



**Generation Interconnection
Feasibility Study Report
for
Queue Project AG1-245
WAKEFIELD 12.47 KV
6.5 MW Capacity / 10 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 PPL.

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 Lancaster County, Pennsylvania. The installed facilities will have a total capability of 10 MW with 6.5 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-245
Project Name	WAKEFIELD 12.47 KV
State	Pennsylvania
County	Lancaster
Transmission Owner	PPL
MFO	10
MWE	10
MWC	6.5
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

AG1-245 will interconnect with the PPL Distribution system via the Wakefield 12kV circuit 74-01, 3.12 miles from the Wakefield 69/12 kV Substation Bus. The Point of Interconnection (POI) will be where the PPL EU's 12kV terminates, prior to the customer's transformer/switchgear.

5 Cost Summary

The AG1-245 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$ 3,165,000
Total System Network Upgrade Costs	\$ 0
Total Costs	\$ 3,165,000

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.

6 Transmission Owner Scope of Work

The AG1-245 is interconnection to a non-Ferc jurisdictional circuit. As a result, a detailed scope, cost and scheduled estimate will be provided in the two party Interconnection Agreements between the Interconnection Customer and the Transmission Owner. A preliminary estimate is provided below.

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

Description	Total Cost
Attachment Facilities	\$ 107,000
Non Direct Connection Network Upgrades	\$ 3,058,000
Total Physical Interconnection Costs	\$ 3,165,000

PPL can accommodate this interconnection by completing reinforcements at Wakefield 69/12 kV Substation and on its associated 74-1 12 kV line.

AG1-245 will interconnect with the PPL EU distribution system using a 10 MW Solar generator on the Wakefield 74-01 12 kV line in the vicinity of 39.8051930, -76.1825240 through a 12 kV point of contact recloser at the customer point of interconnection.

6.1 Attachment Facilities

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

Description	Item Line Cost
12 kV point of contact recloser	\$ 102,000
12 kV line extension to point of interconnection	\$ 5,000
Total Cost Estimate	\$ 107,000

6.2 Direct Connection Cost Estimate

None.

6.3 Non-Direct Connection Cost Estimate

The following non-direct facilities will be required at the Wakefield 69/12 kV substation:

- 12 kV Line Reconductoring
- 12 kV Line Recloser Upgrade
- Upgrade Wakefield substation SCADA
- Install (1) 69 kV Circuit Switcher
- Modify existing 69 kV structure
- Modify existing 12 kV structure

- Install (1) 12 kV Circuit Breaker
- Install (2) 69 kV Potential Transformers (PTs)
- Install (1) Transformer Differential Cabinet
- Install (1) Bus Differential Cabinet
- Install (1) 12 kV Sync Check Cabinet & Potential Transformer

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.

Description	Item Line Cost
12 kV Line Reconductoring	\$ 1,169,000
12 kV Line Recloser	\$ 102,000
1 x SCADA upgrade	\$ 72,000
1 x 69 kV structure modification	\$ 100,000
1 x 12 kV structure modification	\$ 100,000
1 x 69 kV Circuit Switcher	\$ 300,000
1 x 12 kV Circuit Breaker	\$ 180,000
2 x 69 kV Potential Transformers (PTs)	\$ 60,000
1 x Bus Differential Cabinet	\$ 720,000
1 x Transformer Differential Cabinet	\$ 180,000
1 x 12 kV Sync Check Cabinet & Potential Transformer (PT)	\$ 75,000
Total Non-Direct Connection Facility Costs	\$ 3,058,000

7 Schedule

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

8 Interconnection Customer Requirements

8.1 Voltage Rise Control

To ensure that the voltage rise at the point of interconnection does not exceed 2.5%, the Interconnection Customer will be required to operate at a power factor of 96.5% lagging (absorbing VARs) at all times. If customers served from Wakefield 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 EU Distribution system.

8.2 Transformer Winding

The customer's transformer windings shall be "WYE" to "WYE" with a solidly grounded high side transformer winding.

8.3 Intertie Protective Relaying Equipment

The customer will have to install an Intertie Protective Relaying (IPR) scheme at their facility for their 10,000-kW solar generator. The customer should refer to the PPL EU web site for the IPR requirements. PPL EU's preference for IPR is the SEL-751 relay package. Note that failure of the single microprocessor-based relay will disable the protection. For that reason, PPL EU requests that a backup relay be installed. Suitable choices for backup are the SEL 351-1 or SEL-751 packages. Note that the SEL-751-A is not allowed. The alternative would be to disconnect the generation in the event that the single relay is out of service. The website addresses are noted below:

[https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallel-generation-requirements-distribution12kVandbelow.pdf?la=enPoint-of-Contact \(POC\) Recloser](https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallel-generation-requirements-distribution12kVandbelow.pdf?la=enPoint-of-Contact (POC) Recloser)

PPL Relay Test personnel will require a written commissioning procedure proposed by the IPP's contractor. This procedure should cover a step-by-step listing of the tests required to ensure that the IPP's schemes operate properly. This commissioning procedure should be supplied to PPL EU at least two weeks prior to the scheduled in-service testing process. The generator shall provide a detailed procedure of the initial phase-out and synchronization to PPL EU, which must be reviewed and approved by PPL EU prior to actual synchronization. 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>

A point of contact recloser, to be provided by PPL EU 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 EU's Point of Contact Requirements for Distribution Voltage Customer-Owned Facilities document, linked above.

8.4 Other Requirements

The customer will normally be served by the Wakefield 74-01 12 kV feeder. If PPL EU 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 EU also reserves the right to change the normal source to the customer as required by system conditions.

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

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

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 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)

9.3 Interconnected Transmission Owner Requirements

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

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

10 Summer Peak - Load Flow Analysis

The Queue Project AG1-245 was evaluated as a 10.0 MW (Capacity 6.5 MW) injection at the Wakefield 12.47 kV Substation in the PPL area. Project AG1-245 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-245 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

None

10.2 Multiple Facility Contingency

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

None

10.3 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

10.4 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.

None

10.5 System Reinforcements - Summer Peak Load Flow - Primary POI

None

11 Short Circuit Analysis

The following Breakers are overdutied:

None

11.1 System Reinforcements - Short Circuit

None

12 Affected Systems

12.1 NYISO

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