Generation Interconnection Feasibility Study Report Web Version

For

PJM Generation Interconnection Request Queue Position X3-034

Windsor-Gordon 138kV Project

February 2012

Feasibility Study Report

Windsor-Gordon 138kV Generation Project

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by PJM Interconnection, L.L.C. (PJM) and FirstEnergy (FE) in response to a request made by Interconnection Customer (IC) for the connection of a 20 MW Solar Photovoltaic (PV) Generation (X3-034) facility to the West Penn Transmission System on the Windsor-Gordon 138kV line. The IC has proposed a commercial operation date of August 2012 for the proposed facility. As per the PJM study process, the 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 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, the "FE Requirements for Transmission Connected Facilities", and the "FE Study Guide".

Connection Facilities

In compliance with the PJM Interconnection protocol, Interconnection Customer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram (see Attachment 8) that identifies its plan to construct an installation with three different sectors of solar panels totaling 83.95 acres. This property will be adjacent to the Windsor-Gordon 138kV line (see Attachment 1). For purposes of this report, it has therefore been designated as the “Windsor-Gordon 138kV X3-034 Project” (hereinafter, the “Project”) to reflect its interconnection voltage and its proximity to the Windsor-Gordon 138kV line. The IC has requested the study of a Primary Point of Interconnection (POI) for the 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. 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: Windsor-Gordon 138kV Line

The Primary POI for the Project will be accomplished by constructing a new 138kV 3 breaker ring bus and looping the Windsor-Gordon 138kV line. The new 138kV 3 breaker ring bus will be approximately 13.6 miles from Windsor substation. Interconnection Customer will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 138kV 3 breaker ring bus interconnection substation and the associated attachment facilities. The 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 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 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 X3-034 was studied as a 20.0 MW (0.0 MW of which was Capacity) injection into APS's system at the 65.0% tap between Windsor and Lagonda138.0 kV line. Project X3-034 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 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*.

No violations identified.

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.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed 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 Power Flow Analysis was performed using a 2015 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the West Penn transmission system in the area of the Windsor-Gordon 138kV line. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Project was conducted to test for criteria compliance. The direct connection of the Windsor-Gordon 138kV (X3-034) Project to the West Penn transmission system was studied at the Primary POI.

The PJM and FE analysis show that the Project does not cause additional overloads or criteria violations. As such, no new network upgrades are required for the Project.

Short Circuit and Dynamics Analysis

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 Project. The study also showed no significant fault current contribution to the breakers which are near the over-duty limit.

System Protection Analysis

A System Protection Analysis will be performed during the System Impact Study.

Metering

Interconnection Customer 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

Interconnection Customer 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.

Interconnection Customer must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Interconnection Customer 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 Project. Therefore in accordance with the PJM procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, Interconnection Customer is not responsible for network upgrades.

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. Interconnection Customer 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, 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 a fully rated circuit breaker on the high side of the X3-034 138/34.5kV 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 a 138kV 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 X3-034 138kV interconnection substation when the units are out-of-service. This assumes the intent of Atlantic Wind LLC is to net the generation with the load.

9. The rough grade of the property for the X3-034 138kV 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 Project direct connection will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the 138kV three breaker ring bus substation is $5,343,900. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $803,600. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. The Project does not have any required network upgrades.

Based on the scope of the direct connection, 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 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 X3-034 138kV interconnection substation. It also assumes that the Interconnection Customer will provide the property for the X3-034 138kV 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 1
Windsor-Gordon 138kV (X3-034) Project
Project Location

Attachment 2
Windsor-Gordon 138kV (X3-034) Project
Primary POI Interconnection Substation Configuration

Attachment 3
Windsor-Gordon 138kV (X3-034) Project
Direct Connection Requirements

Upgrade ID	Description	Total with Tax	Tax	Total Cost
WP-S-41-1 (X3-034)	**Burkett SS.** Install 3-breaker 138kV ring bus SS (Burkett SS). Install 2-138kV DE structures, 9-138kV CVT's, 2-138kV wave traps, 3-138kV, 3000A breakers, 7-1200A, 138kV GOAS, 9-138kV arresters, structures and foundations, control building, AC & DC panels, battery & charger, station service, control panels and cables, ground grid, and associated material. Provide 138kV metering material for customer SS. Assume fence-to-fence connection to developer SS. Developer to provide property at no cost to FE. Developer to install fiber link between Burkett SS and X3-034. The requested 8/12 ISD cannot be met due to engineering and construction lead times. A 6/13 ISD is proposed for this study. Feasibility study.	5,343,900	803,600	4,540,300
WP-S-41-2 (X3-034)	**Windsor SS.** Install transfer trip facilities for X3-034. Feasibility study.	58,600	8,800	49,800
WP-S-41-3 (X3-034)	**Gordon SS.** Install transfer trip facilities for X3-034. Feasibility study.	58,600	8,800	49,800
WP-T-5 (X3-034)	**Line Estimate Windsor-Gordon: Tap to Burkett X3_034 Ring Bus Interconnection.** Loop the Windsor-Gordon 138kV Line one span into the proposed Burkett Substation.	278,400	41,900	236,500
EOC	Engineering Oversight and Commissioning	156,900	23,600	133,300
	TOTAL	**5,896,400**	**886,700**	**5,009,700**

Attachment 4
Feasibility Study Results

There were no overloaded facilities.

Attachment 5
Windsor-Gordon 138kV (X3-034) Project
FE Network Facility Reinforcement Conceptual Costs Estimates

Not Required

Attachment 6
Windsor-Gordon 138kV (X3-034) Project
FE Network Facility Reinforcement Conceptual One Line Diagrams

Not Required

Attachment 7
FE Revenue Metering Requirements

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