Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-071

Lackawanna-Paupack 230kV
8.74 MW Capacity / 67.25 MW Energy

June 2019

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff §207, as well as the Facilities Study Agreement between Waymart Wind II, LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). The Interconnected Transmission Owner (ITO) is PPL Electric Utilities (PPL EU).

General

The IC has proposed to interconnect a wind generating facility with a total capability of 67.25 MW, with 8.74 MW of this output being recognized by PJM as Capacity. The generation facility is planned to be located in the Wayne, Lackawanna and Susquehanna Counties of Pennsylvania, which is part of the PPL Electric Utilities (PPL EU) Northeast region. The proposed in-service date as stated in the Attachment N for the AC1-071 project is December 2018. Subsequently, the IC revised the requested in service date to 10/15/2020. **This study does not imply a PPL EU commitment to this in-service date.**

Point of Interconnection

AC1-071 will interconnect with the ITO transmission system via a new breaker and a half switching station tapping the Lackawanna – Paupack 230kV.

Cost Summary

The AC1-071project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 14,448,000
Non Direct Connection Network Upgrades	$ 5,626,000
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 20,074,00**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Waymart Wind II, LLC, the Interconnection Customer (IC), has proposed to interconnect a wind generating facility with a total capability of 67.25 MW, with 8.74 MW of this output being recognized by PJM as Capacity. The generation facility is planned to be located in the Wayne, Lackawanna and Susquehanna Counties of Pennsylvania, which is part of the PPL Electric Utilities (PPL EU) Northeast region. The proposed in-service date as stated in the Attachment N for the AC1-071 project is December 2018. Subsequently, the IC revised the requested in service date to 10/15/2020. This study does not imply a PPL EU commitment to this in-service date.

Point of Interconnection:

The IC's collector substation is assumed to be located approximately 0.7 miles from the existing Lackawanna-Paupack (LACK-PAUP) 230kV transmission line. In order to interconnect with the PPL EU transmission system, a new PPL EU 230kV switchyard is required. The IC has proposed the switchyard to be located 0.1 miles from the collector substation. The new 230kV switchyard will connect the LACK-PAUP 230kV line and the generator lead line from the IC's collector bus. The Point of Interconnection (POI) will be where the IC generator lead line terminates (with insulators) at the first dead end structure inside the new 230kV interconnection switchyard. The communication POI will be at the fiber splice box located at the base of this dead-end structure. Refer to Attachment 1 and 2 of this Facilities Study report for more information.

2. Amendments to the System Impact Study data or System Impact Study Results

PPL EU has updated its standards in regard to the layout of the 230kV interconnection switchyard. PPL EU now requires a two bay Breaker and a Half switchyard—one bay fully built out for breaker and a half, and one bay initially populated as double breaker using one bus and one tie breaker in the 2nd bay. Refer to Attachment 1 of this Facilities Study report for a single line diagram representation of the switchyard. The new standard, which includes the 230kV general arrangement and one-line diagrams, is available on the PJM website at the following link:

https://www.pjm.com/planning/design-engineering/to-tech-standards/private-ppl.aspx

Additionally, the project's estimated costs and construction schedule have been refined in this report and differ from that which was presented in the Feasibility and System Impact Study reports.

3. Interconnection Customer's Submitted Milestone Schedule

- Substantial site work completed 7/31/2020
- Delivery of major electrical equipment 8/1/2020
- Commercial Operation 10/15/2020

4. Scope of Interconnection Customer's Work

The AC1-071 generating facility will consist of twenty-seven (27) GE 2.3 and three (3) GE 1.7 wind turbines collected through twenty-seven (27) 2.42 MVA GSUs and three (3) 1.85 MVA GSUs stepping up the voltage from 0.69kV to 34.5kV. The main GSU then steps the voltage from 34.5kV to 230kV.

The turbines were modeled as one unit and will inject 67.3 MW into the PPL EU's system.

Per the AC1-071 supplied data the following was used in modeling the generator and the GSU:

AC1-071 Generator:

GE 1.7 Wind Turbine:

- Number of Turbines: 3
- Size: 1.715 MW per turbine
- MVA Base: 1.889 MVA
- Voltage Level: 0.69 kV

GE 2.3 Wind Turbine:

- Number of Turbines: 27
- Size: 2.3 MW per turbine
- MVA Base: 2.421 MVA
- Voltage Level: 0.69 kV

Transformers:

GSU (Generator Step Up Transformer):

- Number of machines per GSU: 30
- Rating: 45 MVA
- MVA Base: 45 MVA
- Voltage Levels: 230/34.5 kV
- Impedance: 8%

GSU (Wind Turbine unit):

- MVA Base (GE 1.7 Wind Turbine) : 1.85 MVA
- MVA Base (GE 2.3 Wind Turbine): 2.385 MVA
- Voltage Levels: 34.5/0.69 kV
- Impedance: 5.8%

IC Transmission Line (Generator Lead Line):

- Voltage Level: 230kV
- MVA Base: 100 MVA

- Length: ~0.1 miles

The IC is responsible for the design, construction and costs for all attachment facilities associated with Queue AC1-071 on the IC side of the POI as shown on the one-line diagram in Attachment 1.

