Generation Interconnection Facilities Study Report

For

PJM Generation Interconnection Request Queue Position AC1-091/092/093/094

"Cedar Creek 138kV I-IV"

March 2021

Table of Contents

A. Transmission Owner Facilities Study Summary

1. Description of Project

The Interconnection Customer (IC), has proposed a 74.3 MW (28.1 MWC) solar generating facility to be located in Townsend, Delaware. PJM studied the AC1-091, AC1-092, AC1-093, & AC1-094 group of projects as an injection into the Delmarva Power & Light Company (DPL) system at the Cedar Creek 138kV Substation and evaluated it for compliance with reliability criteria for summer peak condition in 2020. Although there are four separate queue projects covered as part of this study, all work contained herein is the responsibility of the initiating project, AC1-091.

The substation work required to accommodate this interconnection consists of establishing a 4th 138kV terminal position on Cedar Creek's existing ring bus. This will be accomplished by installing a new 138kV breaker (CB 134) in the "future" position between breakers 130 and 137. This new terminal will require the installation of a 138kV three phase gang-operated line disconnect switch, surge arresters, CVT's, bus support structures and a 138kV takeoff structure. The existing control building at Cedar Creek will require relay upgrades as well as the installation of a new DC supply system.

The IC is required to construct a switching station within 500 feet of Cedar Creek Substation's yard. This station will contain a circuit breaker as well as the revenue metering equipment and will act as the POI. A new transmission line is required to connect the IC station to the new terminal at Cedar Creek Substation. See Attachment #1.

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

The scope of the project as stated in the System Impact Study, submitted in February 2020, has changed. It has been determined that the existing control house DC supply system cannot adequately support this project, therefore a new DC supply system will be required. In addition, the estimates herein provided were performed in more detail than those provided in the Impact Study. The project schedule has also changed due to anticipated start date and project lifecycle schedule.

3. Interconnection Customer's Milestone Schedule

The revised in-service date is August 15, 2023.

Delmarva Power & Light Company's (DPL's) portion of the project is projected to be completed approximately 18-24 months following an executed Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA). This is assuming a standard land use and environmental permitting and approval process.

4. Customer's Scope of Work

The Interconnection Customer (IC) is responsible for all design and construction related to activities on their side of the Point of Interconnection (POI). Site preparation, including clearing, grading and an access road, as necessary, is assumed to be by the IC. The access road design must be approved by DPL to ensure it provides adequate access to the substation to support construction and maintenance activities. Route selection, line design, and right-of-way acquisition for the IC's facilities are not included in this report and are the responsibility of the IC. Protective relaying and metering design and installation must comply with DPL's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

DPL Interconnection Customer Scope of Direct Connection Work Requirements:

- DPL requires that an IC circuit breaker is located within 500 feet of the DPL substation to facilitate the relay protection scheme between DPL and the IC at the Point of Interconnection (POI).

Special Operating Requirements

1. DPL will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker or other method depending upon the specific circumstances and the evaluation by DPL.
2. DPL reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering and telecommunications facilities, owned by DPL.

Additional Interconnection Customer Responsibilities:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

5. Description of Facilities Included in the Facilities Study (DPL's Scope of Work)

Substation Interconnection Estimate

Scope: The Cedar Creek Substation 138kV yard presently consists of a 3-position ring bus with two positions occupied by T1 and AT-20, and one position occupied by Line #13832. This 138kV bus arrangement will be expanded to a 4-position ring bus to accommodate the AC1-091 interconnection.

The ring bus will consist of one terminal and takeoff tower for Line 13832 (to Clayton Substation), one existing terminal for Transformer T1, one existing terminal for Auto Transformer AT-20, and one new terminal for the subject generation's interconnection point. The expansion of this bus will require that a new 138kV circuit breaker, disconnect switches, and new three-phase CVTs to be installed throughout the 138kV yard.

