

Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AH1-672

“Farmview 138kV”

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff, as well as the Application and Studies Agreement between the Project Developer and PJM Interconnection, LLC (PJM or Transmission Provider (TP)). The Transmission Owner (TO) is Delmarva Power and Light (DPL).

This Facility Study was performed to satisfy the Phase 2 Facility Study requirement of the PJM Tariff. The Facility Study is intended to provide scope, cost and schedule estimates for the project as currently defined and approved for Phase 2 study. In the event project changes are made during DP2 that impact this report, updates will be provided as part of the Phase 3 report. Following execution of the project's final agreement, this report will not be updated to account for other changes made as part of the agreements modification clause and instead the scope change process will be followed.

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a solar Generating Facility located in Sussex County, Delaware with a designated PJM Project ID of AH1-672. The installed facilities will have a total Maximum Facility Output (MFO) of 75 MW with 48.9 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with the DPL transmission system via a direct connection into the Farmview 138 kV substation.

The proposed generation interconnection is shown on the single line diagram in Attachment#1.

3. POINT OF CHANGE IN OWNERSHIP

The Point of Change in Ownership will be located at the first dead-end transmission structure outside the Farmview Substation fence line.

4. SCOPE OF PROJECT DEVELOPER INTERCONNECTION FACILITIES

Project Developer will design, build, own, operate and maintain the Project Developer Interconnection Facilities on Project Developer's side of the Point of Change in Ownership (PCO). This includes, but is not limited to:

- Circuit breakers and associated equipment located between the high side of the MPT(s) or GSU(s) and the Point of Change in Ownership
- Generator lead line from the Generating Facility to the Point of Change in Ownership
- Relay and protective equipment, telecommunications equipment, and Supervisory Control and Data Acquisition (SCADA) to comply with the TO's Applicable Technical Requirements and Standards

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AH1-672 project to DPL's transmission system. These facilities shall be designed according to DPL's Applicable Technical Requirements and Standards. Once built, DPL will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The DPL Interconnection Facilities will include, but not be limited to, the following.

- One (1) 138 kV dead-end structure and foundation outside the fence of Farmview Substation, to terminate the Project Developer's generator lead line.
- 1590 ACSR "LAPWING" 45/7 single line conductor from the dead-end structure outside the fence of Farmview Substation to the bus position in the switchyard of Farmview Substation.

2. STAND ALONE NETWORK UPGRADES

There are no Stand Alone Network Upgrades associated with this work.

3. NETWORK UPGRADES

The Network Upgrades will include, but not be limited to, the following.

Expanding existing DPL substation:

Farmview Substation Upgrade

The existing substation, Farmview 138 kV, will be expanded/upgraded to interconnect the project with the DPL transmission system.

Major equipment to be installed as part of these upgrades is as follows:

- (1) 145kV, 2000A, 63kA, Clean Air Circuit Breaker
- (3) CCVTs
- (3) 108kV 88kV MCOV Lighting/Surge Arrestors
- (2) 145kV, 2000A, 100kA, 3-Pole Gang Operated Switches
- (1) 145kV, 2000A, 100kA, 3-Pole Gang Operated, w/ Arcing Horns & Quick Break Whips (12' phase spacing) Switch
- (1) Breaker Control Panel (10")
- (1) Line Protection Panel (20")
- (2) SEL-411L (13773F-SEL411L & 13774F-SEL411L) Individual Remote-End Relays

The total Limit of Disturbance (LOD) is expected to be less than 5,000 square feet, therefore it is assumed that only minor site work and restoration will be required. Extent of necessary site work and storm water management to be determined during detailed design.

Total number of pier foundations (of various sizes) will be (24). Total number of slab/mat/spread foundations will be (1).

Installation of grounding conductor, ground rods, and connections from ground grid to new equipment and structures per DPL standards. Ground mats are to be installed at all new switch operator locations.

Total number of structures (of various sizes and configurations) will be (12).

Installation and splicing of OPGW fiber cable from the Project Developer's 138kV transmission line into the substation control house will be required, as well as creation of fiber communications paths between the new AH1-672 interconnection substation and Farmview Substation for the purposes of end-to-end protective relay communications.

AC & DC Distribution System studies will need to be conducted during detailed design to determine the impact to each system by the connection of the new equipment listed in this scope.

If necessary, the extent and configuration of site lighting will be determined by lighting study to be completed during detailed design.

Lightning masts to be located as needed per lightning protection study.

All current DPL substation design and engineering standards are to be followed during detailed design.

