Generation Interconnection Feasibility Study Report – Web Version

For

PJM Generation Interconnection Request Queue Position AA2-173

Hatfield 500 kV Project

August 2015

Feasibility Study Report

Hatfield 500 kV Project

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by FirstEnergy (FE) in response to a request made by the Interconnection Customer (or IC) for the connection of a 515 MW Natural Gas Generation (AA2-173) facility with the Primary Point of Interconnection (POI) at the Hatfield 500 kV Substation and a Secondary POI on the Hatfield – Yukon 500 kV line approximately 0.5 miles from the Hatfield 500 kV Substation. The IC has proposed a commercial operation date of June 2019 for the proposed facility..

Connection Facilities

In compliance with the RTEP protocol, Interconnection Customer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM (see Attachment 8) that identifies its plan to construct a natural gas generation facility connected to a common bus with a total capability of 515 MW (515 MW capacity.) For purposes of this report, it has been designated as "Hatfield 500 kV Substation Interconnection" (hereinafter, the "Project") to reflect its proximity to the Hatfield 500 kV Substation (see Attachment 1). 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.

Primary Point of Interconnection: Hatfield 500 kV Substation
The Primary POI for the Project will be accomplished by constructing a new 500 kV cross-bus at Hatfield 500 kV Substation and providing a 500 kV meter package. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct the associated attachment facilities. A summary of the Project direct connection facilities and their estimated costs are shown on Attachment 3. The one-line for the project is shown in Attachment 2.

Secondary Point of Interconnection: Hatfield - Yukon 500 kV Line
The Secondary POI will be accomplished by building a new 500 kV three breaker ring-bus substation, owned by West Penn Power, adjacent to the Hatfield - Yukon 500 kV line and looping the Hatfield – Yukon 500 kV line into the new substation. Estimates are not provided for the Secondary POI and the FE Substation and Transmission Line Design have not reviewed a specific location. No summaries of the Project direct connection facilities, estimated costs or one-lines are provided for the Secondary POI.

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

The Queue Project AA2-173 was evaluated as a 515.0 MW (Capacity 515.0 MW) injection at Hatfield 500kV substation in the APS area. Project AA2-173 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AA2-173 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2019

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

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

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

To be determined

Affected System Analysis & Mitigation

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.

Not Applicable

Light Load Analysis - 2019

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis 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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

Light Load Load Flow Analysis 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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

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Additional Interconnection Customer Responsibilities:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

Transmission Owner's Analysis

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 West Penn Power (WPP) 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 2019 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the WPP system. A simulation of contingencies within the FE Planning Standards that are impacted by the Project were analyzed to test for criteria compliance. The WPP transmission system was studied for both the Primary POI and Secondary POI.

The generation facility's minimum requirement shall be the provision of a
reactive power capability sufficient to maintain a composite power factor at continuous rated power output for the facility at the generator terminals between 0.95 leading (absorbing VARs) and 0.90 lagging (producing VARs).

Short Circuit and Dynamics Analysis

A short circuit analysis for the Primary POI and Secondary POI 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.

System Protection Analysis

An analysis of the Primary POI was conducted to assess the impact of the Project on the system protection requirements in the area. Results of this review have identified the following:

Hatfield 500 kV Substation

- Install two 500 kV breakers (each new breaker will have a dedicated breaker failure scheme utilizing an SEL-501 relay to trip all other breakers on associated bus, trip the new breaker, and send transfer trip to Interconnection Customer via fiber)
- Install dual SEL-411L relays, each using dedicated fiber
- Each new breaker will have a dedicated breaker failure scheme utilizing an SEL-501 relay to trip all other breakers on associated bus, trip the new breaker, and send transfer trip to Interconnection Customer via fiber
- Each breaker will need to interface to the existing bus differential and breaker failure schemes for the bus to which each breaker is connected.

An analysis of the Secondary POI is not required and was not conducted to assess the impact of the Project on the system protection requirements in the area.

Metering

Interconnection Customer will be required to comply with all FE revenue metering requirements for generation interconnection customers. These FE requirements are detailed at the link 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:

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

Interconnection Customer must meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures. 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 WPP system.

FE Facility Upgrades and Costs

Results from the power flow analysis (Attachment 4) show there are no FE Transmission Planning Criteria violations directly attributable to the capacity of the Project at the Primary POI. As such, there are no network upgrade costs or scope of work which is noted in Attachment 5 and Attachment 6.

Results from the power flow analysis (Attachment 4) show there are FE Transmission Planning Criteria violations directly attributable to the capacity of the Project at the Secondary POI. Estimates for system reinforcements are not provided for the Secondary POI.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to revision. More accurate estimates will be determined as a part of the System Impact Study. The 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 WPP 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 AA2-173 step-up transformer.

2. The purchase and installation of a lockable load-break switch at the point of interconnection. This switch must be accessible by FirstEnergy.

3. 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.

4. The purchase and installation of a 500 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

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

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

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

9. The execution of a back-up service agreement to serve the customer load supplied from the AA2-173 25 kV interconnection substation when the units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the load.

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

Summary

The Project direct connection at the Primary POI will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the direct connection facilities is $7,806,900. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $1,783,100. 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 require network upgrades as defined in Attachment 5 for the Primary POI.

Based on the scope of the direct connection of the Primary POI, it is expected to take a minimum of twenty three (23) months from the signing of an Interconnection Service Agreement/Construction 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 AA2-173 500 kV interconnection substation. It also assumes that the IC will provide 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
Project Location

Attachment 2
Primary POI Interconnection Substation Configuration

Attachment 3
Direct Connection Requirements

SS/LN	Estimate No.	Description	Total with Tax	Tax	Total Cost
SS	WP-S-334	Hatfield SS - Expand 500kV bus and install 2-500kV breakers and associated equipment for AA2-173 interconnection.	7,806,900	1,783,100	6,023,800
		DC Sub-Total.	**7,806,900**	**1,783,100**	**6,023,800**
		NDC Sub-Total.	**-**	**-**	**-**
		TOTAL	**7,806,900**	**1,783,100**	**6,023,800**

Attachment 4
Contingency Analysis Results

FE Study Thermal Violations Primary POI:

Generator Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)
None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)
None

Contribution to Previously Identified Overloads
None

FE Study Thermal Violations Secondary POI:

Generator Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)
None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)
None

Identified Overloads

1. Yukon - Smith 138 kV line overloads to 113.94% of its emergency rating (332 MVA) for the tower line contingency outage of Charleroi – Westraver 138 kV and Charleroi – Yukon 138 kV.
2. Yukon - Smith 138 kV line overloads to 112.52% of its emergency rating (332 MVA) for the tower line contingency outage of Westraver – Yukon 138 kV and Charleroi – Yukon 138 kV.
3 Yukon - Smith 138 kV line 107.06% of its emergency rating (332 MVA) for the single line contingency outage of Keystone – Southbend 500 kV line.

Attachment 5
Hatfield 500 kV Substation Interconnection (AA2-173) Project
FE Network Facility Reinforcement Conceptual Costs Estimates

Primary POI: No Reinforcements or Costs Needed

Attachment 6
Hatfield 500 kV Substation Interconnection (AA2-173) Project
FE Network Facility Reinforcement Conceptual One Line Diagrams

Primary POI: No Reinforcements or Costs Needed

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

