Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-234

SUNBURY YARD #1-RICHFIELD TIE #2 69 KV

24 MW Capacity / 40 MW Energy

July 2020

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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), the 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-Battery Storage hybrid generating facility located in Snyder County, Pennsylvania. The installed facilities will have a total capability of 40 MW with 24 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 15, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-234
Project Name	SUNBURY YARD #1-RICHFIELD TIE #2 69 KV
State	Pennsylvania
County	Snyder
Transmission Owner	PPL
MFO	40
MWE	40
MWC	24
Fuel	Solar; Battery Storage
Basecase Study Year	2023

New Service Customers proposing queue projects that 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

AF2-234 will interconnect with the PPL transmission system via one of the following options:

Option 1: via a tap 11 miles from the **Sunbury Yard 1 69 kV** bus and 0.95 miles from the **Richfield Tie 2 69 kV** bus on the **Sunbury – Middleburg #2 69 kV line**. The Point of Interconnection (POI) will be at the PPL EU owned termination structure where the Interconnection Customer's transmission line terminates (with insulators).

Option 2: via a tap 4.72 miles from the **Penns 69 kV** bus and 0.95 miles from **Richfield Tie 1 69 kV** bus on the **Sunbury – Middleburg #1 69 kV line**

5 Cost Summary

The AF2-234 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$ 1,104,000
Total System Network Upgrade Costs	$ 0
Total Costs	$ 1,104,000

This cost excludes CIAC Tax Gross Up charges. 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	$ 869,400
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ $ 234,600
Total Physical Interconnection Costs	$ 1,104,000

PPL EU can accommodate this interconnection by constructing a new transmission line tap off the Sunbury – Middleburg #2 69 kV line and completing associated remote end relay work.

Risks and Assumptions

- No major environmental, real estate, siting, 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 Cost Estimate

69 kV Transmission Line Tap

PPL EU will tap the Sunbury – Middleburg #2 69 kV line at or near GPS Coordinates: 40.7586310, -76.9595130. PPL EU will extend the tap south towards the IC site. PPL EU will install a motor operated switch and POI termination 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:

- Install one (1) new double circuit, tension, monopole, custom steel/foundation, tap structure.
- Install one (1) new single circuit, direct-embed, custom steel, motor operated switch structure.
- Install one (1) new single circuit, direct-embed, steel, tension structure (POI structure) with one fiber splice box.
- Extend (3) phase 556.6 kcmil 24/7 ACSR conductor and 144-ct optical ground wire (OPGW) from the tap structure to the POI structure. The new tap line will need to go under the Sunbury-Middleburg #1 69 kV line to extend south to the POI structure.

Based on the site plan and new tap coordinates provided, there is not enough room to install a motor operated switch structure on the tap. The IC substation location and/or tap coordinates will need to be modified.

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

Description	Total Cost
69 kV Transmission Line Tap	$ 869,400
Total Attachment Facility Costs	$ 869,400

6.2 Direct Connection Cost Estimate

None.

6.3 Non-Direct Connection Cost Estimate

Remote End Relay Work – Sunbury 69 kV Substation

- Complete remote end relay work at Sunbury 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).

Sunbury – Middleburg #2 69 kV Modifications to tie in the AF2-234 Attachment Facilities

- Tie the new AF2-234 Attachment Facilities into the Sunbury - Middleburg #2 69 kV line.
- Reframe (2) existing structures on each side of the tap. Install a fiber section throw to tie into the 144-ct OPGW on the Sunbury-Middleburg #2 69 kV 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
Remote End Relay Work – Sunbury 69 kV Substation	$ 138,000
Sunbury – Middleburg 69 kV Modifications to tie in the AF2-234 Attachment Facilities	$ 96,600

Description	Total Cost
Total Non-Direct Connection Facility Costs	$ 234,600

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

8.2 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 Sunbury 69 kV Substation breakers 4S and 4T. The IC may elect to obtain DTT via the Sunbury-Lock Haven 69 kV line by completing upgrades at the Sunbury and Lock Haven 69 kV Substations. This would enable AF2-234 to generate on the Sunbury – Lock Haven 69 kV line in the event that the POI is ever sourced from the Sunbury – Lock Haven 69 kV line. Substation upgrades for the Sunbury – Lock Haven 69 kV line are not currently in the scope and estimate of this report. PPL EU can evaluate this at the request of the IC during subsequent study phases from both a cost and interconnection analysis perspective.

PPL EU currently has OPGW on the Sunbury – Middleburg #2 69 kV line available for DTT to the Sunbury 69 kV Substation. PPL EU assumes strands of this fiber will be used for the independent communication pathway. However, the IC may choose to procure a third-party communication circuit at its own discretion in lieu of the OPGW.

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:

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

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 - Primary POI

The Queue Project AF2-234 was evaluated as a 40.0 MW (Capacity 24.0 MW) injection tapping the **Sunbury Yard 1 to Richfield Tie 2 69 kV** line in the PPL area. Project AF2-234 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-234 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

11 Short Circuit Analysis - Primary POI

To be performed during the System Impact Study

12 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AF2-234 was evaluated as a 40.0 MW (Capacity 24.0 MW) injection tapping **the Penns to Richfield Tie 1 69 kV** line in the PPL area. Project AF2-234 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-234 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

12.1 Generation Deliverability

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

None

12.2 Multiple Facility Contingency

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

None

12.3 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

12.4 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

13 Affected Systems

13.1 NYISO

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