IC Attachment Facilities Work

Note: The transmission scope of work below on the IC side of the POI is for informational purposes only. The associated costs for this scope of work are not included in the total estimated cost of this Facilities study. It involves the following:

- Building a new 230kV line (approximately 0.1 miles) from the new proposed 230kV switchyard to the AC1-071 generating substation dead-end structure.
- Installing dual OPGW (approximately 0.1 miles) from the new proposed 230kV switchyard to the AC1-071 generating substation dead-end structure.

The 230kV transmission and OPGW lines between the generator substation dead-end structure and the new proposed 230kV switchyard will be built, owned, operated, and maintained by the IC.

Refer to Attachment 2 of this report for more information.

New 230kV Switchyard Work

The IC is responsible for the following with regards to the new 230 kV switchyard; all work must be performed to PPL EU Standards and specifications:

- All real estate, siting, right of way, vegetation, and permitting scope of work for the new 230 kV switchyard per PPL EU Standards and specifications.
- Geotechnical studies, including but not limited to mining and core boring, per PPL EU Standards and specifications
- Design and construction of the access road per PPL EU Standards and specifications. This includes all required enhancements to existing PPL EU transmission access roads.
- Grading of the new 230 kV switchyard per PPL EU Standards and specifications (design and construction)

PPL EU will only grant acceptance upon satisfactory demonstration of adherence to all Standards and specifications.

IC Protective Relaying Requirements

At a minimum, the IC shall install the following relaying equipment at their substation for protection of the 230kV generator lead line:

- Two (2) SEL-411L relays for primary and backup protection, including DTT

The above relaying equipment shall communicate with their respective matching relaying equipment, via individually dedicated fiber optic circuits, at the new 230kV interconnection switchyard.

The IC will also need to install suitable protection and control equipment at its facilities based on PPL EU parallel generation requirements. This includes IPR, POC and DTT relaying equipment. Refer to the PJM website addresses shown below for the IPR and POC requirements:

IPR Requirements

https://www.pjm.com/-/media/planning/plan-standards/private-ppl/parallel-generation-requirements.ashx?la=en

IC Substation Intertie Protective Relaying (IPR) and Point of Contact (POC) Fault Interrupting Device (FID) Requirements

IPRFIDs

Based on the latest conceptual single line diagram provided by the IC, the IPR FIDs, up to three (3) 34.5kV rated circuit breakers in this case, shall be equipped with dual trip coils and capable of interrupting worst-case scenario fault currents with a rated speed of three (3) cycles or less. The IPR FID circuit breakers shall be operated by their respective IPR and DTT relaying equipment.

POCFIDs

The IC provided POC FID, one (1) 230kV rated circuit breaker in this case, shall be equipped with dual trip coils and capable of interrupting worst-case scenario fault currents with a rated speed of two (2) cycles or less. The POC FID circuit breaker shall be operated by its respective primary, backup, and DTT, relaying equipment.

IC Voice Communication Circuit Requirements

PPL EU will require an independent communication path for one (1) voice circuit. The IC will be responsible for providing reliable voice communication attachment facilities. The voice communication path is required to allow direct communication between PPL EU and the IC Operations personnel.

All installation, maintenance, and monthly lease or billing charges for the communications facilities are the responsibility of the IC.

IC Generator Harmonic and Flicker Requirements

On the PPL EU 230kV system, the total harmonic distortion to the fundamental voltage wave from a single customer is limited to 1.0% of nominal. In addition, no individual harmonic component can exceed 0.7% of the fundamental system voltage. If PPL EU discovers that objectionable harmonics in excess of the stated limits are being injected into the system from the IC equipment, then the IC will be responsible for taking corrective measures to mitigate harmonic currents.

The IC must limit the severity of their voltage variation to within a level which will not cause objectionable flickers to other customers. A voltage drop greater than 5% at the POI is not acceptable. The frequency and severity of the voltage variation will be considered when determining whether the IC equipment is violating PPL EU flicker guidelines. PPL EU uses the General Electric flicker-irritation curves as a guideline to determine if the system is operating within acceptable limits. **PPL EU will require corrective actions by the IC if their operation causes flickers that exceed PPL EU guidelines.** One such correction could be the installation of static VAR compensators (SVC) to hold a constant voltage.

IC Generator Regulation and Reactive Support Requirements

As specified in Part VI, Attachment O Appendix 2 at 4.7.1.1 of the PJM Open Access Transmission Tariff (OATT), the IC generator shall design its Customer Facility to maintain a composite power factor delivery at continuous rated power output at the generator terminals at a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs).

IC Generator Voltage Schedule Requirements

PPL EU preliminary load flow studies have indicated that the AC1-071 generation should maintain the required voltage regulation of **234kV** with a +/- **4kV** bandwidth, based on the latest IC machine and step-up transformer data received at the time of this Facilities study.

PPL EU requires that the IC has a power factor delivery at continuous rated power output, at the high-side of the facility substation main transformer, of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs).

A final voltage schedule will be determined before the commercial operation date of the AC1-071 project, based on the "as-built" IC machine and step-up transformer data received.

IC PA PUC Certification & Environmental Requirements

The IC shall provide all required land and right of way (ROW) to PPL EU at no cost to PPL EU for the switchyard and transmission tie-in lines. To avoid overlap of permitting boundaries and duplication of permitting efforts and costs, PPL EU requires that the IC share pertinent information with PPL EU during the permitting process. Since the IC chooses to self-perform the ROW acquisition, then the IC shall purchase the PPL EU standard bundle of rights.

