



**Generation Interconnection
Combined Feasibility / Impact Study Report
for
Queue Project AG1-142
BETHELBORO 12.47 KV
1.4 MW Capacity / 2.5 MW Energy**

January 2021

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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 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 Fayette County, Pennsylvania. The installed facilities will have a total capability of 2.5 MW with 1.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-142
Project Name	BETHELBORO 12.47 KV
State	Pennsylvania
County	Fayette
Transmission Owner	APS
MFO	2.5
MWE	2.5
MWC	1.4
Fuel	Solar
Basecase Study Year	2024

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

AG1-142 will interconnect with the APS distribution system at the Bethelboro 12.47 kV substation. The distribution line tap will be located approximately 1.15 miles from Bethelboro substation. The interconnection of the project at the POI will be accomplished by tapping the Bute 12.47 kV line and constructing a one span tap to a 12.47kV metering package. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 12.47kV line and the associated attachment facilities.

5 Cost Summary

The AG1-142 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$74,000
Total System Network Upgrade Costs	\$0
Total Costs	\$74,000

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 2016-36, 2016-25 I.R.B. (6/20/2016). 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.

6 Transmission Owner Scope of Work

AG1-142 will interconnect with the APS distribution system at the Bethelboro 12.47 kV substation. The distribution line tap will be located approximately 1.15 miles from Bethelboro substation. The interconnection of the project at the POI will be accomplished by tapping the Bute 12.47 kV line and constructing a one span tap to a 12.47kV metering package. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 12.47kV line and the associated attachment facilities.

The total physical interconnection costs is given in the table below:

Description	Total Cost
Connection to a 12.47 metering package and GOAB switch install	\$48,000
SCADA Connection Costs and change LC setting at Bethelboro SS	\$26,000
Total Physical Interconnection Costs	\$74,000

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **12 months** after the signing of an Interconnection 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.

8 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AG1-142 project did not contribute to any overloads on the FE transmission <100 kV system.

9 Interconnection Customer Requirements

9.1 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.

All new generator only and new generator plus load facilities must be isolated from the FE transmission System by a Power Transformer. Section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document specifies the winding configurations of the transformer connecting to a non-effectively grounded portion of the FE Transmission system shall be determined by FE on a case-by-case basis.

9.2 Compliance Issues and Interconnection Customer Requirements

The IC will be responsible for meeting all FE criteria as defined in the FE Requirements for Distribution Connected Facilities.

The IC must meet all PJM and NERC reliability criteria and operating procedures required for standards compliance.

West Penn Power requests a copy of relay settings to insure they meet the requirements of Section 6.0 of the Customer Interconnection Guide.

West Penn Power Regional Engineering requires a transformer configuration of wye grounded – wye grounded connection unless determined otherwise by West Penn Power Regional Engineering.

Section 7.1 of the Customer Interconnection Guide requires access via SCADA and will be required as spelled out as described in Section 7.1 of the Customer Interconnection Guide.

Section 9.0 of the Customer Interconnection Guide requires either pre-certification or acceptance testing to ensure compliance with IEEE 1547.1 Standard Conformance Test Procedure for Equipment Interconnecting Distributed Resources with Electric Power Systems. When Acceptance Testing is required, it must be performed by a third-party testing organization. West Penn Power must be notified of when the testing is to occur and have the option to attend.

In addition to the IC requirements identified in this report, the customer's interconnection must conform with all the requirements identified in IEEE Std. 1547-2018, unless a requirement has been specifically waived or altered, in writing, by The Company. The IC is advised to review all of the interconnection guidance provided in the document titled, Customer Guide for Retail Interconnection of Electric Power Producing and Storage Facilities, Commercial/Industrial located on the FirstEnergy/Company website for any additional requirements beyond those provided in IEEE-1547-2018. This guide is applicable to wholesale or retail interconnections.

9.3 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.

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) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter²) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- 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/>

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-142 was evaluated as a 2.5 MW (Capacity 1.4 MW) injection at the Bethelboro 12.47 kV substation in the APS area. Project AG1-142 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-142 was studied with a commercial probability of 100.0 %. 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
169890125	957850	AF2-079 TAP	138.0	DAY	253089	09WMILT N	138.0	DAY	1	Base Case	operation	165.0	99.82	100.09	DC	0.44

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".