Local, state, and environmental permits will be required and are the responsibility of the Project Developer.

Install New Transmission Assets from the Interconnect Substation to the Existing DPL Farmview Substation

Approximately 0.02-miles of new 138kV Circuit will be built to interconnect the project with the DPL transmission system.

Major equipment to be installed as part of these upgrades is as follows:

- (1) 80' Vertical Dead End SC 138kV Steel Pole Assembly
- (1) Drilled Pier Anchor Bolt (8' diameter)

Total approximate linear footage of 1590 ACSR "LAPWING" 45/7 Single will be (550).

Total approximate linear footage of .638" 96-count OPGW will be (175).

Total approximate linear footage of 7#8 AW will be (175).

Approximately 35,000 square feet of matting will be needed.

The circuit will have 0.638" 96-count OPGW end to end and include ADSS entrances at each end into the substation control houses.

All current DPL transmission design and engineering standards are to be followed during detailed design.

Upgrades to Neighboring Facilities:

South Harrington Substation:

Removal of existing 13774F-SEL421 relay from Panel RW. Installation, testing, and commissioning of one (1) new SEL-411L relay installed within existing Panel RW and labeled 13774F-SEL411L.

Milford Substation:

Removal of existing 13773F-SEL421 relay from Panel RAB. Installation, testing, and commissioning of one (1) new SEL-411L relay installed within existing Panel RAB and labeled 13773F-SEL411L.

4. OTHER SCOPE OF WORK

The Other Scope of Work will include, but not be limited to, the following:

- Metering installation work – see Section B-7 below.

5. MILESTONE SCHEDULE FOR COMPLETION OF DPL WORK

Facilities outlined in this report are estimated to take 36 months to construct, from the time of the first PJM Project Kick-Off Meeting. This schedule may be impacted by the timeline for procurement and installation of long lead items, the ability to obtain outages to construct and test the proposed facilities.

Description	Start month	Finish month
Detailed Design	1	16
Permitting	8	20
Construction	20	36

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

- This scope assumes that the Project Developer will have all generation connected behind one Point of Interconnection as required by Exelon Interconnection Standards. If the developer has more than one POI, this scope will need to be revised.
- This scope assumes that the tie-line between DPL and the Project Developer will be built as an overhead transmission line. If either the Project Developer or DPL need to build the tie-line as an underground transmission line, this scope and estimate will need to be revised.
- At a minimum, Lidar will need to be obtained to complete the As-Built process once all Overhead Transmission construction is completed. There could be a need for Lidar prior to the start of design for accurate structure placement during design, separate from the As-Built Lidar.
- This scope assumes that the protection package for the AH1-672 terminal will utilize Line Current Differential protection and that the Project Developer's protection at their substation can communicate with the relays being installed at Farmview Substation. If the protection

methodology ultimately changes, this scope and estimate will need to be revised.

- This scope assumes that there is sufficient available space within the existing control house at Farmview substation to install the additional relay panels and equipment described in the scope section above. Should it be found that sufficient available space does not exist, this scope and estimate will need to be revised.
- A formal alternative route analysis will be performed in subsequent phases of this project; however, it is assumed the existing right-of-way will remain for a large portion of the circuit
- No additional ROW will be required. The new structures will be placed in DPL-owned easement. Detailed design will evaluate any blowout or edge of ROW concerns.
- It is assumed that 1590 ACSR “Lapwing” single conductor will be used for the full length of the project.
- No distribution underbuild, road crossings, distribution crossings, railroad crossings, or waterway crossings will need to be accounted for in the proposed design.
- The OPGW will need to be tied into the control houses at each substation via ADSS. As such, associated fiber entrance projects will be required for this project.
- The following studies will be completed as part of this project, and associated assumptions for each are listed (if applicable):
 - Geotechnical investigation (Soil Boring Report)
 - Assume one (1) boring to depth of 50-feet at every new structure location.
 - Assume no permitting will be required to complete the borings.
 - Wetland Delineation
 - RTE Plant/Animal Surveys
 - Includes Raptor Nest Survey
- The following calculations may need to be completed as part of this project:
 - Voltage Drop Calculations
 - AC Calculations
 - DC Calculations
 - Grounding Calculations (if necessary)
 - Foundation Design Calculations
 - Structural Calculations
 - Rigid Bus Evaluation Calculation
 - Soil Resistivity Analysis (if necessary)

7. REVENUE METERING REQUIREMENTS

All revenue metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AH1-672 GIA, and in PJM Manuals M01 and M14D. The details

of applicable revenue metering requirements are given in the DPL interconnection guideline document posted on PJM website.