PA PUC approval is required prior to the initiation of construction of the 230kV tap lines between the LACK-PAUP 230kV lines and the 230kV switchyard. PPL EU will prepare and submit a Letter of Notification (LON) seeking PA PUC approval for these facilities. The lead time required for preparing the LON and PA PUC decision is approximately 15 months. PPL EU will determine the environmental impacts and mitigation strategies (if any) of the facilities being certified (i.e., the transmission lines). These costs to address environmental impacts are not included in the final estimate of this Facilities Study report.

IC Real Estate, Right of Way Acquisition, and Permitting Requirements

The IC will be required to follow the technical standards, requirements, and procedures for the acquisition and permitting of real estate and right-of-way (ROW). These requirements must be followed if the IC is to acquire real estate or ROW to be owned by PPL EU.

Refer to the link shown below to obtain these requirements:

https://pjm.com/-/media/planning/plan-standards/private-ppl/5474-re-row-acq-and-permit-req-proced-for-ipps.ashx?la=en

IC Distribution Service Requirements

The IC must submit a request for electric service through PPL EU Industrial and Commercial Services (ICS) group if back-up electric service is required at a voltage less than 69kV. The ICS Help Desk can be reached at 1-888-220-9991. Cost for distribution electric service is NOT included in the PPL EU scope of work transmission or substation estimates.

IC Alternate Outlet for Generation Operation during PPL EU Maintenance

During maintenance, Queue AC1-071 facility will be able to generate into the PPL EU network via the LACK-IPP Switchyard 230kV line or the IPP Switchyard-PAUP 230kV line. PPL EU's on-going annual and long-term planned maintenance of these circuits may require PPL EU to remove them from operation for an outage period of up to two (2) weeks. The actual duration may be shorter. The circuits may or may not be returned to service during the evening hours. That decision depends on the type of work being performed. Unexpected and unplanned maintenance outages are not included in the above duration time.

Annual inspections that uncover damaged poles, conductors, or hardware, which require immediate repair, are scheduled as soon as possible. These types of unplanned outages may last up to 24 hours.

5. Description of Facilities Included in the Facilities Study

All the facilities located on the PPL EU side of the POI will be built, owned, operated and maintained by PPL EU. This includes the PPL EU's transmission line and fiber tie-in work, the 230kV interconnection switchyard and any necessary remote-end work.

All facilities located on the IC side of the POI will be built, owned, operated and maintained by the IC, unless otherwise specified. This includes the generator lead line with fiber between the IC's collector bus and the new interconnection switchyard, the collector substation and any other generation facilities. The IC is also required to procure and acquire all the land necessary for the new 230kV switchyard, and all associated easements and Right of Way (ROW).

This study report includes the scope, cost estimates, milestone schedules, and assumptions for the engineering, design and construction work of the facilities located on the PPL EU side of the POI. Other facilities scope of work, unless otherwise specified, (i.e. on the Interconnection customer side of the POI including real estate, siting, permitting, environmental, etc.) are not included in this Facilities Study report and must be evaluated by the IC to capture the complete scope, cost and schedule for the AC1-071 project.

6. Total Costs of Transmission Owner Facilities included in Facilities Study

The estimated total cost for the Transmission Owner facilities scope of work for the AC1-071 project is approximately **$20,074,000**. The IC will be fully responsible for the following costs as identified in the following tables:

Description	Estimated Cost
Attachment Facilities	
	$ 0
Direct Connection Facilities	
230kV Interconnection Switchyard	$ 14,448,000
Non-Direct Connection Facilities	
230kV Transmission Tie-In work (w/ fiber)	$ 5,410,000
Lackawanna 230kV substation work	$ 108,000
Paupack 230kV substation work	$ 108,000
Total Estimated Cost	**$ 20,074,000**

Category	Estimated Cost
Direct Labor	$ 11,424,000
Direct Material	$ 6,753,000
Indirect Labor	$ 1,082,000
Indirect Material	$ 815,000
Total Estimated Cost	**$ 20,074,000**

The total estimate above is based on the assumptions stated in this Facilities Study report. This estimate is dependent upon the assumptions made for the switchyard location and orientation. The estimate also excludes any applicable state or federal taxes. If at a future date Federal CIAC (cost in aid of construction) taxes are deemed necessary by the IRS or other governing taxing authority for this project, both PJM and PPL EU shall be reimbursed by the IC for such taxes.

7. Summary of Milestone Schedules for Completion of Work Included in Facilities Study:

The milestone schedule to accommodate the interconnection of the AC1-071 project would depend on the project's start date and outage feasibility of required facilities. PPL EU's outage windows for construction are typically available in the spring and fall. Missing an outage window could result in significant project delays.

The estimated time frame for the completion of the direct connection and non-direct connection is approximately **21 months** after the PJM three-party ISA and ICSA are signed, and the

Construction Implementation kick-off is held. This study does not imply a PPL EU commitment to this estimated schedule.

PPL EU will commence siting, engineering design, material purchase and construction of the facilities on the PPL EU side of the POI after receiving written authorization by PJM to begin work and after receiving all required information from the IC. PPL EU will not begin the full development of those facilities until all concerns around the land for the switchyard, siting, permitting, environmental, geotechnical, and right of way impacts are addressed and mitigated. Any required mitigation may extend the schedule provided in this Facilities Study report. Similarly, any failure by the IC to timely provide permitting, environmental, and geotechnical deliverables will extend the schedule.

