

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AD2-077***

***Buxmont 69kV
100 MW Capacity / 200 MW Energy***

February 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 an Inverter-connected battery energy storage facility located in Bucks County, Pennsylvania. The installed facilities will have a total capability of 200 MW with 100 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31st, 2021. **This study does not imply a PPL EU commitment to this in-service date.**

Point of Interconnection (POI)

AD2-077 will interconnect with the PPL EU transmission system via one of the following points of interconnection:

Option 1: a direct connection into the Buxmont 69kV Substation. 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.

Option 2: a tap of the Buxmont – Blooming Glen #2 69 kV line

Cost Summary

AD2-077 will be responsible for the following estimated costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrades	\$ 0
Non Direct Connection Network Upgrades	\$ \$ 1,588,000
Total Costs	\$ 1,588,000

In addition, the AD2-077 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 18-24 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
- Outage feasibility not assessed until Facilities Study
- No major environmental, real estate, or permitting issues

Transmission Owner Scope of Work

Attachment Facilities

This study assumes customer will construct and own the Attachment Facilities. The customer's 69kV lead line will terminate at the dead end structure inside the PPL substation.

Direct Connection Network Upgrades

None

Non Direct Connection Network Upgrades

Construct one (1) new bay (Double Bus and Single Breaker arrangement) at Buxmont 230-69kV substation by utilizing the existing future Bay twelve (12) position.

- Install one (1) new Circuit Breaker, three (3) 3-Phase Hook Stick Operated Switches, one (1) 3-Phase PT, one (1) 3-Phase Surge Arrestor, one (1) new Line Dead-end support structure & one (1) Transmission Tension Custom Steel Foundation Pole.
- Include all required foundations, grounding, support structures, termination structures, cabling, raceway and bus work. Also add in the control cubicle with protection, control and SCADA equipment, yard lighting.

The following Protection and Control upgrades are required at Buxmont substation:

- Install a new line protection panel for Bay 12 addition.
- Modify the existing Buxmont 69kV bus differential scheme to include new Bay 12 breaker.
- Modify relay settings for existing Bay 7 tie circuit breaker to add a new Settings Group to accommodate protection during Bay 12 breaker maintenance outage. If fed via an inspection bus, the settings must be transferred from line differential pilot scheme to a step distance (POTT/DCB) protection on both ends.
- Modify the existing SCADA & Alarm Management System (AMS) to add new Bay 12 line.

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	Total Cost
Buxmont New Bay Expansion	\$ 1,340,000
Remote End Work – Buxmont Substation	\$ 248,000
Total Non-Direct Connection Facility Costs	\$ 1,588,000

Interconnection Customer Requirements

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.
2. 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 into the Buxmont substation. The POI will be where the IC generator lead line terminates (with insulators) at the first deadend structure inside the PPL EU substation.

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

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

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.

OPTION 1

Network Impacts

The Queue Project AD2-077 was evaluated as a 200.0 MW (Capacity 100.0 MW) injection into the Buxmont 69 kV substation in the PPL area. Project AD2-077 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-077 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

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)

To be determined during Impact Study

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)

OPTION 2

Network Impacts

The Queue Project AD2-077 was evaluated as a 200.0 MW (Capacity 100.0 MW) injection tapping the Buxmont – Blooming Glen #2 69 kV line in the PPL area. Project AD2-077 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-077 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

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

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(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

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