The revenue metering will be installed on the Project Developer side of the Point of Change in Ownership, but will be installed, owned and maintained by DPL.

Project Developer will be required to install telemetry equipment at the Point of Interconnection identified in Schedule B of the AH1-672 GIA to provide real-time telemetry data to PJM in accordance with the requirements listed in PJM Manuals 01, 14A, 14B, and 14D. Protective relaying and metering design and installation must comply with the Applicable Technical Requirements and Standards identified in Schedule D of the AH1-672 GIA.

A three-phase 138kV revenue metering point will need to be established within the Generating Facility at the Point of Interconnection. Project Developer will purchase and install all metering instrument transformers as well as construct a metering structure per DPL's Applicable Technical Requirements and Standards identified in Schedule D of the AH1-672 GIA. The secondary wiring connections at the instrument transformers will be completed by Project Developer. The secondary wiring connection at the metering enclosure will be completed by DPL. The metering control cable and meter cabinets will be supplied by the Project Developer and installed by DPL. Project Developer will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined during construction and must be approved by DPL. The meter enclosure must be designed with vehicular access to allow DPL crews the ability to access the location for installation, maintenance, and testing. Project Developer will provide 120V AC uninterruptible power source to the meter cabinet. DPL will provide both the primary and backup meters. DPL will program, install, and own the primary & backup solid-state multi-function meters for the new metering position.

Each meter will be equipped with load profile, telemetry, and DNP outputs. Project Developer will be provided with a single DNP output for each meter. DPL will supply a wireless modem for remote meter interrogation. If a wireless modem is unable to reliably communicate, Project Developer will be required to make provisions with the utility to implement an alternative communication solution. This resulting technology must be approved by DPL and located within approximately three feet of the DPL metering position to facilitate remote interrogation and data collection. It is Project Developer's responsibility to send the data that PJM and DPL require directly to PJM. Project Developer will grant permission for PJM to send DPL the following telemetry that Project Developer sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

DPL's revenue meters will be the official meters and must be the source for reporting generation output to PJM. Project Developer is responsible for installing telemetry equipment necessary to obtain the revenue meter data and submitting the data to PJM.

8. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

This generation project will not require additional land for the interconnection substation, as all new facilities will be installed within the existing substation fence line.

9. APPLICABLE TECHNICAL REQUIREMENTS AND STANDARDS

Applicable Technical Requirements and Standard: The below standards were used by each discipline to develop the scope of work and equipment specified in this document.

Substation

- PHI Substation Design Manual
- S-DM-002 Drawing Identification and Numbering Systems
- S-DM-003 Symbols, Abbreviations, and Nomenclature
- S-DM-004 One-Line and Three-Line Diagrams
- S-DM-005 Bus Arrangements
- S-DM-006 Primary System Design
- S-DM-007 Primary Bus Design
- S-DM-008 Primary Bus Conductor Materials
- S-DM-010 Clearances
- S-DM-012 Surge Arresters, Insulation Coordination, and Lightning Protection
- S-DM-014 Insulators and Bushings
- S-DM-015 Switches and Switching Devices
- S-DM-016 Connections
- S-DM-021 AC Distribution System
- S-DM-022 DC Distribution System
- S-DM-023 Secondary Cables, Wiring, and Panels
- S-DM-026 Instrument Transformers
- S-DM-027 Metering
- S-DM-029 Site Development
- S-DM-030 Substation Grounding
- S-DM-031 Cable Trough, Tray, and Conduit
- S-DM-033 Structure Design
- S-DM-035 Foundation and Wall Design
- S-DM-036 Lighting
- S-DM-039 Permitting and Zoning

Transmission

- TS-5-103 Vertical Dead End SC 138kV Steel Pole Assembly
- TS-12-210 OPGW Splice Point Assembly
- TS-13-122 Glass Dead End Assembly Compression Dead End
- TS-13-130 Polymer Horizontal Jumper Post Trunnion Assembly

10. ENVIRONMENTAL AND PERMITTING

All work to accommodate the interconnection of the AH1-672 Generating Facility is dependent upon the Project Developer obtaining all necessary permits. Moreover, the Project Developer shall be responsible for acquiring all necessary real property rights and acquisitions, including but not limited to rights of way, easements, and fee simple, in a form approved by DPL. Any setbacks in obtaining the necessary real property rights, acquisitions and permits required for this interconnection may delay the construction schedule.

C. APPENDICES

Attachment #1: Single line Diagram for the Physical Interconnection

AH1-672

Farmview 138kV