Milestone-Activity	Date
Customer Down Payment Received/PJM Notification to Proceed (NTP)	11/1/2019
Right of Way Acquisition	ROW performed by IPP
PPL EU Engineering, Permitting, Siting Start, receipt and PPL EU approval of required environmental and geotechnical studies	12/18/2019
Letter of Notification Submittal (LON)	2/12/2020
PA PUC Approval of LON	8/12/2020
Engineering End	12/6/2020
PPL EU Approval of the Grading of the Switchyard Site, Permitting, and Substation Access Road	10/11/2020
Pre-Outage Construction Start	11/15/2020
Outage Construction Start	6/29/2021
Outage End and Backfeed to Switchyard	8/1/2021

Assumptions:

The following assumptions were made in preparing the Facilities Study report:

a. All real estate, siting, right of way, vegetation, geotechnical, and permitting scope of work for the new 230kV switchyard will be performed by the IC, reviewed and approved by PPL EU.
b. All siting, right of way, vegetation, and permitting scope of work for the new Transmission Tie-In work will be performed by PPL EU.
c. The Engineering, Permitting, Siting start date is contingent upon the IC's turnover and PPL EU's approval of all required property and switchyard information.
d. IC permitting, substation grading, and access roads have been completed and approved by PPL EU by 10/11/2020
e. A Letter of Notification (LON) for the siting of the Transmission Tie-In work will need to be filed with the PA PUC by PPL EU. PA PUC approval is required prior to the initiation of construction of the 230kV tap lines. The IC is responsible to supply all required documentation/information (i.e. final 230kV switchyard orientation and location) needed to prepare the LON. This review timeline for the LON is outside of PPL EU's control and is contingent upon PUC's schedule.
f. It is assumed that 30% engineering of the 230kV tap lines is completed 30 days prior to the LON submittal.
g. Lead-time to obtain custom-designed steel transmission poles is approximately 32 to 42 weeks.
h. There are no delays due to equipment delivery, environmental, regulatory, permitting, siting, real estate, and extreme weather events.
i. There are no geotechnical issues will be encountered during construction. Soil conditions are assumed to be suitable for standard ground-grid and foundation installations.
j. PPL EU will own the Revenue Metering equipment (Current Transformers, Potential Transformers and Meters) at the new 230kV interconnection switchyard. The Revenue Metering costs are included in the above estimate.
k. Suitable line/equipment outages can be scheduled as required. Failure to meet a scheduled facility outage may result in project delays.
l. All ROW and easements are secured by the anticipated construction start date.
m. During construction, if extreme weather conditions or other system safety concerns arise, field construction may need to be rescheduled, which could possibly delay the schedule.
n. In the event of any operational, governmental, and/or environmental regulatory delays, the use of additional resources, such as overtime, premiums for expedited material, and/or contractor labor, may enable PPL EU to decrease this construction period but no guarantees can be made.
o. The ISA/ICSA must be signed by the IC, PJM, and PPL EU before any PPL EU design and construction activities may commence.

p. The IC will purchase the property rights needed for PPL EU's facilities and transfer the rights to PPL EU per PPL EU' standards and procedures.
q. Acceptance of the land to be owned by PPL EU is subject to the IC clearing all objections to the 100 year title search and mitigating any identified environmental and geotechnical risks per PPL EU Standards and specifications.
r. The final grading of the new switchyard must be performed by the IC and accepted by PPL EU by the date established in the schedule above.
s. The expected in-service date of the AC1-071 project is dependent upon the NTP date established with PJM and the IC.

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

None

2. Transmission Line – Upgrades

PJM Network Upgrade Number n5924

Tie in the interconnection Switchyard to the Lackawanna-Paupack 230kV line

PPL EU will be performing the design, procurement, and construction to install new tie-line facilities to the new switchyard. Two (2) new single circuit 230kV tie lines will be required to break the existing LACK-PAUP 230kV line. The existing LACK-PAUP line will be re-designated: one 230kV line will run from Lackawanna substation to the new PPL EU 230kV switchyard and another 230kV line will run from the new PPL EU 230kV switchyard to Paupack substation. The existing 1590 ACSR conductor will transfer to new structures and new 1590 ACSR conductor will be installed for each 230kV tie line. A fiber path will be installed for each 230kV tie line connecting to the existing fiber path into the new switchyard.

Following is a more detailed summary for the break-in and tie-in of the LACK-PAUP 230kV line:

- Tap the existing LACK-PAUP 230kV line between structures 58810N49395 and 58808N49438
- Install two (2) new dead-end foundation monopoles to route the Lackawanna and Paupack lines to the new switchyard located at approximately 59116N49233
- Install three (3) new double circuit custom foundation suspension monopoles in the new corridor
- Install a new custom two foundation dead-end monopole outside the new switchyard and terminate the Lackawanna and Paupack lines in the associated bays
- The new lines are to be single bundle 1590 ACSR conductor with dual 48-count OPGW
- New tap length will be approximately 0.7 miles
- Extend .752" 48 count OPGW on the AC1-071 Switchyard to Paupack tap to pole 58808N49438 and tie into existing splice box. Extend .752" 48 count OPGW on the

AC1-071 Switchyard to Lackawanna tap to pole 58810N49395. Train OPGW down pole 10/95 and tie over to pole 58781N49350. Splice OPGW into existing splice box on pole 81/50

3. New Substation/Switchyard Facilities

PJM Network Upgrade Number n5900

New 230 kV Breaker and A Half Interconnection Substation

PPL EU will perform the design, procurement, and construction to install a two Breaker and a Half bays switchyard—one bay fully built out for breaker and a half (designated as Bay 1), and one bay initially populated as double breaker using one bus and one tie breaker (designated as Bay 2). The new IC generator lead line and the PPL EU line from the Paupack Substation will terminate in Bay 1. The PPL EU line from the Lackawanna Substation will terminate in Bay 2.

