Generation Interconnection

Combined Feasibility/System Impact Study Report

for

Queue Project AF1-006

FAIRVIEW EAST 34.5 KV

12.8 MW Capacity / 20 MW Energy

January 2020

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1 Introduction

This Combined Feasibility/System Impact 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- Penelec zone).

2 Preface

The intent of the Combined Feasibility/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, if any, is included in the System Impact 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.

The 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 associated with them will be addressed when seeking an Interconnection Agreement as outlined below. Developer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Erie County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 12.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is March 1, 2023. This study does not imply a TO commitment to this in-service date.

Final attachment facilities and local upgrades (if required) along with terms and conditions to interconnect AF1-006 will be specified in a separate two party Interconnection Agreement (IA) between MAIT (Penelec) and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT).

From the transmission perspective, no network impacts or system reinforcements were identified as detailed in the "Network Impacts" section below.

Queue Number	AF1-006
Project Name	FAIRVIEW EAST 34.5 KV
State	Pennsylvania
County	Erie
Transmission Owner	PENELEC
MFO	20
MWE	20
MWC	12.8
Fuel	Solar
Basecase Study Year	2023

3.1 Point of Interconnection

AF1-006 will interconnect with the Penelec distribution system via a tap on the 34.5 kV Erie West circuit at pole # FV-41234. The IC's proposed generating unit site is approximately 1.1 miles northeast of Girard, PA., near Rt. 20 and Trinity Drive.

Attachment 1 shows a one-line diagram of the proposed connection facilities for the AF1-006 generation project to connect to the Penelec distribution system. IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the Penelec distribution system's facilities.

3.2 Cost Summary

Total estimated cost for the required Interconnection Facilities is **$188,100**. 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.

From the transmission perspective, no network impacts or system reinforcements were identified as detailed in the "Network Impacts" section below.

4 Transmission Owner Scope of Work

The AF1-006 project will interconnect with the Penelec distribution system via a tap on the 34.5 kV Erie West circuit at pole # FV-41234.

Attachment 1 shows a one-line diagram of the proposed connection facilities for the AF1-006 generation project to connect to the Penelec distribution system. The IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE distribution system's facilities.

Description	Total Cost
Fairview East 34.5kV SS. Adjust Remote Relay and Metering Settings.	$ 13,200
Lake City 34.5kV SS. Adjust Remote Relay and Metering Settings.	$ 13,200
Tap near pole FV-41234, new SCADA recloser, and new primary metering	$ 161,700
Total Estimated Connection Facility Costs	**$ 188,100**

5 Schedule

Based on the scope of work for the connection facilities, it is expected to take a minimum of **6 months** after the signing of an Interconnection Agreement 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 connection and that any distribution system outages will be allowed when requested.

6 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AF1-006 project did not contribute to any overloads on the distribution system.

7 Interconnection Customer Requirements

7.1 System Protection

An analysis was conducted to assess the impact of the Fairview East 34.5 kV (AF1-006) Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Proposed single line diagrams show the IC constructing a generation facility tapping Penelec's Fairview East - 34.5kV Erie West circuit at pole FV-41234.

The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled "Technical Requirements for the Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System". Anti-islanding system shall meet IEEE 1547 and UL 1741 Therefore no Direct Transfer Trip (DTT) will be required.

Protection requirements are included in the "Technical Requirements" document.

7.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause IC's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, IC will, via Penelec's direction, be required to disconnect the generation from Penelec's system and remain disconnected (**units are required to be OFF LINE**), until the Penelec system normal circuitry is restored. These abnormal conditions will be reviewed by Penelec system operators as to the need for the generation facility to be disconnected.

7.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection IC's facilities must be designed in accordance with the document titled *FirstEnergy Distribution Engineering Practices Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System* dated 11/17/14 located at the following link:

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

The document is referred to as engineering practice EP(# 02-280) with section 4 part C specifically referencing the "interconnection technical requirements". Certain protection requirement are shown.

Additionally, IC is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'Re-synchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

IC's protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

IC's electrical protection and control schematics shall be provided to FE for consideration. FE may request modifications, if required, to meet the technical requirements.

7.4 Compliance Issues

IC will be responsible for meeting a power factor between 0.90 lagging (producing MVARs) to 0.95 leading (absorbing MVARs) and assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Solar Gen operating conditions due to the inherent dynamic reactive power capability of this solar facility.

Generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar sized synchronous generator. A Dynamic Reactive Compensation (either Static VAR Compensator (SVC) or STATCOM) or other method be applied in order to maintain the required specifications at the POI. IC is responsible for the installation of equipment on its side of the POI in order to adhere to the criteria stated above by FirstEnergy.

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 PENELEC Requirements

IC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are the following:

The FE operating company (Penelec) shall provide, own, operate, test, and maintain the revenue metering equipment at the Interconnection Customer's (IC) expense. The revenue metering equipment includes, but is not limited to, current transformers, voltage transformers, secondary wires, meter socket, bidirectional revenue meter, and associated devices. The IC shall mount the instrument transformers unless otherwise agreed to by Penelec. The instrument transformers and meter socket shall be installed in a location that is readily accessible to authorized Penelec representatives. Penelec will provide the IC access to bidirectional kWh and kVARh pulses from the Penelec meter at the IC's expense if requested. The IC shall, at its expense, install, own, operate, test, and maintain any metering and telemetry equipment that may be required to provide real-time meter data to FE or PJM.

9 Network Impacts

The Queue Project AF1-006 was evaluated as a 20.0 MW (Capacity 12.8 MW) injection at the Fairview East 34.5 kV substation in the PENELEC area. Project AF1-006 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-006 was studied with a commercial probability of 100%. 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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4233821 8	20076 9	26HOME R CY	345. 0	PENELE C	99939 1	STAR60 2	1. 0	PENELE C	S	PN-P1-3-PN-230-003A	operatio n	824.0	99.86	100.18	AC	3.08

14 System Reinforcements

None

Affected Systems

15 Affected Systems

None

16 Contingency Definitions

Contingency Name	Contingency Definition
PN-P1-3-PN-230-003A	CONTINGENCY 'PN-P1-3-PN-230-003A' /* HOMER CITY NORTH 345/230KV XFMR DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202640 CKT N/* 26HOMER CY 345 26HOMER CT 230 26HOMERCITYN 23.00 END

Short Circuit

17 Short Circuit

The following Breakers are overduty:

None

Stability

18 Stability

Not required for this project.

19 Attachment One: One Line Diagram