'APS_B_G100'. This project contributes approximately 8.96 MW to the thermal violation.

CONTINGENCY 'APS_B_G100' / 235122 01LKLYNN 138 235207 01LARDIN 138 1
OPEN BRANCH FROM BUS 235122 TO BUS 235207 CKT 1
END

2. (AP) The Lake Lynn-Lardin 138 kV line (from bus 235122 to bus 235207 ckt 1) loads from 100.95% to 102.23% (DC power flow) of its emergency rating (113 MVA) for the operational contingency 'APS_B_G101'. This project contributes approximately 8.96 MW to the thermal violation.

CONTINGENCY 'APS_B_G101' / 235122 01LKLYNN 138 235207 01LARDIN 138 2
OPEN BRANCH FROM BUS 235122 TO BUS 235207 CKT 2
END

3. (AP) The Lardin-Gates Hill 138 kV line (from bus 235207 to bus 235184 ckt 1) loads from 95.98% to 96.79% (DC power flow) of its emergency rating (113 MVA) for the operational contingency '01YUKON _01BRNRUN _084_A'. This project contributes approximately 5.66 MW to the thermal violation.

CONTINGENCY '01YUKON _01BRNRUN _084_A'
DISCONNECT BRANCH FROM BUS 235116 TO BUS 292625 CKT 1 /* 500/500KV, AREA 201/201. / BUS 235850 -> 292625. T174.
END

Transmission Owner's Analysis Results

The following is the report generated by the Transmission Owner (TO) based upon its analysis of the project's impacts on the lower voltage system and the costs and schedules for any transmission and distribution system upgrades.

FE Connection Facility Costs

The total estimated cost for the connection facilities is shown to be $176,500. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $24,600. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. A summary of the William Wind (X3-036) project direct connection facilities and the system reinforcements that will be required with their cost estimate is shown on Attachment 2.

Note that all cost data contained in this document should be considered as only ballpark estimates produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FirstEnergy 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.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed William Wind (X3-036) Project on the FE Transmission System. This study was completed using a 2015 summer peak load power flow that contains a detailed representation of the MonPower transmission networks in the area of the proposed William Wind (X3-036) Project. The findings and the recommendations from this analysis are based on a contingency review that was performed to identify the facility loadings and/or voltage conditions that violate the ReliabilityFirst, PJM or FE Planning Criteria and are either directly attributable to this project or for which it will have a shared responsibility. As a part of this review, a simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the William Wind (X3-036) Project was conducted.

The FE Power Flow analysis of the capacity-only portion of the generation and N-1 contingencies shows that there were no criteria violations identified directly attributable to the William Wind (X3-036) Project. The FE Power Flow analysis of the full capacity and energy generation output with double circuit tower line contingencies shows that there were no criteria violations identified directly attributable to the William Wind (X3-036) Project. PJM's findings confirm these results. Stuck breaker and bus fault contingencies will be analyzed during the System Impact Study.

PJM's findings at full capacity and energy generation output with N-1 contingencies show that there are criteria violations which may have an impact on network congestion and local energy delivery. Due to this, the William Wind (X3-036) Project may be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

A short circuit analysis was conducted by PJM and confirmed by FE Planning and Protection Staff. This analysis showed that no FE circuit breaker will exceed its interrupting capability due to the implementation of the William Wind (X3-036) Project. Therefore no breaker reinforcements will be required.

In accordance with the PJM Impact Study process, the PJM staff is responsible for the performance of a dynamic analysis for the William Wind (X3-036) Project. The results of these studies will be included in the PJM Impact Study report if this project proceeds.

System Protection Analysis

An analysis was conducted to assess the impact of the William Wind (X3-036) Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Direct Connection Requirements

William SS Henry 138kV terminal

- Install control panel and terminate cables including primary differential protection provided by an SEL-311L current differential relay with communication to the NUG facilities via OPGW fiber, and backup protection provided by an SEL-351 relay.
- Make fiber connections to developer OPGW Fiber
- Test and commission controls and SCADA

Henry SS 138kV Breaker

- Interconnection Customer to install the following at Henry SS for William 138kV line protection
  - SEL-311L current differential relay with fiber optic communication port for primary line differential protection, compatible with First Energy SEL-311L relay part # 0311L0HD04254X1XX
  - (1) relay to provide backup protection for William 138kv line utilizing non-pilot step distance scheme with ground overcurrent backup
  - (1) relay for breaker failure to trip protection to operate a lockout relay that will assert an input on the SEL-311L to key direct transfer trip to William SS over the fiber digital channel in the event of a breaker failure to trip at Henry SS
  - Over/under voltage and frequency protection embedded as a function in line protection relays or as a separate relay

- Interconnection Customer to install OPGW between William SS and Henry SS to establish a fiber optic digital channel for line current differential and breaker failure transfer trip protection

Due to the magnitude of this project, only high level costs have been developed for this Feasibility Study. A detailed system protection analysis will be deferred to the Facilities Study if this project proceeds. However, the system upgrade information reported on Attachment 2 includes a generic cost estimate for the system protection upgrades that will be required to support the William Wind (X3-036) Project.

Revenue Metering

The FirstEnergy Revenue Metering Requirements may be found in the FirstEnergy Requirements for Transmission Connected Facilities document located at the following links:

www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Compliance Issues

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 from .95 leading (absorbing MVARs) to .95 lagging (producing MVARs).

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.

Interconnection Customer Requirements

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 connecting transformer shall have a wye grounded winding on the high (transmission system) side of the transformer and have a delta connected winding on the low (generation) side.

3. The purchase and installation of a 138 kV 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 to measure the power delivered in compliance with the FE standards.

5. Compliance with the FE and PJM generator power factor and voltage control requirements.

6. The execution of a back-up service agreement to serve the customer load supplied from the William 138 kV substation when the William Wind (X3-036) Project units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the load.

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. Breaker position on the William Wind (X3-036) Project electrical system 138kV breaker.
   b. Generator real and reactive power output measured at the high-side of the generator step-up transformer.
   c. Generator voltage at the William Wind (X3-036) Project electrical system 138kV bus.

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

Summary

The Direct Connection of the William Wind (X3-036) Project to the William substation will require the facility upgrades as defined in Attachment 2. The total estimated cost of these upgrades $151,900 plus a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $24,600 for a total of $176,500. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129.

Based on the project scope of the FE direct connection required to support this project, it is expected to take a minimum of twelve (12) months from the signing of an Interconnection Construction Service Agreement to complete the upgrades required for the William Wind (X3-036) 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 at the William substation. It also assumes that the Interconnection Customer will construct all facilities to the point of interconnection at the William 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.

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 Impact Study.