The switchyard will include all required foundations, grounding, support structures, termination structures, cabling, raceway and bus work. Also, the switchyard will include a new pre-fabricated control cubicle with protection, control and SCADA equipment; AC & DC power supply with battery system; metering equipment; yard lighting, signage and perimeter security system.

Following is a more detailed summary of the direct connection work that will be required for the proposed 230kV interconnection switchyard:

Physical & Electrical

- Develop all engineering packages including BOM, construction support and close-out in compliance with PPL EU Standards and Specs:
  - Rigid- and Strain- Bus Calculations. New bus work shall be designed with appropriate structural and electrical properties to accommodate the ultimate fault levels
  - AC and DC loading, short-circuit, coordination studies and arc-flash calculations
  - Lightning protection calculations
  - Cable and conduit sizing calculations
  - Station Ground Grid design. Involves Grounding Study to determine safe step and touch voltages based on soil resistivity and grid resistance test
  - Equipment sizing and selection, as applicable
  - Pre-Fabricated Control Cubicle designed to the ultimate development of the switchyard
  - Underground Cable (Power, Control and Fiber Optic) raceway and conduit design.
  - Complete AC and DC Station Service Infrastructure.
  - Yard lighting and Perimeter Security System design.
  - Geotechnical Investigation and Site Survey
  - Equipment and Structural Foundation Design including loading calculations.

  - Structural Steel Design Package including loading calculations.
  - Access Roads Design Review
- Provide testing, commissioning and start-up of all metering equipment.

Major Equipment included in the 230kV Switchyard (Physical & Electrical)

This list is meant to outline major equipment only. PPL EU does not represent that all equipment has been captured in this Facilities Study report. The full BOM will be captured during engineering.

- Line Deadend Support Structure, 3-phase, 230kV Qty. 3
- Bus Deadend Support Structure, 3-phase, 230kV Qty. 4
- CCVT & SA combined Support Structure, 3 phase, 230 kV Qty. 3
- Bus CCVTs (6 nos.) mounted on the Bus Deadend
- CCVT, 1-phase, 230kV, 132.8kV-67/115V Qty. 15
- Surge Arresters Support Structure, 3-phase, 230kV (9 Surge Arresters located on CCVT structures) Qty. 2
- Surge Arresters, 1-phase, 230kV Qty. 15
- Circuit Breaker, Dead Tank, 3-phase, 230kV, 3000A, 63kA, 2 cycle Qty. 5
- MOD Switch Support Structure, 3-phase, 230kV Qty. 10
- MOD Switch, 3-phase, 230kV, 3000A Qty. 10
- Lightning masts, 230kV Qty. 6
- Station Service Voltage Transformer (SSVT) Support Structure, 1-phase, 230kV Qty. 6
- SSVT, 1-phase, 230kV, 100kVA, 132.8kV-120/240V Qty. 6
- Station Post Insulator Support Structure, 3-phase, 230kV Qty. 4
- Station Post Insulator, 1-phase, 230kV, 900 kV BIL, 80" High, High Strength Qty. 12
- 18" Deep x 24" Wide Cable Trench Raceway (≈ 1000 feet) Qty. 1
- Level 2 Perimeter Security System (Per PPL EU Standard 2-099) Qty. 1
- Control Cubicle (per PPL EU Standard EU00517973) Qty. 1
  - Automatic Transfer Switch (ATS)
  - Non-Fused Safety Switch(s)
  - AC Power Distribution Panel(s)
  - AC Lighting Panel(s)
  - DC Distribution Panel(s)
  - HVAC Unit(s)
  - Battery Charger(s)
  - Battery Bank(s)

Protection & Control

Develop all engineering packages including BOM, construction support and close-out in compliance with PPL EU Standards and Specs:

- Develop relay protection scheme documents for new IC Switchyard
- Develop relay settings for the three line positions at the new IC 230kV switchyard.

- Review and coordinate all relay settings from the IC
- Required Relaying and Communication Devices:
  - Six (6) SEL-411L relays for primary and backup line control and protection of three (3) lines, including DTT.
  - Three (3) SEL 2440 relays for MOD control of three (3) lines
  - Four (4) SEL-487B relays for primary and backup protection of two (2) busses
  - Two (2) Novatech Orion communication processors with two (2) SEL-2440 relays for SCADA control
- Perform fiber work to include:
  - One (1) fiber optic entry rack to terminate/marshal all fiber optic protection circuits from the Paupack, Lackawanna, and IC facility
  - Fiber optic cable between splice boxes and control cubicle fiber rack
  - Fiber optic cable between control cubicle fiber rack and relay and communication panels
  - Splicing and testing of fiber cable at both ends (PPL EU and IC)

Major Equipment included in the 230kV Switchyard (Protection & Control)

This list is meant to outline major equipment only. PPL EU does not represent that all equipment has been captured in this Facilities Study Report. The full BOM will be captured during engineering.

- Relay/Control Panel, Duplex Style Qty. 12
  - SCADA Control Qty. 2
  - Line Backup Protection including DTT and Breaker/MOD Control Qty. 3
  - Line Primary Protection Qty. 3
  - Bus Primary and Backup Protection Qty. 4
- Fiber Optic Entry Rack Qty. 1
- EU Net High Speed Communications Cabinet Qty. 1
- Metering Cabinet Qty. 1

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade Number n5901 and n5902

Remote protection and communication work at Lackawanna (n5901) and Paupack (n5902).

The protection systems at the remote ends of the LACK-PAUP 230kV line will be modified to support this interconnection. The existing SEL-411L and SEL-421 relays at both remote substations will retain their original functionality providing line current differential primary protection and DCB backup protection respectively. To accommodate the AC1-071 project, the following upgrades are required at PPL EU's Lackawanna and Paupack 230kV Substations:

Develop all engineering packages including BOM, construction support and close-out in compliance with PPL EU Standards and Specs:

- Model IC in CAPE and conduct a wide area short-circuit study from the IC facilities. Identify affected relays and revise settings as needed.
- Revise relay settings at both Paupack and Lackawanna Substations to accommodate the effects of infeed from the IC.
- Revise DTT schemes at both Paupack and Lackawanna Substations to reflect new IC switchyard.
- At Paupack Substation, update all Lackawanna line designations on equipment, panels, and drawings. Items associated with this line should be updated to reference the new interconnection switchyard.
- At Lackawanna Substation, update all Paupack line designations on equipment, panels, and drawings. Items associated with this line should be updated to reference the new interconnection switchyard.

5. Metering & Communications

PJM Requirements

The IC 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.

ITO Requirements

Revenue Metering Equipment Installation at the POI

Installation of revenue grade Bi-directional Metering Equipment will be required in the vicinity of the AC1-071 POI to measure kWh and kVARh. This metering equipment shall be designated as the "Primary" Billing Meter. A "Backup" Billing meter is also required at the POI to serve as a replacement for the primary metering system. PPL EU will review the design of the high voltage metering equipment. PPL EU will specify and supply the required Metering Equipment (including PTs and CTs) as required at the Interconnection Customer's expense.

All metering equipment must meet applicable PPL EU standards as well as being compliant with all applicable requirements of the PJM agreements. The revenue meters should be housed in a control cabinet or similar enclosure (per PPL EU specification) and must be accessible to PPL EU metering personnel.

PPL EU requires real time values of MW, MVAR for IC generation from PJM. Additional transmitted include the following:

- Status of all circuit breakers and motor-operated switches between the customer's point of contact and the generator(s). This would include:
  - High side MOD which separates the customer's facilities from the PPL EUsystem
  - the POC (Point of Contact) breaker

    - the GSU (Generator Step Up) transformer high side breaker
    - the GSU transformer low side breaker, if present
    - the generator breaker
- Status of the generator Automatic Voltage Regulator (AVR)
- Status of the Power System Stabilizer (PSS) if one exists
- Three-phase megawatts and megavars on the high voltage side of each GSU transformer
- Three-phase megawatts and megavars for each station service transformer
- Three-phase megawatts and megavars at each of the generators
- Frequency at the IPP's collector bus
- Three phase voltage at the IPP's collector bus
- Hourly integrated megawatt hours delivered to the PPL EU system
- Hourly integrated megawatt hours delivered to the generation facility
- Status of the direct transfer trip and protective relay equipment

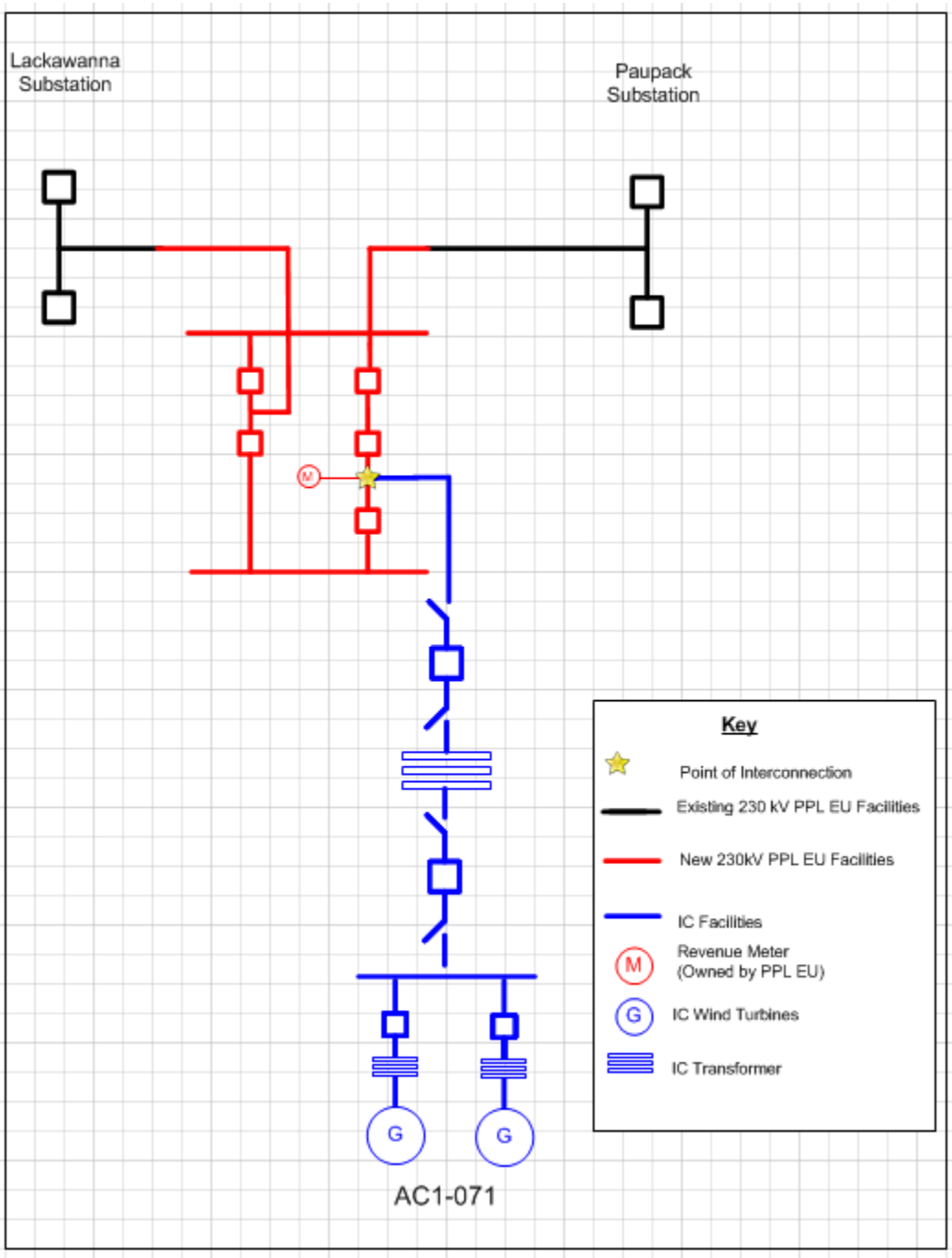
6. Real Estate, Right of Way Acquisition and Permitting Issues

