Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AB2-036

"Church-Steele 138 kV"

April 2017
Revised: March 2020

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. 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 System Impact Study is performed.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The Interconnection Customer 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.

General

Cherrywood Solar 1, LLC, the Interconnection Customer (IC), has proposed a 92 MW (34.9 MWC) solar generating facility to be located in Caroline County, Maryland. PJM studied AB2-036 as a 92 MW injection into the Delmarva Power and Light Company (DPL) system at a tap of the Church-Oil City 138 kV circuit and evaluated it for compliance with reliability criteria for summer peak conditions in 2020. The revised in-service date is calculated to be August 31, 2024.

Point of Interconnection

The Interconnection Customer requested a transmission level interconnection. As a result, AB2-036 will interconnect with the DPL system at a new three breaker 138 kV ring bus substation to be constructed adjacent to the Church-Steele 138 kV circuit.

Transmission Owner Scope of Work

Substation Interconnection Estimate

Scope: Build a new 138 kV substation with a 3 position ring bus. Two of the positions on the ring bus will be transmission line terminals for the tie-in of Line 13701 to the substation. The other position will be a terminal configured for the interconnection of a generator.

Estimate: $4,300,000

Construction Time: 24 months

Major Equipment Included in Estimate:

- Control Enclosure, 20’ x 15’ Qty. 1
- Power Circuit Breaker, 138 kV, 2000A, 40kA, 3 cycle Qty. 3
- Disconnect Switch, 138 kV, 2000A, Manual Wormgear, Arcing Horns Qty. 9
- CT/VT Combination Units, 138 kV Qty. 3
- CVT, 138 kV Qty. 6
- Disconnect Switch Stand, High, 138 kV, Steel Qty. 5
- Disconnect Switch Stand, Low, 138 kV, Steel Qty. 4
- CT/VT Stand, Single Phase, Low, 138 kV, Steel Qty. 3
- CVT Stand, Single Phase, Low, 138 kV, Steel Qty. 6
- SSVT, 138 kV/240-120 V Qty. 1
- Relay Panel, Transmission Line, FL/BU (20”) Qty. 3
- Control Panel, 138 kV Circuit Breaker (10”) Qty. 3
- Take-off structure, 138 kV Qty. 2
- Bus Support Structure, 3 phase, 138 kV, Steel Qty. 8

Estimate Assumptions:

- