Generation Interconnection

Combined Feasibility / System Impact Study Report

for

Queue Project AF2-268

ORRTANNA 13.2 KV

0 MW Capacity / 2 MW Energy

July 2020

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is ME.

2 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

3 General

The Interconnection Customer (IC), has proposed a Solar; Storage generating facility located in Adams County, Pennsylvania. The installed facilities will have a total capability of 2 MW with 0 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is July 01, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-268
Project Name	ORRTANNA 13.2 KV
State	Pennsylvania
County	Adams
Transmission Owner	ME
MFO	2
MWE	2
MWC	0
Fuel	Solar; Storage
Basecase Study Year	2023

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AF2-268 will interconnect with the ME distribution system.

The interconnection of the project at the Primary POI will be accomplished by tapping 00761-4, a 13.2 kV line out of Orrtanna Substation near pole 12493-19258 and constructing a one span tap. The distribution line tap will be located approximately 3.1 miles from Orrtanna substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities. The project will also require non-direct connection upgrades at Richmond substation.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-268 generation project to connect to the FirstEnergy ("FE") transmission system. IC will be responsible for constructing the facilities on its side of the POI, including the attachment facilities which connect the generator to the Met-Ed distribution system's direct connection facilities.

5 Cost Summary

The AF2-268 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$323,900
Total System Network Upgrade Costs	$0
Total Costs	$323,900

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

6 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by tapping 00761-4, a 13.2 kV line out of Orrtanna Substation near pole 12493-19258 and constructing a one span tap. The distribution line tap will be located approximately 3.1 miles from Orrtanna substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities. The project will also require non-direct connection upgrades at Richmond substation.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-268 generation project to connect to the FirstEnergy ("FE") transmission system. IC will be responsible for constructing the facilities on its side of the POI, including the attachment facilities which connect the generator to the Met-Ed distribution system's direct connection facilities.

The total physical interconnection costs is given in the table below:

Description	**Total Cost**
Tap 13.2 kV distribution circuit.	$ 10,000
Fuse	$ 5,000
Direct transfer trip scheme to prevent reverse power flow on the substation transformer.	$ 308,900
Total Physical Interconnection Costs	$323,900

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **9 months** after the signing of an Interconnection Agreement and construction kickoff call to complete the installation. This assumes 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 work, and that all system outages will be allowed when requested.

8 Transmission Owner Analysis

Met-Ed performed an analysis of the 13.2 kV distribution system.

Under normal circuit configurations, when fed from the Orrtanna substation, the AF2-268 project did not contribute to any overloads or voltage flicker violations on the Met-Ed distribution system

Under abnormal circuit configurations, when fed from the North Hanover substation, the AF2-268 project results in reasonable cause for concern for voltage flicker violations on the Met-Ed distribution system. FirstEnergy may require the installation of a PQ monitoring system to permit ongoing assessment of compliance with these criteria.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Distribution Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

9.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Distribution Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

The purchase and installation of a fully rated 13.2 kV circuit breaker to protect the AF2-268 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

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.

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.

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

The execution of a back-up service agreement to serve the customer load supplied from the AF2-268 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures 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.

9.3 Power Factor Requirements

The IC shall design its solar-powered, non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the Met-Ed distribution system.

If high voltage, low voltage, or objectionable voltage flicker arises due to the operation, frequent tripping, and/or frequent starting and stopping of the generator, the generator owner may be required to disconnect its generation equipment from the FirstEnergy system until the problem has been fully investigated and resolved.

10 Revenue Metering and SCADA Requirements

10.1 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 Section 8 of Attachment O.

10.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter^2)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)
- Wind speed (meters/second) – (Accepted, not required)

Wind direction (decimal degrees from true north) – (Accepted, not required)

10.3 ME Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Generation Interconnection Technical Requirements for Distribution Connected Facilities" document located at:

http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

11 Summer Peak - Load Flow Analysis

The Queue Project AF2-268 was evaluated as a 2.0 MW (Capacity 0.0 MW) injection at the Orrtanna 115 kV substation in the ME area. Project AF2-268 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-268 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10124502 5	93397 0	AD1-020 TAP	115. 0	METE D	20453 9	27HUNTRST N	115. 0	METE D	1	ME-P2-3-ME-115-019-B	breake r	160.0	118.29	119.29	DC	1.6

11.4 Steady-State Voltage Requirements

None

11.5 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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
10124542 8	93397 0	AD1-020 TAP	115. 0	METE D	20453 9	27HUNTRST N	115. 0	METE D	1	ME-P1-2-ME-115-061	operatio n	160.0	113.79	114.79	DC	1.6

11.6 System Reinforcements - Summer Peak Load Flow - Primary POI

None

11.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

None

11.8 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

None

11.9 Contingency Descriptions

None

12 Light Load Analysis

Not required for this project.