Establishing the IC's terminal position will require the installation of a new 138kV takeoff structure, a three-phase line disconnect switch, and surge arresters. The bus section for this terminal will be equipped with new protective relaying. All new equipment will be installed with associated support structures and foundations. All new equipment will be connected to the station's existing ground grid.

Major Equipment Included in Estimate:

- Power Circuit Breaker, SF6, 145kV, 2000A, 63kA, 3-cycle
- CVT, 138kV Class, 1Ø
- Disconnect Switch, 3Ø, Group Operated, Manual Worm Gear, 145kV, 2000A, Vertical Break with Quick Break Whips, 12' Spacing
- Disconnect Switch, 3Ø, Group Operated, Manual Worm Gear, 145kV, 2000A, Vertical Break with Standard Arcing Horns, 9' Spacing
- Surge Arrester, 108kV Station Class, Polymer
- Insulator, Station Post, 138kV, High Strength, 650kV BIL
- Yard Light, LED (TBD per lighting study)
- 138kV Standard Frontline/Backup Bus Differential Panel, 20"
- 138kV Standard Breaker Control Panel, 20"
- Cable Trench, H-20 Rated
- 125V DC Battery System, 60 cells
- Battery Charger, 125V

Substation Estimate Assumptions:

- The exact sizing of the new 125VDC source system shall be determined by way of a DC system calculation during detailed design.
- No additional lightning protection will be required. This assumption should be verified during detailed design.
- Soil borings and a geotechnical report will need to be obtained if this information is not already available.
- The existing support structures on either side of the "Future CB #134" location are in good condition and can support the proposed disconnect switch installations.

Required Relaying:

The following are the relaying requirements for this project:

- The AC1-091 line/bus will use separate differential relays for front line and back-up protection.
- Protective schemes for T1 and AT-20 will need to be modified to incorporate the new bus arrangement. Stuck breaker schemes will also require modification.

- The new 138kV circuit breaker will use a microprocessor-based relay for breaker control and stuck breaker protection.
- Current and control cables will need to be installed between the IC's control enclosure and the existing substation's trench system. These will be installed in underground conduit.

DPL reserves the right to review the electrical protection design and relay settings for interconnecting customer facilities to ensure that the protective relaying equipment will be compatible with that installed at the remote substations. DPL personnel must be present at the time of commissioning to witness proper function of the protection scheme and related coordination.

Transmission Line Estimate

Scope: A new 138kV transmission line (no longer than 500 feet) will be installed to connect the IC's POI station to Cedar Creek Substation.

Major Equipment Included in Estimate:

- 1590 ACSR Lapwing 45/7 or equivalent
- 138kV Dead-End monopole structures, weathering steel, tapered tube design
- Optical Ground Wire
- Static Wire
- 138kV Dead-End Insulator Assemblies

Transmission Line Estimate Assumptions:

- The new 138kV line connecting the IC's switching station to the take-off tower in Cedar Creek Substation's 138kV yard will be overhead construction and will be constructed by DPL. It is assumed that water and public road crossings are not necessary.
- It is assumed that the stub line connecting the IC's switching station to the POI at Cedar Creek will require two (2) 138kV monopole structures, and that no other intermediary transmission structures will be required.

6. Total Cost of Transmission Owner Facilities Included in the Facilities Study

Item	*Total Cost*
Non-Direct Connection Facilities	$1,799,733
Attachment Facilities	$1,186,515
Total Cost	**$2,986,248**

7. Summary of the Schedule for Completion of Work for the Facilities Study

DPL's portion of the project is projected to be completed approximately 18-24 months following an executed Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA).

Attachment Facility	*Timeframe*
Engineering, Procurement, and Construction	18-24 months

B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by DPL to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

1. Transmission Lines –New

- Install two (2) drilled piers, estimated to be 7' in diameter and 30' long for the two new dead-end monopole structures
- Install two (2) 138 kV dead-end weathering steel monopole structures, tapered tube construction
- Install phase and static wires between the IC's take-off tower and Cedar Creek Substation's take-off tower along with all transmission insulator assemblies and hardware

2. Transmission Lines – Upgrade

Not applicable

3. New Substation/Switchyard Facilities

Not applicable

4. Substation/Switchyard Facility Upgrades

- Install substation equipment grounding in areas of equipment additions
- Install trench, cable and conduit as required
- Install new Control House DC Supply system
- Install thirteen (13) drilled piers for support structures
- Install one (1) 138kV H-Frame takeoff structure, tapered tube design
- Install one (1) disconnect switch, 138kV, 2000A, three-phase, group operated, vertical break, w/ quick-break whips
- Install one (1) 138kV breaker foundation, pad
- Install one (1) 138kV gas circuit breaker, 2000A, 63kA
- Install two (2) disconnect switches, 138kV, 2000A, three-phase, group operated w/ manual worm gear, vertical break with standard arcing horns

- Install three (3) surge arresters, 138kV station class, polymer
- Install one (1) CVT support structure, three-phase, 1-leg
- Install three (3) CVTs, 138kV class, single phase, dual-windings
- Install four (4) 138kV bus support structures
- Install two (2) microprocessor-based relay & control panels
- Install 138kV substation bus, insulators, connectors, etc. as required
- Test and commission all new relay, control, and communications configurations
- Install Digital Revenue Grade Meters
- Update affected substation drawings and documentation

5. Telecommunications Facilities – Upgrades

The new relays will need to be connected to the station's existing GPS clock and Ethernet switches.

6. Metering & Communications

A three phase 138 kV revenue metering point will need to be established within the Interconnection Customer Facilities at the Point of Interconnection. The Interconnection Customer will purchase and install all metering instrument transformers as well as construct a metering structure per the Interconnected Transmission Owner's specifications. The secondary wiring connections at the instrument transformers will be completed by the Interconnection Customer. The secondary wiring connection at the metering enclosure will be completed by the Interconnected Transmission Owner. The metering control cable and meter cabinets will be supplied and installed by the Interconnected Transmission Owner. The Interconnection Customer 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. The Interconnection Customer will provide 120V power to the meter cabinet. The Interconnected Transmission Owner will provide both the primary and backup meters. The Interconnected Transmission Owner 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. The Interconnection Customer will be provided with one meter DNP output for each meter. DPL will supply a wireless modem for remote meter interrogation. In the event that a wireless modem is unable to reliably communicate, the IC will be required to make provisions for a POTS (Plain Old Telephone Service) line or equivalent technology approved by DPL within approximately three feet of the DPL metering position to facilitate remote interrogation and data collection. It is the Interconnection Customer's responsibility to send the data that PJM and Interconnected Transmission Owner require directly to PJM. The Interconnection Customer will grant permission for PJM to send Interconnected Transmission Owner the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

The Interconnected Transmission Owner's revenue meters will be the official meters and must be the source for reporting generation output to PJM. The Interconnection Customer is responsible for installing telemetry equipment necessary to obtain the revenue meter data and submitting the data to PJM.

Additional metering point(s) will need to be established with the local electric distribution company for Station Power should the Customer Facility location reside outside of Transmission Owners franchised service territory.

7. Environmental, Real Estate and Permitting

All work to accommodate the interconnection of AC1-091 is dependent upon the IC obtaining all necessary permits. Moreover, the IC 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. It should be noted the heavy tree clearing is anticipated for the transmission line portion of this project.

8. Summary of Results of Study

Non- Direct Connection Facilities	$ 1,799,733
Attachment Facilities	$ 1,186,515

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. DPL does not expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

DPL reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by DPL.

9. Schedules and Assumptions

The overall estimated timeline for DPL to place its direct connect facilities in service for this project is approximately 18-24 months after receipt of a fully executed Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA).

Storm damage and restoration, time of year limitations, permitting issues, outage scheduling, system emergencies, and contractor and equipment availability could also impact the schedule. It is important to note that this project will be incorporated into the existing project work load at DPL at the time of contract execution. If the work load of existing projects is extensive, resource constraints may cause this project to be delayed beyond the projected in-service date.

Attachment #1