The IC will be required to follow the technical standards, requirements, and procedures for the acquisition and permitting of real estate and right-of-way (ROW). These requirements must be followed if the IC is to acquire real estate or ROW to be owned by PPL EU.

Refer to the link shown below to obtain these requirements:

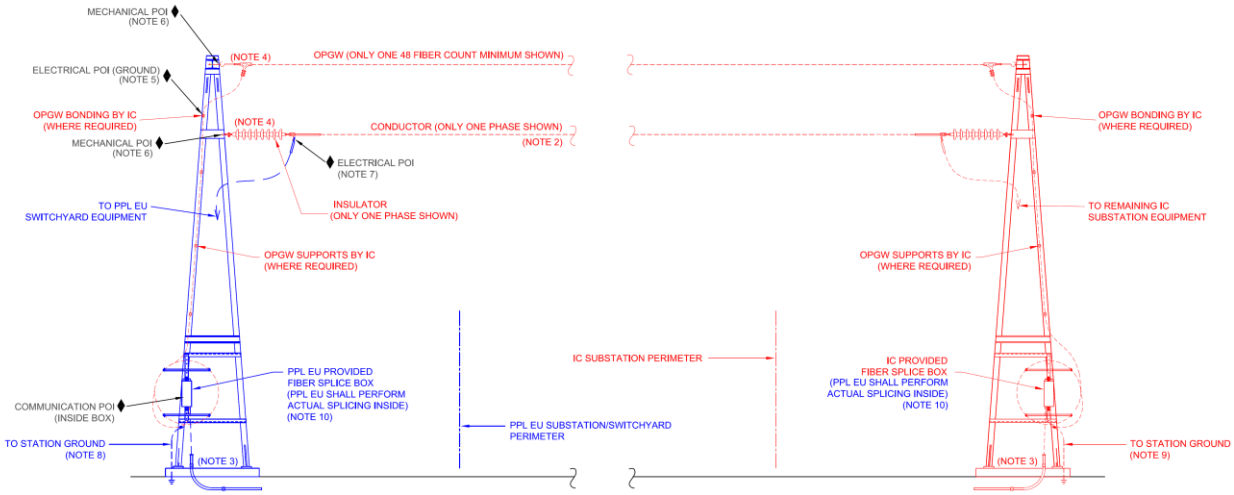
https://pjm.com/-/media/planning/plan-standards/private-ppl/5474-re-row-acq-and-permit-req-proced-for-ipps.ashx?la=en

Attachment 1.
Single Line



The Point of Interconnection shall be located where the IC conductor terminates with insulators at the PPL EU dead-end structure inside the PPL EU 230 kV switchyard

Attachment 2.
AC1-071 POI Details



LEGEND

<PJM QUEUE #> FACILITIES (OWNED BY IC)

