



**Generation Interconnection
Feasibility Study Report
for
Queue Project AE2-244
EAST CARBONDALE 12.47 KV II
2.3 MW Capacity / 16.5 MW Energy**

July, 2019

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 Wind generating facility located in Wayne County, Pennsylvania. The installed facilities will have a total capability of 16.5 MW with 2.3 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is March 31, 2021. **This study does not imply a TO commitment to this in-service date.**

Queue Number	AE2-244
Project Name	EAST CARBONDALE 12.47 KV II
State	Pennsylvania
County	Wayne
Transmission Owner	PPL
MFO	16.5
MWE	16.5
MWC	2.3
Fuel	Wind
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-243 will interconnect with the PPL EU distribution system via new feeders supplied from a new 69/12kV Substation. The POI will be where the Customer Interconnection Facilities interconnect with the Distribution Owner Interconnection Facilities. Those specifications can be found below under the Interconnection Customer Requirements.

2.2 Cost Summary

The AE2-244 project will be responsible for the following shared costs with AE2-243:

Description	Total Cost
Attachment Facilities	\$18,840,521
Direct Connection Network Upgrade	\$0
Non Direct Connection Network Upgrades	\$370,000
Total Costs	\$19,210,521

In addition, the AE2-244 project may be responsible for a contribution to the following costs:

Description	Total Cost
System Upgrades	\$

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

3 Transmission Owner Scope of Work

Detailed scope, cost, and schedule will be provided in a separate two party Interconnection Agreement (IA) between PPL EU and the Interconnection Customer.

A preliminary scope and estimate is provided below:

3.1 Attachment Facilities

Attachment Facilities for the interconnection of the 16.5MW of proposed wind generation are as follows:

- Construct a new 69kV-12kV distribution substation GPS coordinates 41.5817194, -75.4770056. The location of this substation is subject to change as part of the scope refinement. Therefore, some costs associated with the Attachment Facilities and Non-Direct Connection Network Upgrades may change accordingly.
- Install new double circuit 69kV tap off the East Carbondale tap, and Waymart tap 69kV lines to new PPL distribution substation being installed to serve AE2-243 & 244 projects.
- Remove pole 61984N52122 and install a two-pole double circuit tap structure.
- Intersperse switch poles on either side of the tap.
- Install 0.6-mile double circuit transmission line to the PPL substation. Utilize 556 ACSR conductor and dual .567 OPGW.
- Install the following equipment for the new 69/12kV substation:
 - Two 69kV circuit breakers
 - Two 69kV dead-end structures
 - Two 28 MVA 69kV-12kV LTC transformers
 - Two 12kV transformer circuit breakers
 - Two operating buses separated by one 12kV normally open bus tie circuit breaker
 - Two line and terminals, including two 12kV feeder circuit breakers with sync check enabled
- Build two line and terminals (approximately 6.3 miles per line from the substation to the Point of Interconnection (POI)).
Please refer to the PPL EU Interconnection Customer Requirements section 5.1 for additional requirements pertaining to the new feeders.
- Install two 12kV vacuum circuit reclosers (VCRs) at the POI with sync check enabled

The total preliminary cost estimate for the Attachment Facilities work is given in the table below. These costs do not include CIAC Tax Gross-up. The AE2-243 project will be responsible for the following shared costs with AE2-244:

Description	Total Cost
Two new line and terminals and express feeders	\$5,861,343
Two point of contact reclosers	\$110,000
Sync Check on the feeder breakers	\$100,000

Transmission Scope of Work	\$1,937,178
Construct a new 69kV-12kV distribution substation	\$10,832,000
Total Attachment Facility Costs	\$18,840,521

3.2 Direct Connection Cost Estimate

None.

3.3 Non-Direct Connection Cost Estimate

Install MOLBABS on either side of the transmission line tap point

- Install MOLBAB on East Carbondale tap line north of the north tap point
- Install MOLBAB on Waymart tap line south of the southern tap point

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 AE2-243 project will be responsible for the following shared costs with AE2-244:

Description	Total Cost
(2) MOLBABS	\$370,000
Total Non-Direct Connection Facility Costs	\$370,000

4 Schedule

The estimated time to complete the scope of work is 30-36 months after the PJM three-party Interconnection Service Agreement (ISA) and the Interconnection Construction Service Agreement are signed and PPL EU receives notice to proceed from the IC.

5 Interconnection Customer Requirements

5.1 PPL EU Interconnection Customer Requirements

The customer will be supplied from two 12kV line and terminals, each with a rating of 11 MVA. Given the generation is 16.5MW, each line shall supply 8.25 MW of generation without the capability to the total generation to a single feeder.

Operating at unity power factor will result in a significant voltage rise on the distribution system. At 16.5 MW, the voltage rise will exceed 13% which significantly exceeds the 2.5% allowable voltage rise on the distribution system. Even at a 95% leading power factor, the voltage rise will still exceed 4%. This violates the PPL Distribution Planning Principle and Practices. As a potential Distribution Customer, PPL is accountable for the voltage and power quality on the distribution system. As a result, this customer cannot be served from Distribution Substations serving other customers due to power quality concerns.

PPL EU applicable technical standards that address requirements for interconnection of generation, transmission, and end user facilities can be found at the following link:

<https://pjm.com/planning/design-engineering/to-tech-standards/private-ppl.aspx>

5.2 IC Direct Transfer Trip (DTT) Requirements

PPL EU will require an independent communication path, for Direct Transfer Trip (DTT) of the IC Intertie Protective Relaying (IPR) Fault Interrupting Devices (FIDs), consisting of one communication circuit.

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 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 also requires that the customer installs SCADA at the common generator bus to provide PPL with real time operation parameters, including but not limited to amps, voltage, megawatts, megavars, 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 remote disconnect the BESS system in emergency situations. The PPL SCADA requirements can be found in the [RELAY AND CONTROL REQUIREMENTS FOR PARALLEL OPERATION OF DISTRIBUTED GENERATION](#) document.

7 Network Impacts

The Queue Project AE2-244 was evaluated as a 16.5 MW (Capacity 2.3 MW) injection at the East Carbondale 69kV substation in the PPL area. Project AE2-244 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-244 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

12 System Reinforcements

None

Affected Systems

13 Affected Systems

13.1 LG&E

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

13.2 MISO

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

13.3 TVA

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

13.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

13.5 NYISO

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

Short Circuit

14 Short Circuit

The following Breakers are over duty:

None