



Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-002

BERWICK 12.47 KV

2.1 MW Capacity / 5 MW Energy

January 2020

1 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a \$10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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.

2 General

The Interconnection Customer (IC) has proposed a Solar generating facility located in Luzerne County, Pennsylvania. The installed facilities will have a total capability of 5 MW with 2.1 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is March 31, 2020. **This study does not imply a TO commitment to this in-service date.**

Queue Number	AF1-002
Project Name	BERWICK 12.47 KV
State	Pennsylvania
County	Luzerne
Transmission Owner	PPL
MFO	5
MWE	5
MWC	2.1
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-002 will interconnect with the PPL distribution system via the Berwick 12 kV circuit 60-01.

2.2 Cost Summary

The AF1-002 project will be responsible for the following costs for the physical interconnection:

Description	Total Cost
Transmission Owner Distribution Scope of Work	\$174,000
Non-Direct Scope of Work	\$1,196,000
Total Costs¹	\$1,370,000

In addition, the AF1-002 project may be responsible for a contribution to the following costs for Network Upgrades identified in this report:

¹ Total Costs do not include metering and service installation

Description	Total Cost
System Upgrades	\$0

Cost allocations for these upgrades will be provided in the System Impact Study Report.

3 Transmission Owner Scope of Work

A preliminary scope of work is provided below. A more detailed scope of work will be provided in the two party agreement between the Interconnection Customer and the Transmission Owner.

AF1-002 will interconnect with the PPL distribution system on the Berwick 60-01 12 kV line in the vicinity of 41.06397, -76.20572. An underground dip will be required from 41.06397, -76.20572 to the north side of side of the road using 750 Aluminum underground cable due to the 69 kV line running double circuit with 60-01 12 kV line. From there, a short section of 477 Aluminum overhead line will be constructed to the customer point of interconnection on the north side of the road near 41.06397, -76.20572. A point of contact recloser will be installed at the customer point of interconnection.

3.1 Distribution Cost Estimate

The following facilities will be constructed from the Berwick Substation to the Point of Interconnection:

- 1 point of contact recloser
- Approximately 50 feet of 750 Aluminum underground cable
- Approximately 500 feet of 477 Aluminum overhead cable to the Point of Interconnection

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Install 50 feet of 750 Aluminum UG cable	\$60,000
Install 500 feet of 477 Aluminum to customer point of interconnection.	\$48,000
Install a point of contact recloser	\$66,000
Total Costs	\$174,000

3.2 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

The following non-direct facilities will be required:

- Install (2) 69 kV circuit breakers at Berwick substation

- Install (2) sets of 69 kV disconnects at Berwick substations
- Modify the 69 kV structures at Berwick substation to allow for circuit breaker installations
- Install bus differential relaying at Berwick
- Increase the capacity of the battery system at Berwick
- Install synch check on the Berwick 60-01 12 kV circuit breaker
- Install additional cable trenching for the 69 kV breakers
- Replace an existing fixed capacitor bank with a switched capacitor bank and modify two other switched capacitor banks

Description	Total Cost
Install (2) 69 kV breakers at Berwick substation	\$480,000
Install (2) 69 kV disconnect switches at Berwick substation	\$60,000
Modify the 69 kV structures at Berwick for 69 kV breakers	\$180,000
Bus differential relaying at Berwick	\$240,000
Berwick substation battery capacity increase	\$30,000
Synch check 12 kV PT on the Berwick 60-01 breaker	\$48,000
Cable trench for 69 kV breakers	\$120,000
Berwick 12 kV line cap bank upgrades and modifications	\$38,000
Total Non-Direct Connection Facility Costs	\$1,196,000

4 Schedule

The estimated time to complete the scope of work is **18 to 24 months** after an Interconnection Agreement (IA) is signed and PPL Electric receives Notice to Proceed from the IC.

5 Interconnection Customer Requirements

In order to ensure that the voltage rise at the point of interconnection does not exceed 2.5%, AF1-002 will be required to operate at a power factor of 99% leading (absorbing VARs) at all times. If customers served from Berwick substation begin to experience unacceptable voltage fluctuation due to the customer’s operations, the customer will be disconnected by PPL EU System Operations and will be required to cease operations and construct reinforcements necessary to mitigate the problem at their expense before being re-energized. Power factor will be monitored via SCADA to ensure this operational requirement is met and maintained. Deviation from this power factor at any time will result in being disconnected from the PPL Distribution system.

The customer's transformer windings shall be "WYE" to "WYE" with a solidly grounded high side transformer winding. Additional information can be found in PPL's Relay and Control Requirements for Parallel Operation of Distributed Generation document found at the following location:

<https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallel-generation-requirements-distribution12kVandbelow.pdf?la=en>

If PPL needs to operate the system in an abnormal configuration so that the customer is served by a different line, the customer may be asked to turn off their generation while abnormally configured. PPL also reserves the right to change the normal source to the customer as required by system conditions.

A point of contact recloser, to be provided by PPL and paid for by the customer, will be required at the customer's point of interconnection. Additional details on the customer point of contact requirements can be found on PPL's Point of Contact Requirements for Distribution Voltage Customer-Owned Facilities document:

<https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/point-of-contact-requirements-12kV.pdf?la=en>

In addition, information about requirements for a 12.47 kV service can be found at PPL's Rules for Electric Meter and Service Installations website:

<https://www.pplelectric.com/at-your-service/electric-rates-and-rules/remsi.aspx>

6 Revenue Metering and SCADA Requirements

6.1 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.

6.2 PPL Requirements

Installation of revenue grade Bi-directional Metering Equipment will be required near the point of interconnection to measure kWh and kVARh. PPL EU will design and supply the required metering equipment; all installation costs would be borne by the IC including CTs/PTs. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements. The equipment must provide bidirectional revenue metering (kWh and kVARh) and real-time data (kW, kVAR, circuit breaker status, and generator bus voltages) for the IC's generating resource. The metering equipment should be housed in a control cabinet or similar enclosure and must be accessible to PPL EU metering personnel.

PPL also requires that the customer install SCADA at the common generator bus to provide PPL with real time operation parameters, including, but not limited to amps, voltage, MW, MVAR, power factor, etc. The SCADA system shall meet PPL SCADA standards and will primarily be for monitoring purposes but will provide PPL the ability to remotely disconnect the solar generation in emergency conditions. Additional details on the SCADA requirements for generators connecting to the PPL distribution system can be found in PPL's Relay and Control Requirements for Parallel Operation of Distributed Generation, which may be found on the PPL website or at the following link:

<https://www.pplelectric.com/-/media/PPElectric/At-Your-Service/Docs/transmission-services/parallel-generation-requirements-distribution12kVandbelow.pdf?la=en>

7 Network Impacts

The Queue Project AF1-002 was evaluated as a 5.0 MW (Capacity 2.1 MW) injection at the **Berwick 69 kV** substation in the PPL area. Project AF1-002 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-002 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

8 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

9 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

10 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 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.

None

Short Circuit

12 Short Circuit

The following Breakers are over duty

None