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

None

12 Short Circuit Analysis

The following Breakers are overdutied:

None

13 Affected Systems

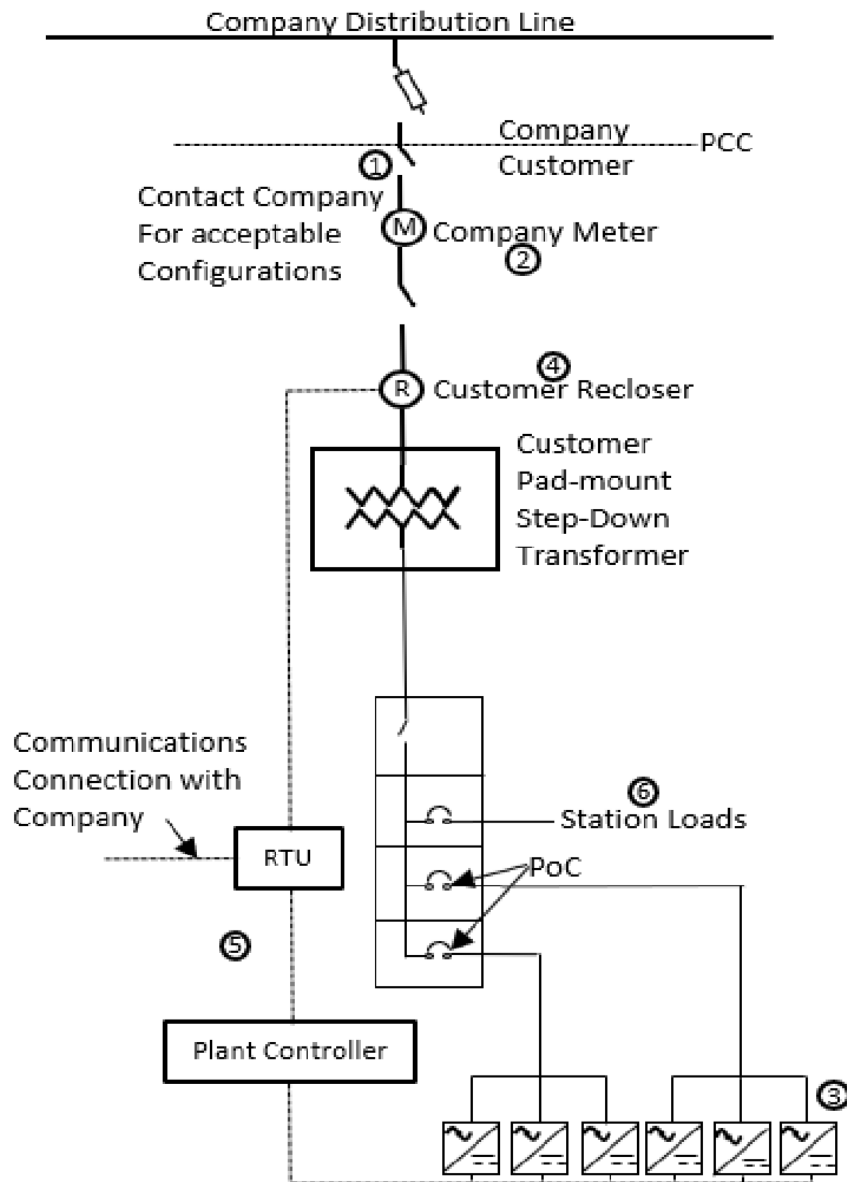
13.1 MISO

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

13.2 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

14 Attachment 1: One Line Diagram



Notes:

1. Lockable disconnect switch with a visible open is required to be installed outdoors near the Company meter, or electric service point.
2. No Customer connections are permitted in the Company meter equipment area
3. UL-1741 listed inverters meeting the requirements of IEEE-1547. Adjustable settings are to be as defined in Table 2, or as specified by the Company
4. Recloser with integral , or external multi-function relay required if inverter rating 300 kW, or larger
5. RTU and optional plant controller required for SCADA, 1000 kW, or larger
6. Contact Company for metering and service requirements