Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-057

JACKSON-THREE MILE ISLAND 230 KV II

8.4 MW Capacity / 20 MW Energy

January 2020

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Mid-Atlantic Interstate Transmission (MAIT- Meted zone).

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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 impact study is performed.

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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model.

The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

The Feasibility 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.

3 General

The Interconnection Customer (IC) has proposed an uprate to a planned solar generating facility located in York County, Pennsylvania. This project is an increase to the Interconnection Customer's AE2-211 project, which will share the same property and point of interconnection. The AF1-057 queue position is a 20 MW uprate (8.4 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 75 MW with 31.5 MW of this output being recognized by PJM as Capacity (see table below for clarity). The proposed in-service date for this uprate project is June 30, 2022. This study does not imply a TO commitment to this in-service date.

Queue	Maximum Facility Output (MFO) (MW)	Energy (MW)	Capacity (MW)
AE2-211	55	55	23.1
AF1-057	75	20	8.4
Total	**75**	**75**	**31.5**

Queue Number	**AF1-057**
Project Name	JACKSON-THREE MILE ISLAND 230 KV II
State	Pennsylvania
County	York
Transmission Owner	ME
MFO	75
MWE	20
MWC	8.4
Fuel	Solar
Basecase Study Year	2023

3.1 Point of Interconnection

AF1-057 will interconnect with the Meted transmission system as an uprate to AE2-211. The interconnection of the AE2-211 project will be accomplished by constructing a new 230 kV (3) breaker ring bus substation and looping the Jackson-TMI 230 kV line into the new interconnection yard. It is anticipated that there will be no additional connection costs associated with the AF1-057 project.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-211/AF1-057 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 FE transmission system's direct connection facilities.

3.2 Cost Summary

The AF1-057 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$0
Total Costs	$0

In addition, the AF1-057 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$0

AF1-057 is an uprate to the AE2-211 project. There is no additional interconnection work required to accommodate the AF1-057 uprate.

4 Transmission Owner Scope of Work

AF1-057 will interconnect with the Meted transmission system as an uprate to AE2-211. The interconnection of the AE2-211 project will be accomplished by constructing a new 230 kV (3) breaker ring bus substation and looping the Jackson-TMI 230 kV line into the new interconnection yard. It is anticipated that there will be no additional connection costs associated with the AF1-057 project.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-211/AF1-057 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 FE transmission system's direct connection facilities.

4.1 Attachment Facilities

There is no Attachment Facility scope of work required.

4.2 Direct Connection Cost Estimate

There is no Direct Connection scope of work required.

4.3 Non-Direct Connection Cost Estimate

There is no Non-Direct Connection scope of work required.

5 Schedule

AF1-057 is an increase to the AE2-211 project. Therefore, there are no Attachment Facilities, Direct, and Non-Direct Connection facilities work to be completed outside of the scope of the AE2-211 project.

6 Transmission Owner Analysis

6.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF1-057 project did not contribute to any overloads on the FE transmission <100 kV system.

7 Interconnection Customer Requirements

7.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission 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.

7.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission 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:

1. The purchase and installation of a fully rated 230 kV circuit breaker to protect the AE2-211/AF1-057 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.

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 supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

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

5. The execution of a back-up service agreement to serve the customer load supplied from the AE2-211/AF1-057 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.

7.3 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 FE transmission system.

8 Revenue Metering and SCADA Requirements

8.1 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.

8.1.1 Meteorological Data Reporting Requirement

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

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

8.2 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 "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

9 Network Impacts

The Queue Project AF1-057 was evaluated as a 20.0 MW (Capacity 8.4 MW) injection as an uprate to AE2-211 tapping the Jackson to TMI 230 kV line in the Meted area. Project AF1-057 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-057 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

10 Generation Deliverability

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

None

11 Multiple Facility Contingency

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

None

12 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

13 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.

None

14 System Reinforcements

None

Affected Systems

15 Affected Systems

15.1 LG&E

LG&E Impacts to be determined in System Impact phase.

15.2 MISO

MISO Impacts to be determined during System Impact phase.

15.3 TVA

TVA Impacts to be determined during System Impact phase.

15.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during System Impact phase.

15.5 NYISO

NYISO Impacts to be determined during System Impact phase.

Short Circuit

16 Short Circuit

The following Breakers are overduty:

None

17 Attachment One: One Line Diagram