Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AE1-127

Eldred-Sunbury 69kV

50.0 MW Energy / 32.1 MW Capacity

January 2019

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 Electric Utilities (PPL EU).

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. 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 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.

General

The IC has proposed a Solar generating facility located in Northumberland County, Pennsylvania. The installed facilities will have a total capability of 50.0 MW with 32.1 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 7, 2021. **This study does not imply a PPL EU commitment to this in-service date.**

There is a PPL EU initiated supplemental project s0965.4 near the requested POI with a scheduled in service date of August 2022. s0965.4 is a supplemental project to rebuild 12.9 miles of the Eldred–Reed 69kV line. Significant portions of this project must be in service for the IC to operate at maximum facility output. If the IC desires to interconnect prior to the completion of the project, the IC may be required to limit facility output until the supplemental project is complete. PPL EU will analyze this in further detail as part of the System Impact Study.

Point of Interconnection (POI)

AE1-127 will interconnect with the PPL EU transmission system via the existing Sunbury-Fairview tie (future Sunbury-Eldred #2) 69kV line. The Point of Interconnection will be where the Customer Interconnection Facilities interconnect with the Transmission Owner Interconnection Facilities. Those specifications can be found below under the Interconnection Customer Requirements.

Cost Summary
AE1-127 will be responsible for the following estimated costs:

Description	Total Cost
Attachment Facilities	$ 633,000
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 889,000
Total Costs	$ 1,522,000

In addition, the AE1-127 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 0
Previously Identified Upgrades	$ 0
Total Costs	**$ 0**

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

Estimated Schedule
The estimated time to complete the scope of work is 12-18 months after the PJM three-party Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (ICSA) are signed and PPL EU receives Notice to Proceed from the IC.

Assumptions

- Availability of optimal transmission line route
- PPL Supplemental Project s0965.4 Scheduled In-Service date does not change
- Outage feasibility not assessed until Facilities Study
- No major environmental, real estate, or permitting issues

Attachment Facilities

The Attachment Facilities will interconnect with existing Sunbury-Fairview tie (future Sunbury-Eldred #2) 69kV line 10.8 miles from the Eldred substation and 14.8 miles from the Sunbury substation.

Tap the existing Sunbury-Fairview Tie 69kV line.

- Install new tap pole and extend tap to customer substation dead-end.
- Design tap for initial and final single circuit.
- Install new MOLBAB on customer tap.

This scope of work is based on the IC collector substation within 1500ft of GPS Coordinates provided on the Feasibility Study Kick Off call.

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

Description	Total Cost
SUNB-FAIR Tie Tap	$633,000
Attachment Facilities	**$633,000**

Direct Connection Network Upgrades

None.

Non Direct Connection Network Upgrades

The following Protection and Control upgrades are required at the Eldred substation:

- Install new telephone-based DTT equipment.
- Add telephone facilities accordingly to accommodate the new DTT telephone circuit.
- Modify the existing Fairview 69kV #2W circuit breaker (FAIR 2 WEST) protection and control scheme.
- Modify the existing Fairview 69kV #2T circuit breaker (FAIR 2 TIE) protection and control scheme.
- Modify the existing SCADA for new alarms.
- Modify the existing Alarm Management System (AMS).
- Install new cables and modify control wiring for the above.
- Perform system checks and test equipment before placing in service.

The following Protection and Control upgrades are optional at the Sunbury substation if the IC elects to generate when the line is connected to the Sunbury substation:

- Install new telephone-based DTT equipment.
- Add telephone facilities accordingly to accommodate the new DTT telephone circuit.
- Modify the existing Fairview Tie 69kV #7E circuit breaker (FAIR TIE 7 EAST) protection and control scheme.
- Modify the existing Fairview Tie 69kV #7W circuit breaker (FAIR TIE 7 WEST) protection and control scheme.
- Modify the existing SCADA for new alarms.
- Modify the existing Alarm Management System (AMS).
- Install new cables and modify control wiring for the above.
- Perform system checks and test equipment before placing in service.

If the IC elects to complete the optional Protection and Control Upgrades at Sunbury substation, PPL EU recommends the installation of two new MOLBABs on the Sunbury Fairview Tie Line to increase operational flexibility for alternate generation paths.

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

Description	Total Cost
Remote End Work – Eldred Substation	$300,000
Remote End Work- Sunbury Substation (Optional)	$300,000
Two New MOLBABs (Optional)	$289,000
Total Non-Direct Connection Facility Costs	**$889,000**

Interconnection Customer Requirements

Requirement from the PJM Open Access Transmission Tariff:

1. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

PPL EU Interconnection Requirements

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

PPL EU Point(s) of Interconnection (POI) Requirements

The IC will interconnect with the PPL EU transmission system on the Sunbury Fairview Tie. The POI will be where the PPL EU tap line terminates (with insulators) at the first deadend structure inside the IC substation.

The scope of work provided in this Feasibility Study is for facilities to be constructed on the PPL EU side of the POI.

IC Direct Transfer Trip (DTT) Requirements

PPL EU will require an independent communication path, for DTT of the IC Intertie Protective Relaying (IPR) Fault Interrupting Devices (FIDs), consisting of one communication circuit with the Eldred 69kV Substation. The IC may elect to obtain DTT to Sunbury 69kV substation. This would enable AE1-127 to generate to Sunbury 69kV substation in the event the Sunbury Fairview 69kV tie line is ever operated in network or an outage requires AE1-127 to operate radially with the Sunbury Substation. DTT with Sunbury 69kV substation is included in the scope and estimate of this Feasibility Study. PPL EU can remove this scope .at the request of the IC during subsequent study phases.

To ensure reliable communication, the IC shall also provide DTT relaying equipment identical to the PPL EU DTT relaying equipment. All DTT relaying equipment shall connect to the respective telephone communication path. The IC would be responsible for all installation, maintenance, and monthly lease or billing charges for the telephone communications facilities. All DTT relaying equipment should reside within the same location as the IPR and Point of Contact (POC) relaying equipment.

Revenue Metering and SCADA Requirements

PJM Requirements

The IC 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 Sections 24.1 and 24.2.

Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

PPL EU 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.

Network Impacts

The Queue Project AE1-127 was evaluated as a 50 MW (Capacity 32.1 MW) injection tapping the REED TP1 – REED TM1 69kV line in the ITO area. Project AE1-127 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-127 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2022

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None

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

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

Not required

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:
None

Contributions to previously identified circuit breakers found to be over-duty:
None

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None

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 IC 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

Light Load Analysis

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B)