PPL OWNED FACILITIES

POI

IC - INTERCONNECTION CUSTOMER

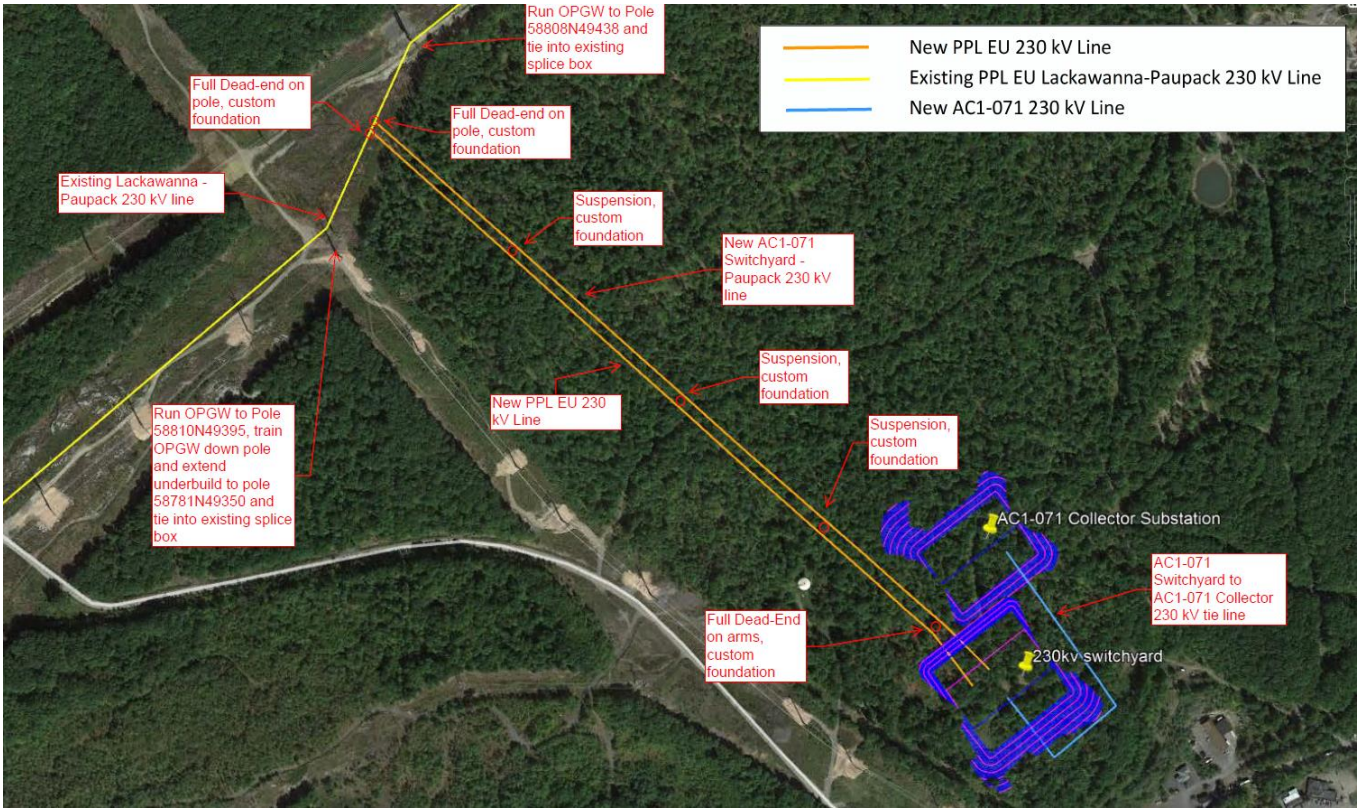
OPGW - OPTICAL GROUND WIRE (FIBER)

POI - POINT OF INTERCONNECTION

NOTES

1. THE INTENT OF THIS DIAGRAM IS TO CLEARLY DELINEATE THE OWNERSHIP BOUNDARIES BETWEEN PPL EU AND THE IC. THIS DIAGRAM IS NOT INTENDED TO ILLUSTRATE ACTUAL DESIGN DETAILS. ANY DETAILS ON THIS DIAGRAM THAT MAY ILLUSTRATE ACTUAL DESIGN DETAILS, IN ANY WAY, ARE PURELY COINCIDENTAL.
2. ONLY ONE PHASE CONDUCTOR IS SHOWN FOR CLARITY. MULTIPLE BUNDLED CONDUCTORS (DOUBLE, TRIPLE, ETC.) PER PHASE MAY ALSO EXIST, BUT ARE NOT SHOWN ON THIS DIAGRAM.
3. THE DEADEND STRUCTURES ILLUSTRATED ARE REPRESENTATIVE OF TYPICAL DEADEND STRUCTURES. ACTUAL DEADEND STRUCTURE TYPES MAY BE DIFFERENT.
4. SEE PPL EU STANDARD ELECTRICAL ASSEMBLIES FOR MORE INFORMATION. THE NUMBER OF INSULATOR SEGMENTS WILL BE DEPENDENT ON THE LINE VOLTAGE AND BASIC INSULATION LEVEL (BIL) RATINGS.
5. THE IC SHALL FASTEN OPGW AND SUPPORT EXCESS GROUND WIRE DOWN THE PPL EU DEADEND STRUCTURE AND COIL NEAR PPL EU PROVIDED FIBER SPLICE BOX.
6. THE IC SHALL PROVIDE AND INSTALL ALL LINE MOUNTING HARDWARE TO CONNECT TO THE PPL EU DEADEND STRUCTURE.
7. PPL EU SHALL PROVIDE AND INSTALL ALL JUMPER LOOP HARDWARE TO CONNECT TO THE IC PHASE CONDUCTOR NEMA PADS.
8. PPL EU SHALL GROUND THE OPGW IN ACCORDANCE WITH PPL EU STANDARD SPECIFICATIONS.
9. THE IC SHALL GROUND THE OPGW AND DEADEND STRUCTURE IN ACCORDANCE WITH PPL EU STANDARD SPECIFICATIONS.
10. PPL EU SHALL PERFORM END-TO-END FIBER TESTING.

Attachment 3.
AC1-071 Switching Station Plan



*switchyard dimensions not to scale