



# **Generation Interconnection**

## **Feasibility Study Report**

**for**

### **Queue Project AF1-167**

**WEST FREEDOM-C&K COAL 25 KV**

**9.54 MW Capacity / 15.9 MW Energy**

January, 2020

# Table of Contents

- 1 Introduction..... 3
- 2 Preface..... 3
- 3 General ..... 4
  - 3.1 Point of Interconnection ..... 5
  - 3.2 Cost Summary..... 5
- 4 Transmission Owner Scope of Work for Interconnection Facilities ..... 6
- 5 Schedule..... 6
- 6 Transmission Owner Analysis..... 7
  - 6.1 Power Flow Analysis ..... 7
- 7 Interconnection Customer Requirements..... 8
  - 7.1 System Protection..... 8
  - 7.2 Compliance Issues and Interconnection Customer Requirements ..... 8
  - 7.3 Power Factor Requirements..... 9
- 8 Revenue Metering and SCADA Requirements ..... 10
  - 8.1 PJM Requirements ..... 10
    - 8.1.1 Meteorological Data Reporting Requirement..... 10
  - 8.2 APS Requirements ..... 10
- 9 Network Impacts ..... 11
- 10 Generation Deliverability ..... 13
- 11 Multiple Facility Contingency ..... 13
- 12 Contribution to Previously Identified Overloads ..... 13
- 13 Potential Congestion due to Local Energy Deliverability..... 13
- 14 System Reinforcements for Low Voltage Violations ..... 14
- 15 Affected Systems ..... 16
- 16 Contingency Description..... 17
- 17 Short Circuit..... 19
- 18 Stability ..... 21
- 19 Attachment One: One Line Diagram..... 22

## 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 West Penn Power (WPP - APS).

## 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 Clarion County, Pennsylvania. The installed facilities will have a total capability of 15.9 MW with 9.54 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 1, 2022. 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 AF1-167 will be specified in a separate two party Interconnection Agreement (IA) between West Penn Power and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT).

**There are low voltage system violations identified by FirstEnergy (see Section 6 for “Transmission Owner Analysis”).**

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

<b>Queue Number</b>	<b>AF1-167</b>
<b>Project Name</b>	WEST FREEDOM-C&K COAL 25 KV
<b>State</b>	Pennsylvania
<b>County</b>	Clarion
<b>Transmission Owner</b>	APS
<b>MFO</b>	15.9
<b>MWE</b>	15.9
<b>MWC</b>	9.54
<b>Fuel</b>	Solar
<b>Basecase Study Year</b>	2023

### 3.1 Point of Interconnection

The interconnection of the project at the Primary POI will be accomplished by tapping the West Freedom-C&K Coal 25 kV line and constructing a one span tap. The transmission line tap will be located approximately 5.7 miles from West Freedom substation and 1.75 miles from C&K Coal 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.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF1-167 generation project to connect to the FirstEnergy (“FE”) transmission 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 FE transmission system.

### 3.2 Cost Summary

Total estimated cost for the required Interconnection Facilities is:

Physical Interconnection to System	\$ 223,400
Lower Voltage System Upgrades identified by FE <sup>1</sup>	\$ 9,960,000
<b>Total</b>	<b>\$10,183,400</b>

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.

**There are low voltage system violations identified by FirstEnergy (see Section 6 for “Transmission Owner Analysis”). Cost Allocation for these upgrades will be assessed in the System Impact Study phase.**

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

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<sup>1</sup> First Energy identified lower voltage system violations with the addition of this project onto the system. Cost allocation for these upgrades will be assessed in the System Impact Phase.

## 4 Transmission Owner Scope of Work for Interconnection Facilities

The interconnection of the project at the Primary POI will be accomplished by tapping the West Freedom-C&K Coal 25 kV line and constructing a one span tap. The transmission line tap will be located approximately 5.7 miles from West Freedom substation and 1.75 miles from C&K Coal 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.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF1-167 generation project to connect to the FirstEnergy (“FE”) transmission 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 FE transmission system.

Description	Total Cost
Construct one span 25 kV tap to customer’s substation.	\$ 30,000
Install 25 kV metering in the customer’s substation.	\$ 38,900
Construct 25 kV tap with 2 line switches.	\$62,500
Update relay settings at Burma	\$14,400
Update relay settings at Templeton	\$14,400
Review drawings and provide nameplates for customer substation.	\$63,200
<b>Total Estimated Connection Facility Costs</b>	<b>\$ 223,400</b>

## 5 Schedule

Based on the scope of work for the connection facilities, it is expected to take a minimum of **12 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.

The schedule for the required Lower Voltage System Reinforcements will be more clearly identified by FirstEnergy in their Facilities Study. The estimated elapsed time to complete each of the required reinforcements is identified in the “System Reinforcements” section of the report.

## 6 Transmission Owner Analysis

### 6.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. At the Primary POI, the AF1-167 project contributes to overloads on the FE <100 kV system as shown below.

ID	Contingency Description	Overloaded Element	Rating (MVA)	% Loading After AF1-167	Final % Loading	AF1-167 MW Contrib.	FE Comments/Reinforcements
AF1-167-L1	Basecase	Burns Junction - Burma 25 kV Line	14	113.50	113.5	15.9	<b>Reconductor Line</b> Time Estimate : 18 months Cost : \$1,890,000
AF1-167-L2	Basecase	C&K CL1 - Burns Junction 25 kV Line	14	113.50	113.50	15.9	<b>Reconductor Line</b> Time Estimate : 18 months Cost : \$996,000
AF1-167-L3	Basecase	AF1-167 Tap - C&K CL1 25 kV Line	7.0	227.0	227.0	15.9	<b>Reconductor Line</b> Time Estimate : 12 months Cost : \$1,050,000

## 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.

The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a delta or ungrounded wye connection on the high (utility) side.

### 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 25 kV circuit breaker to protect the AF1-167 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 AF1-167 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 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 APS 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 AF1-167 was evaluated as a 15.9 MW (Capacity 9.5 MW) injection tapping the West Freedom-C&K Coal 25 kV line in the APS area. Project AF1-167 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-167 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
49535909	235151	01BURMA	115.0	AP	200583	26PINEY	115.0	PENELEC	1	PN-P1-2-PN-345-003	operation	277.0	101.51	102.82	AC	3.58

## 14 System Reinforcements for Low Voltage Violations

ID	Index	Facility	Upgrade Description	Cost
AF1-167-L1	N/A	Burns Junction - Burma 25 kV Line	WP-AF1-F-0009 : Reconductor Burns Junction - Burma 25 kV Project Type : FAC Cost : \$1,890,000 Time Estimate : 18.0 Months	\$1,890,000
AF1-167-L2	N/A	C&K CL1 - Burns Junction 25 kV Line	WP-AF1-F-0010 : Reconductor C&K to Burn Junction 25 kV Project Type : FAC Cost : \$996,000 Time Estimate : 18.0 Months	\$996,000
AF1-167-L3	N/A	AF1-167 Tap - C&K CL1 25 kV Line	WP-AF1-F-0019 : Reconductor AF1-167-C&K 25 kV Project Type : FAC Cost : \$1,050,000 Time Estimate : 12.0 Months	\$7,080,000
			<b>TOTAL COST</b>	<b>\$9,960,000</b>

# Affected Systems

## 15 Affected Systems

None

## 16 Contingency Description

Contingency Name	Contingency Definition
<b>PN-P1-2-PN-345-003</b>	CONTINGENCY 'PN-P1-2-PN-345-003' /* HANDSOME LAKE - WAYNE 345KV DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1 /* 26HANDSMLK 345 26WAYNE 345 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