Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-156

JACK FROST - LAKE HARMONY 69 KV

39.5 MW Capacity / 60 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 Carbon County, Pennsylvania. The installed facilities will have a total capability of **60 MW** with **39.5 MW** of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 15, 2024. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-156
Project Name	EAST PALMERTON-POCONO 69 KV
State	Pennsylvania
County	Carbon
Transmission Owner	PPL
MFO	60
MWE	60
MWC	39.5
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

AG1-156 will interconnect with the PPL EU Transmission system via the East Palmerton – Acahela #1 69 kV line, 1.97 miles from the Jack Frost bus and 1.51 miles from the Lake Harmony bus. The Point of Interconnection (POI) will be at the PPL EU owned termination structure where the Interconnection Customer's transmission line terminates (with insulators).

5 Cost Summary

The AG1-156 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$ 1,554,916
Total System Network Upgrade Costs	$ 0
Total Costs	$ 1,554,916

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.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report

6 Transmission Owner Scope of Work

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

Description	Total Cost
Attachment Facilities	$ 893,364
Direct Connection Network Upgrade	$ 0
Non-Direct Connection Network Upgrades	$ 661,552
Total Physical Interconnection Costs	$ 1,554,916

PPL EU can accommodate this interconnection by constructing a new transmission line tap off the East Palmerton – Acahela #1 69 kV line and completing associated remote end relay work.

Risks and Assumptions

- No major environmental, real estate, or permitting issues.
- IC is responsible for acquisition of easements, permits, and right of way for any Direct Connection Network Upgrades and Attachment Facilities per PPL EU standards and requirements.
- PPL EU will perform all grading, site preparation, and establish access roads for the PPL EU owned Attachment Facilities per PPL EU standards and requirements.

6.1 Attachment Facilities

69 kV Transmission Line Tap

PPL EU will tap the East Palmerton – Acahela #1 69 kV line at or near GPS Coordinates: 41.062982, -75.634347. PPL EU will extend the tap towards the IC substation. PPL EU will install a motor operated switch and POI structure. The IC must build the remainder of the Attachment Facilities from the POI termination structure to the IC substation. The IC is responsible for procuring 100 ft. ROW for these facilities. For the purposes of this Feasibility Study Report cost estimate, PPL EU is assuming all engineering and construction responsibility for land development activities, including grading, site preparation, and new access road. During the Facilities Study phase, PPL EU and the IC will review land development activities, and the IC may choose to perform some, or all, of these activities. The cost estimate will be updated accordingly and included in the Facilities Study Report.

PPL EU work will consist of installing the following:

- Intersperse new tap structure on the East Palmerton – Acahela #1 69 kV line.

- Install one (1) new direct-embed, steel, motor operated switch structure.
- Install one (1) new direct-embed, steel, dead-end tension structure (POI structure).
- Install three (3) phase conductors and 48-count Optical Ground Wire (OPGW) from the new tap structure to the POI structure.
- Install one (1) fiber splice box on the tap structure and one (1) fiber splice box on the POI structure in which to terminate the OPGW

The total preliminary cost estimate for the Attachment work is given in the table below.

Description	Total Cost
69 kV Tap line, Motor Operated Switch, structures, and foundations	$ 868,964
IC substation facility acceptance, testing, commissioning, & telemetry coordination	$ 24,400
Total Attachment Facility Costs	$ 893,364

6.2 Direct Connection Cost Estimate

None.

6.3 Non-Direct Connection Cost Estimate

Remote End Relay Work – Acahela 69 kV Substation

- Complete remote end relay work at the Acahela 69 kV substation for Direct Transfer Trip.
- Model IC in CAPE and conduct a wide area short circuit study two busses away from the IC facilities. Identify affected relays and revise settings as needed.
- Conduct a review of the IC relay settings and engineering package (submitted by IC to PPL EU).
- PPL EU currently has OPGW on the East Palmerton – Acahela #1 69 kV line available as the communication circuit for DTT to the Acahela 69 kV substation.

Remote End Relay Work – East Palmerton 69 kV Substation

- Complete remote end relay work at the East Palmerton 69 kV substation for Direct Transfer Trip.
- Model IC in CAPE and conduct a wide area short circuit study two busses away from the IC facilities. Identify affected relays and revise settings as needed.
- Conduct a review of the IC relay settings and engineering package (submitted by IC to PPL EU).

Note: The East Palmerton 69 kV substation is an alternate transmission source for the IC and may be utilized to radially source this project's POI during outages.

East Palmerton – Acahela #1 69 kV line Modifications to tie in the project Attachment Facilities

- Reframe the structures on either side of the new tap structure to tension.
- Add fiber throw & two (2) splice boxes on the East Palmerton – Acahela #1 69 kV line.
- Install motor operated switch structure on each side of the new tap.

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below.

Description	Total Cost
Modifications to East Palmerton – Acahela #1 69 kV Line to tie in the AG1-156 Attachment Facilities	$ 96,552
Install Motor Operated Switches on East Palmerton – Acahela #1 line, one on each side of new tap	$ 289,000
Remote End Relay Work – Acahela 69 kV Substation	$ 138,000
Remote End Relay Work – East Palmerton 69 kV Substation	$ 138,000
Total Non-Direct Connection Facility Costs	$ 661,552

7 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.

8 Interconnection Customer Requirements

8.1 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

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)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (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

10 Summer Peak - Load Flow Analysis

The Queue Project AG1-156 was evaluated as a 60.0 MW (Capacity 39.5 MW) injection Tapping the 69 kV Jack Frost - Lake Harmony Line in the PPL area. Project AG1-156 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-156 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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
167607522	208009	LACK	230.0	PPL	200074	LACKAWANNA	500.0	PPL	4	PL:02:P13:100347	operation	1145.0	115.79	116.26	DC	11.61

10.5 System Reinforcements - Summer Peak Load Flow - Primary POI

None

11 Contingency Descriptions

Contingency Name	Contingency Definition
PL:02:P13:100347	CONTINGENCY 'PL:02:P13:100347' /* LACK 500/230KV T3 DISCONNECT BRANCH FROM BUS 200074 TO BUS 208009 CKT 3 /* LACK-LACKAW 500-230 T3 END

12 Short Circuit Analysis

The following Breakers are overdutied:

None

12.1 System Reinforcements - Short Circuit

None

13 Affected Systems

13.1 NYISO

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