

FE Feasibility/Impact Study

115kV Transmission Connection

for

Pennsylvania Windfarms, LLC

Arnold 115kV (Z1-066) Project

March 2015

FirstEnergy

Transmission Group

**Prepared by
FirstEnergy Corp
Energy Delivery, Planning and Protection Department**



FirstEnergy Feasibility Study Arnold 115kV (Z1-066) Generation Project

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by FirstEnergy (FE) in response to a request made by Pennsylvania Windfarms, LLC (the Interconnection Customer or IC) for the connection of a 10.4 MW (0 MW Capacity) battery storage project (the Project) to the Penelec Transmission System. The direct connection of the project is to the Somerset Rural Electric Cooperative ("Somerset REC") 25kV bus. The Somerset REC owned 115/25kV transformer connects to the Penelec system. The IC has proposed commercial operation date of December 31, 2015 for the Project. This study does not imply a FirstEnergy commitment to this in-service date. As per the PJM RTEP study process, the Arnold 115kV (Z1-066) Project assessment was accomplished by: 1. Evaluating the reliability impact of the proposed facilities and connection on the interconnected transmission system by the performance of a power flow study; 2. Ensuring compliance with the NERC, ReliabilityFirst, PJM and FE Reliability Standards by identifying the system reinforcements that will need to be installed for an interconnection of the proposed project; 3. Coordinating and cooperating with the PJM staff and the IC by participating in project meetings and issuing this report as a part of the RTEP study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting all studies in accordance with the PJM Manuals, the "FE Requirements for Transmission Connected Facilities", and the "FE Study Guide".

Connection Facilities

In compliance with the Regional Transmission Expansion Planning (RTEP) protocol, Pennsylvania Windfarms, LLC has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram (see Attachment 3) that identifies its plan to deactivate its existing 10.4 MW wind generation project connected to the Somerset REC 25kV bus (PJM Queue K18) and replace it with a 10.4 MW battery storage project. For purposes of this report, it has therefore been designated as the Arnold 115kV (Z1-066) Project to reflect its transmission interconnection voltage and its connection to Arnold substation.

Point of Interconnection: Arnold Substation

The IC will deactivate the existing K18 and will re-use the injection rights for the Z1-066 project. The IC must physically disconnect the wind farm the Somerset REC bus prior to connecting the new Z1-066 project. No work is required by FE to accommodate this request. Somerset REC will review the interconnection facilities required to connect the Project to the REC owned 25kV system and will provide these requirements in a separate report.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Arnold 115kV (Z1-066) Project on the FE Transmission System. This included the performance of a contingency analysis to identify any facility overload or voltage condition that violates the FE Planning Criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them. Because the Z1-066 project is re-using the generation injection rights by the K18 project, the project was only studied then the battery storage project was charging.

The Power Flow Analysis was performed using a 2017 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of Arnold substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Project was conducted to test for criteria compliance. The study did not identify any criteria violations on the Penelec transmission system.

Short Circuit and Dynamics Analysis

Due to the limited short circuit capability of inverter based generation, a short circuit study was not performed by FE for this project. Due to the size of the project, a dynamic stability analysis not required.

Metering

Pennsylvania Windfarms, LLC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 2 of this report.

Compliance Issues

Pennsylvania Windfarms, LLC will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. The IC must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required 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. The above requirements are in addition to any PJM or Somerset REC requirements.

Prior to the interconnection of the project, FE will review relay settings at Bigby, Lick Run, and adjacent substations (if required), and adjust settings as necessary to accommodate the change in generation output. FE will also participate in project meetings and commissioning activities related to the

installation of the battery storage project. The estimated cost for these activities is shown in Attachment 1.

FE Facility Upgrades and Costs

The results from the FE Power Flow Analysis show that there are no FE criteria violations that are directly attributable to the capacity of the Project. Therefore in accordance with the RTEP procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, the IC is not responsible for network upgrades.

FE will review relay settings and make adjustments as appropriate due to the change in generation type. FE will also participate in project meetings and commissioning activities, as necessary. The costs are detailed in Attachment 2.

Pennsylvania Windfarms, LLC Requirements

In addition to the FE facilities, Pennsylvania Windfarms, LLC will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

1. 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.
2. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.
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. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.
5. A compliance with the FE, Somerset REC, and PJM generator power factor and voltage control requirements.

The above requirements are in addition to any metering required by PJM or Somerset REC.