13 Short Circuit Analysis

The following Breakers are overdutied:

None

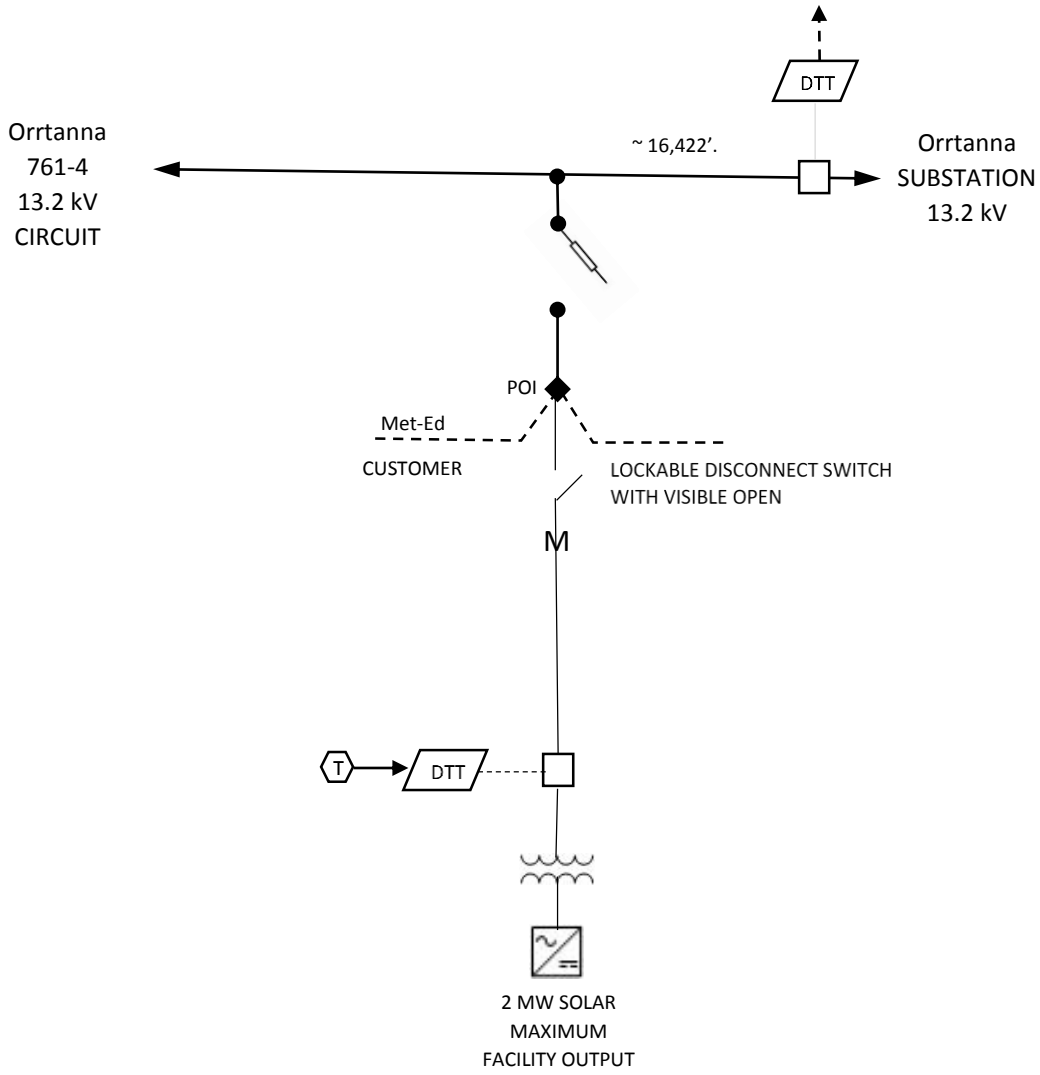
14 Stability and Reactive Power

No Impacts.

15 Affected Systems

None

16 Attachment 1: One Line Diagram



◆ = POI (POINT OF INTERCONNECTION) LOCATED NEAR 12493-19258, ON CUSTOMERS SIDE OF POI

M = REVENUE METERING FOR INTERCONNECTION CUSTOMER IS OWNED, OPERATED, AND MAINTAINED BY INTERCONNECTION CUSTOMER