Generation Interconnection

Combined Feasibility/System Impact Study Report

for

Queue Project AG1-336

HUNTER 12.47 KV

3.8 MW Capacity / 5 MW Energy

January 2021

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1 Introduction

This Combined Feasibility/ System Impact 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/System Impact 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), **ASD Hilcrest PA2 Solar LLC**, has proposed a hybrid Solar-Storage generating facility located in Northumberland County, Pennsylvania. The facility consists of 5 MW solar generation coupled with 3.15 MW (6.3 MWH) battery storage. The installed facilities will have a total capability limited to 5 MW with 3.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is May 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-336
Project Name	HUNTER 12.47 KV
State	Pennsylvania
County	Northumberland
Transmission Owner	PPL
MFO	5
MWE	5
MWC	3.8
Fuel	Solar; Battery Storage
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

AG1-336 will interconnect with the PPL EU Distribution system via Hunter 01-02 12.47 kV circuit, 1.52 miles from the Hunter 69/12 kV Substation Bus. The Point of Interconnection (POI) will be where the PPL EU's 12kV terminates, prior to the customer's transformer/switchgear.

5 Cost Summary

The AG1-336 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$ 8,123,000
Total System Network Upgrade Costs	$ 0
Total Costs	$ 8,123,000

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 88-129. 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	**$ 102,000**
Direct Connection Network Upgrade	$ 1,388,000
Non-Direct Connection Network Upgrades	$ 6,633,000
Total Physical Interconnection Costs	$ 8,123,000

PPL EU can accommodate this interconnection by upgrading substation equipment, relaying, and overhead distribution conductors. A more detailed scope of work will be provided in the two-party Interconnection Agreement between the Interconnection Customer and the Transmission Owner.

AG1-336 will interconnect a 5,000 kW solar generation system, and a 3,150 kW energy storage system, with the PPL EU distribution system on the Hunter 01-02 12 kV line in the vicinity of 40.7576580, -76.7705500 through a 12 kV point of contact recloser at the customer point of interconnection.

6.1 Attachment Facilities

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
Point of Contact Recloser	$102,000
Total Attachment Facility Costs	$102,000

6.2 Direct Connection Cost Estimate

None.

6.3 Non-Direct Connection Cost Estimate

The following non-direct facilities will be required:

- Reconductor approx. 2.38mi. of overhead conductor between Hunter Substation and point of interconnection, to #477 ALX (due to voltage rise/flicker)
- Remove existing 01-01 12kV CB and existing bus structure
- Install 2 x 69kV structures

- Install 2 x 12kV bus structures
- Install 4 x 69 kV Potential Transformers (PTs) at Hunter 69/12 kV substation
- Install 2 x 69 kV 3Ø Current Transformers (CTs) at Hunter 69/12 kV substation
- Install 2 x 12 kV 3Ø Current Transformers (CTs) at Hunter 69/12 kV substation
- Install Bus Differential Scheme and Cabinet
- Install Transformer Differential Scheme and Cabinet
- Install 12kV line PT and Sync Check relay on 01-02 12kV line
- Install 2 x 69kV Circuit Switchers
- Install 2 x 12kV Transformer CB
- Install 2 x 12kV CB for Line Feeders (01-01 & 01-02)
- Install 2 x Relay in a Box (RIAB) on 01-01 and 01-01 feeders
- Install 12kV Operating Bus Section CB
- Install VIP SCADA system at Hunter 69/12kV Substation
- Upgrade the battery system to a 48 VDC system at Hunter 69/12kV Substation
- Extend substation yard and fence as applicable
- Install 2 x transformer foundations
- 2 x transformer rotations & relocations
- Install new control house

Description	Total Cost
2.38mi. 3-Phase Reconductor	$ 1,388,000
Remove existing 01-01 12kV CB and existing structures	$ 200,000
Install 2 x 69kV structures (including removal of existing and 69kV line rerouting)	$ 840,000
Install 2 x 12kV bus structures	$ 200,000
Install 4 x 69kV PTs	$ 100,000
Install 2 x 69kV CTs (including foundation and structure)	$ 240,000
Install 2 x 12kV CTs (including foundation and structure)	$ 240,000
Install Bus Diff Scheme	$ 720,000
Install Trans Diff Scheme	$ 180,000
Install 01-02 12kV Line PT and Sync Check	$ 15,000
Install 2 x 69kV Circuit Switchers (including foundation and structure)	$ 600,000
Install 2 x 12kV Transformer CB (including foundation and structure)	$ 600,000
Install 12kV Bus Sec CB (including foundation and structure)	$ 420,000
Install 2 x 12kV Feeder CB	$ 240,000
Install 2 x RIAB for Feeder CB	$ 204,000
Install VIP SCADA	$ 72,000
Upgrade Battery System	$ 90,000
Substation Yard and Fence Extension	$ 462,000
2 x Transformer Foundation	$ 600,000
2 x Transformer Rotations & Relocations	$ 360,000
Install New Control House	$ 250,000

Description	Total Cost
Total Non-Direct Connection Facility Costs	**$ 6,633,000**

7 Schedule

The estimated time to complete the scope of work is 18-24 months after the Interconnection Agreement (IA) is signed and PPL EU receives Notice to Proceed from the IC.