Summary

The Arnold 115kV (Z1-066) Project direct connection will require the facility upgrades defined in Attachment 1. As shown, the total estimated cost is \$13,200. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of \$3,200. This tax may or may not be

charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. The Project does not have any required network upgrades. Because the direction connection of the Project is to the Somerset REC system, the REC will provide any facility upgrades that are required for connection to the REC system.

Attachment 1

Direct Connection Requirements

Description	Total with Tax	Tax	Total Cost
Protection Analysis with possible relay setting changes. Project oversight and commissioning.	\$13,200	\$3,200	\$10,000

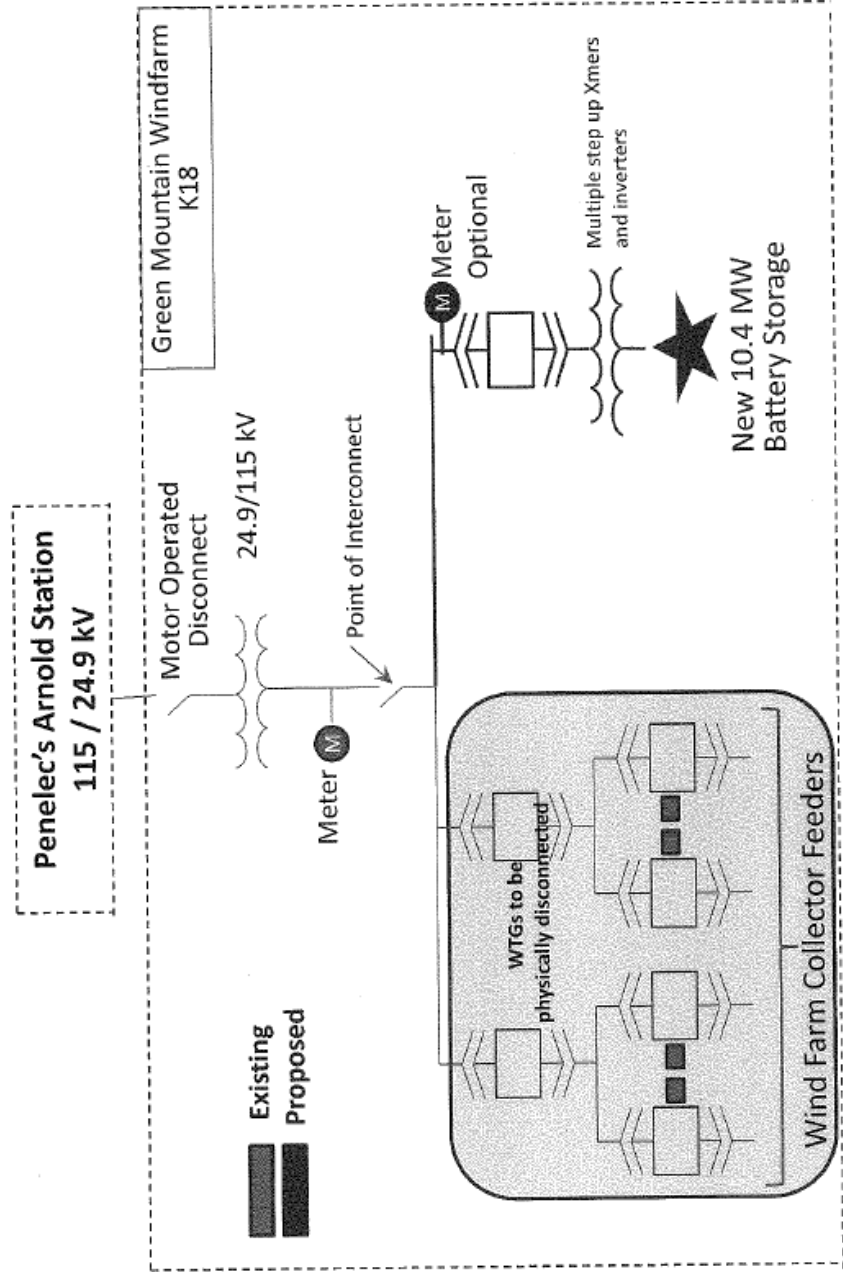
Attachment 2

FE Revenue Metering Requirements

The FirstEnergy Revenue Metering Requirements may be found in the FirstEnergy Requirements for Transmission Connected Facilities document located at the following links:

www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Attachment 3



Attachment 3

