



# **Generation Interconnection**

## **Feasibility Study Report**

**for**

## **Queue Project AF2-229**

### **ROXBURY 23 KV**

**10.9 MW Capacity / 20 MW Energy**

July 2020

# Table of Contents

1	Introduction.....	3
2	Preface.....	3
3	General.....	4
4	Point of Interconnection.....	5
5	Cost Summary.....	5
6	Transmission Owner Scope of Work.....	6
7	Schedule.....	7
8	Transmission Owner Analysis.....	7
9	Interconnection Customer Requirements.....	8
10	Revenue Metering and SCADA Requirements.....	9
10.1	PJM Requirements.....	9
10.2	Meteorological Data Reporting Requirements.....	9
10.3	Interconnected Transmission Owner Requirements.....	9
11	Summer Peak - Load Flow Analysis.....	11
11.1	Generation Deliverability.....	12
11.2	Multiple Facility Contingency.....	12
11.3	Contribution to Previously Identified Overloads.....	12
11.4	Potential Congestion due to Local Energy Deliverability.....	12
11.5	System Reinforcements - Summer Peak Load Flow - Primary POI.....	13
11.6	Flow Gate Details.....	14
11.7	Queue Dependencies.....	15
11.8	Contingency Descriptions.....	16
12	Short Circuit Analysis.....	17
12.1	System Reinforcements - Short Circuit.....	<b>Error! Bookmark not defined.</b>
13	Affected Systems.....	18
13.1	NYISO.....	18
14	Attachment 1: One Line Diagram.....	19

## 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, LLC (MAIT) (PENELEC 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.

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 a Solar generating facility located in Cumberland County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 10.9 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is November 30, 2021. This study does not imply a TO commitment to this in-service date.

The TO determined that the proposed Point of Interconnection (POI) was not feasible (refer to Section 4 for details). An alternative was proposed and the physical interconnection cost estimates contained herein were prepared for the alternate POI proposed by the TO.

<b>Queue Number</b>	<b>AF2-229</b>
<b>Project Name</b>	ROXBURY 23 KV
<b>State</b>	Pennsylvania
<b>County</b>	Cumberland
<b>Transmission Owner</b>	PENELEC (MAIT)
<b>MFO</b>	20
<b>MWE</b>	20
<b>MWC</b>	10.9
<b>Fuel</b>	Solar
<b>Basecase Study Year</b>	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

Developer had requested that AF2-229 would interconnect with the PENELEC distribution system at POI pole KRB-14483, which is located on the 22.86kV KRB-Arco ckt#00601-83 @ Roxbury Transmission substation. Penelec presently has a set of (3)-333kVA regulators in the mainline of this feeder at pole KRB-110A83. AF2-229's requested POI pole is located on the load side of these regulators, the 20MW MFO rating for the generation will back feed through these regulators and overload them. Penelec does NOT have a standard distribution or substation class of regulator capable of handling this much generation. The regulators are needed if/when AF2-229 is out of service for any reason - Penelec cannot simply remove the regulators to address the issue.

**As an alternative, Penelec suggests that the customer consider a new POI that is located on the source side of the existing regulator installation, the closet pole is KRB-11083.** Other POI's that are further upstream toward Penelec's Roxbury Transmission substation can be considered at the developer's request. The results of the analysis are provided assuming that the developer adopts pole KRB-11083 as the new POI. This strategy will require that the developer build a longer customer owned tap to interconnect with the new POI.

Customer did not specify a secondary point of interconnection.

## 5 Cost Summary

The AF2-229 project will be responsible for the following costs:

Description	Total Cost
<b>Total Physical Interconnection Costs</b>	\$998,313 <sup>1</sup>
<b>Total System Network Upgrade Costs</b>	\$0
<b>Total Costs</b>	\$998,313

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.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

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<sup>1</sup> The TO determined that the proposed Point of Interconnection (POI) was not feasible. An alternative was proposed and the physical interconnection cost estimates contained herein were prepared for the alternate POI proposed by the TO.

## 6 Transmission Owner Scope of Work

Developer had requested that AF2-229 would interconnect with the PENELEC distribution system at POI pole KRB-14483, which is located on the 22.86kV KRB-Arco ckt#00601-83 @ Roxbury Transmission substation. Penelec presently has a set of (3)-333kVA regulators in the mainline of this feeder at pole KRB-110A83. AF2-229's requested POI pole is located on the load side of these regulators, the 20MW MFO rating for the generation will back feed through these regulators and overload them. Penelec does NOT have a standard distribution or substation class of regulator capable of handling this much generation. The regulators are needed if/when AF2-229 is out of service for any reason - Penelec cannot simply remove the regulators to address the issue.