8 Interconnection Customer Requirements

8.1 Voltage Rise Control

In order to ensure that the voltage rise at the point of interconnection does not exceed 2.5%, AG1-336 will be required to operate at a power factor of 99% lagging (absorbing VARs) at all times. If customers served from Hunter substation begin to experience unacceptable voltage fluctuation due to the customer's operations, the customer will be disconnected by PPL EU System Operations and will be required to cease operations and construct reinforcements necessary to mitigate the problem at their expense before being re-energized. Power factor will be monitored via SCADA to ensure this operational requirement is met and maintained. Deviation from this power factor at any time will result in being disconnected from the PPL EU Distribution system.

8.2 Transformer Winding

The customer's transformer windings shall be "WYE" to "WYE" with a solidly grounded high side transformer winding. Additional information can be found in PPL EU's Relay and Control Requirements for Parallel Operation of Distributed Generation document found at the following location:

https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallelgeneration-requirements-distribution12kVandbelow.pdf?la=en

8.3 Intertie Protective Relaying Equipment

The customer will have to purchase, install and maintain an Intertie Protective Relaying (IPR) scheme at their facility for their 5,000 kW solar generator with 3,150 kW energy storage system. The customer should refer to the PPL EU web site for the IPR requirements. PPL EU's preference for IPR is the SEL-751 relay package. Note that failure of the single microprocessor-based relay will disable the protection. For that reason, PPL EU requests that a backup relay be installed. Suitable choices for backup are the SEL 351-1 or SEL-751 packages. Note that the SEL-751-A is not allowed. The alternative would be to disconnect the generation in the event that the single relay is out of service. The website addresses are noted below:

https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallel-generation-requirements-distribution12kVandbelow.pdf?la=enPoint-of-Contact (POC) Recloser

PPL Relay Test personnel will require a written commissioning procedure proposed by the IPP's contractor. This procedure should cover a step-by-step listing of the tests required to ensure that the IPP's schemes operate properly. This commissioning procedure should be supplied to PPL EU at least two weeks prior to the scheduled in-service testing process. The generator shall provide a detailed procedure of the initial phase-out and synchronization to PPL EU, which must be reviewed and approved by PPL EU prior to actual synchronization. Additional details on the customer point of contact requirements can be found on PPL's Point of Contact Requirements for Distribution Voltage Customer-Owned Facilities document:

https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/point-of-contact-requirements-12kV.pdf?la=en

A point of contact recloser, to be provided by PPL EU and paid for by the customer, will be required at the customer's point of interconnection. Additional details on the customer point of contact requirements can be found on PPL EU's Point of Contact Requirements for Distribution Voltage Customer-Owned Facilities document, linked above.

8.4 Other Requirements

If PPL EU needs to operate the system in an abnormal configuration so that the customer is served by a different line, the customer may be asked to turn off their generation while abnormally configured. PPL EU also reserves the right to change the normal source to the customer as required by system conditions.

In addition, information about requirements for a 12.47 kV service can be found at PPL EU's Rules for Electric Meter and Service Installations website:

https://www.pplelectric.com/at-your-service/electric-rates-and-rules/remsi.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:

- 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.

PPL EU also requires that the customer install SCADA at the common generator bus to provide PPL EU with real time operation parameters, including, but not limited to amps, voltage, MW, MVAR, power factor, etc. The SCADA system shall meet PPL EU SCADA standards and will primarily be for monitoring purposes but will provide PPL EU the ability to remotely disconnect the solar generation in emergency conditions. Additional details on the SCADA requirements for generators connecting to the PPL EU distribution system can be found in PPL EU's Relay and Control Requirements for Parallel Operation of Distributed Generation, which may be found on the PPL EU website or at the following link:

https://www.pplelectric.com/-/media/PPLElectric/At-Your-Service/Docs/transmission-services/parallelgeneration-requirements-distribution12kVandbelow.pdf?la=en

10 Summer Peak - Load Flow Analysis

The Queue Project AG1-336 was evaluated as a 5 MW (Capacity 3.8 MW) injection at the Hunter 12.47 kV substation in the PPL area. Project AG1-336 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-336 was studied with a commercial probability of 100.0 %. 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

10.5 System Reinforcements - Summer Peak Load Flow - Primary POI

11 Short Circuit Analysis

The following Breakers are overdutied:

None.

11.1 System Reinforcements - Short Circuit

None.

12 Affected Systems

12.1 NYISO

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

13 Attachment 1: One Line Diagram