Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AG2-380

“Carville 138 kV IV”

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 storage Generating Facility located in Queen Anne's, Maryland with a designated PJM Project ID of AG2-380. The installed facilities will have a total Maximum Facility Output (MFO) of 20 MW with 20 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with the Delmarva Power and Light transmission system via a direct connection into the Carville 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 structure outside the Carville 138 kV 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 AG2-380 project to DPL transmission system. These facilities shall be designed according to DPL Applicable Technical Requirements and Standards. Once built, DPL will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

- A 138 kV Dead-end structure and foundation outside the fence of the Interconnection 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 Carville Substation to the bus position in the switchyard of Carville Substation.

2. STAND ALONE NETWORK UPGRADES

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

3. NETWORK UPGRADES

Expanding existing TO substation:

Carville Substation Upgrade

The existing substation, Carville 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:

Major Substation Equipment to be Installed

- 138kV Circuit Breaker, 2000A, 40kA, 3 cycle (1)
- 138kV Line Disconnect Switch, 2000A, Manual, Quick Break Whips (1)
- 138kV CB Disconnect Switch, 2000A, Manual, with Arcing Horns (1)
- 138kV CCVT, 1-Phase (3)
- 138kV Surge Arresters, 1-Phase (hung on take-off structure) (3)
- 138kV Line Disconnect Switch Stand (1)
- 138kV 3-Phase CCVT Stand (1)
- 138kV Dead-end/Take-off Structure (1)
- 138kV Breaker Foundation (slab) (1)

- 138kV Line Disconnect Switch Stand Foundation (group of piers) (1)
- 138kV 3-Phase CCVT Stand Foundation (group of piers) (1)
- 138kV Dead-end/Take-off Structure Foundation (group of piers) (1)
- Control Cable 4C#10AWG (3,500 ft)
- Control Cable 4C#12AWG (2,000 ft)
- Serial/Fiber Optic Transceiver (SEL-2830) (1)
- Multimode (62.5um) Fiber-Optic Cable (100 ft)
- Single-Mode (1300nm) Fiber-Optic Patch Cable (500 ft)
- Control panel with SEL-451/LOR (10” wide) (1)
- Protection panel with two (2) SEL-487B & two (2) LORs (20” wide) (1)

Major Labor Activities

- Disassemble the existing 138kV bus affected by this scope (approx. 90 linear ft).
- Install 138kV breaker.
- Install Dead-end structure.
- Install 138kV Line & CB Switches.
- Install 138kV CCVTs.
- Install surge arresters.
- Install two 3-inch conduits from new breaker to existing trench.
- Install one 3-inch conduit from new CCVT to existing trench.
- Install three 3-inch conduits from existing trench to IC yard.
- Install four 4C#10 cables between POI breaker and control house termination cabinet, and panels.
- Install two 12C#12 cables between POI breaker and control house termination cabinet, and panels.
- Install four 4C#10 cables between new 138kV breaker and control house termination cabinet, and panels.
- Install two 4C#12 cables between new PT and control house termination cabinet, and panels.
- Rewire CT/PT connections for existing equipment in the termination cabinet to reflect new breaker installment.
- Install one Single-Mode Fiber-Optic Patch cable between panels inside the control house.
- Install one SEL-2830 transceiver on new CB 135-SEL451 relay.
- Install new 20” panel for two (2) SEL-487B

- Install new 10” panel for SEL-451.
- Install wireless modem/communication package for telemetry including copper ethernet connection to existing ethernet switch.
- Relay settings for new CB 135-SEL451, 138kVBUSF-SEL487B, 138kVBUSB-SEL487B.
- Review/update settings for existing adjacent relays.
- RTU points list updates and configurations for existing Orion RTU & ethernet switch.
- Testing and commissioning.

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 AG2-380 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 AG2-380 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 AG2-380 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 AG2-380 GIA.

A three-phase revenue metering point must be established at the Point of Change in Ownership, with no line-loss or transformer-loss compensation provided. The Project Developer is responsible for installing proper equipment to supply real-time telemetry data to PJM. The Project Developer will procure, install, own, and maintain revenue grade instrument transformers, and will provide a metering cabinet and structure in accordance with Exelon's specifications. Placement of metering equipment requires Exelon approval and must be in a secure location with unescorted access for Exelon employees. The Transmission Owner will procure, install, own, and maintain the revenue meter. The Project Developer will complete wiring connections at the secondary of the instrument transformers, terminate at a terminal/shorting block, and supply/install conduit as needed for Exelon to finish wiring and connections at the metering enclosure.

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 PERMITING

All work to accommodate the interconnection of the AG2-380 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