**As an alternative, Penelec suggests that the customer consider a new POI that is located on the source side of the existing regulator installation, the closet pole is KRB-11083.**

The total physical interconnection costs is given in the table below assuming the alternate POI proposed by the TO:

Description	Total Cost
Tap the existing 22.86kV KRB-Arco ckt#00601-83 @ Roxbury Transmission at POI pole KRB-11083 and install a SCADA controlled 22.86kV recloser to interconnect queue project AF2-229. Install 22.86kV metering in customer's facilities. The customer is responsible to build their own line from their site to Penelec's existing facilities	\$100,000
Re-conductor multiple spans of undersized three-phase main-line conductor for a total distance of 18,136 feet.	\$858,713
NPs & Cust Dwg Review @ AF2-229	\$25,200
Roxbury Transmission 22.86kV SS. Adjust Remote Relay and Metering Settings.	\$14,400
<b>Total Physical Interconnection Costs</b>	<b>\$998,313</b>

## 7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of 15 months after the signing of an Interconnection Construction Service 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.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases.

## 8 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AF2-229 project did contribute overloads on the distribution system requiring the reconductoring of approximately 3.44 miles of three-phase mainline conductor.

Penelec has a normally open tie switch located on pole 9-1824183 that connects to a feeder sourced from Penelec's Blain substation. AF2-229 will need to cease generation anytime Penelec's operations personnel closes this tie switch. This abnormal configuration could result in a power flow of generation that back feeds through the undersized regulators toward the Blain substation. As stated previously, Penelec is not able to adequately increase the size of the regulators given the standard sizes available.

Penelec requires that the spans of conductor from pole KRB-4783 to the Roxbury Transmission substation be upgraded to a larger size to support the generation when operating under a normal circuit configuration. Abnormally configuring the feeder as described above will overload spans of existing conductor downstream of pole KRB-4783 toward the normally open tie point.

## 9 Interconnection Customer Requirements

### 9.1 System Protection

An analysis was conducted to assess the impact of the Roxbury 23kV (AF2-229) 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 they call "Roxbury 23kV" that will connect to Penelec's 22.86kV Roxbury Transmission substation ckt#00601-83 via a customer owned tap to pole KRB-11083.

The 22.86kV 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".

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

### 9.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause Developer's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, Developer 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.

### 9.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection Owner's/Developer'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 requirements are shown.

Additionally, Owner/Developer 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).

Owner's/Developer'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.

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

#### **9.4 Compliance Issues**

The IC will be responsible for meeting a power factor between 0.95 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/storage 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. The 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.

### **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<sup>2</sup>)
- 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 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/>

The 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.

## **11 Summer Peak - Load Flow Analysis**

The Queue Project AF2-229 was evaluated as a 20.0 MW (Capacity 10.9 MW) injection at the Roxbury 23 kV substation in the PENELEC area. Project AF2-229 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-229 was studied with a commercial probability of 53.0 %. 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)

None

### 11.4 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
100654034	235189	01GUILFD	138.0	AP	235136	01ANTRIM	138.0	AP	1	AP-P1-2-WP-138-112	operation	306.0	105.17	106.7	DC	4.67

## 11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

None

## 11.6 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

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## 11.7 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

## 11.8 Contingency Descriptions

Contingency Name	Contingency Definition
<b>AP-P1-2-WP-138-112</b>	CONTINGENCY 'AP-P1-2-WP-138-112' /* CHERRY RUN - MCCONNELSBURG 138KV DISCONNECT BRANCH FROM BUS 958230 TO BUS 235267 CKT 1 /* 01MCCONL 138 01WARFOR 138 DISCONNECT BRANCH FROM BUS 235267 TO BUS 235453 CKT 1 /* 01WARFOR 138 01CHERYR 138 DISCONNECT BRANCH FROM BUS 235267 TO BUS 236686 CKT 2 /* 01WARFOR 138 01WARFORDS 35 END

## 12 Short Circuit Analysis

The Short Circuit Analysis will be performed during the System Impact Study phase.

## 13 Affected Systems

### 13.1 NYISO

NYISO Impacts to be determined during later study phases (as applicable).

**14 Attachment 1: One Line Diagram**