Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-086

SCOTT TAP-BOWMANS MILL TAP 69 KV

12 MW Capacity / 20 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), 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 Columbia County, Pennsylvania. The installed facilities will have a total capability of **20 MW** with **12 MW** of this output being recognized by PJM as Capacity. The proposed in-service date for this project is **August 01, 2022**. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-086
Project Name	SCOTT TAP-BOWMANS MILL TAP 69 KV
State	Pennsylvania
County	Columbia
Transmission Owner	PPL
MFO	20
MWE	20
MWC	12
Fuel	Solar
Basecase Study Year	2023

New Service Customers are required to request interim deliverability analysis for queue projects that can feasibly be commercially operable prior to June 1st of the basecase study year.

4 Point of Interconnection

AF2-086 will interconnect with the PPL transmission system via one of the following options:

Option 1: via a tap of the Scott Tap 2 - Bowmans Mill Tap 2 69 kV circuit. The Point of Interconnection (POI) will be where the PPL EU tap line terminates (with insulators) at the first dead-end structure inside the IC substation.

Option 2: via a tap of the Scott Tap 1 - Bowmans Mill Tap 1 69 kV circuit

5 Cost Summary

The AF2-086 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 Costs	$ 1,104,000

PPL EU can accommodate this interconnection by constructing a new transmission line tap off the Benton Tap 69 kV line (between the Scott and Bowmans Mill Tap 2 69 kV buses) 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.

Note: The Columbia – Berwick 69 kV line is currently operated in network with the Columbia and Berwick Substations. Under PPL EU Baseline Project b2838, the network line will be broken, and the future circuit will be the Columbia – Glen Brook #2 69 kV line to be operated radially with the Columbia Substation as the source. If AF2-086 interconnects prior to the completion of b2838, additional remote end relay work will be required at the Berwick 69 kV Substation and additional interconnection analyses will need to be performed to confirm deliverability. The target in service date for b2838 is November 1, 2021.

6.1 Attachment Facilities

69 kV Transmission Line Tap

PPL EU will tap the Benton Tap 69 kV line at or near GPS Coordinates: 41.060581, -76.416303. PPL EU will extend the tap east 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, custom steel/foundation, tap pole 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 with custom foundation (dead-end).
- New circuit will consist of three (3) phase 556.6 kcmil 24/7 ACSR conductor and 48-ct optical ground wire (OPGW).

Note: The Benton/Millville Tap circuits are installed on double circuit structures. Scope of this work includes tapping the existing Benton 69 kV Tap to the customer dead-end.

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 – Columbia 69 kV Substation

- Complete remote end relay work at the Columbia 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).

Benton Tap 69 kV Modifications to tie in the AF2-086 Attachment Facilities

- Tie the new AF2-086 Attachment Facilities into the Benton Tap 69 kV line.
- Replace existing pole at Grid # 27503S45352 with a new double circuit foundation tap pole about 40 ft. north of existing pole, remove existing pole.
- Turn exiting OPGW suspension attachment installed on the existing pole # 34 @ Grid# 36761N32888 to tension or suspension-tension set.
- Install two splice boxes on the main line, one on the proposed new double circuit tap pole (Structure # 33) at Grid # 36772N32850 and another one on next existing pole # 34 @ Grid# 36761N32888.

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 – Columbia 69 kV Substation	$ 138,000
Benton Tap 69 kV Modifications to tie in the AF2-086 Attachment Facilities	$ 96,600
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 Columbia 69 kV Substation breaker 13R and Berwick 69 kV Substation breaker. After Baseline Project b2838, AF2-086 will be normally sourced from Columbia 69 kV with Berwick 69 kV as an alternate source. If AF2-086 comes in service after the completion of b2838, the upgrades at Berwick 69 kV are optional as an alternate generation source.

PPL EU currently has OPGW on the Benton Tap 69 kV line available for DTT to the Columbia 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 and expense 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 AF2-086 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection tapping the **Scott Tap 2 to Bowmans Mill Tap 2 69 kV** line in the PPL area. Project AF2-086 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-086 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

Short circuit analysis will be performed during the System Impact Study.

12 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AF2-086 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection tapping the **Scott Tap 1 to Bowmans Mill Tap 1 69kV line** in the PPL area. Project AF2-086 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-086 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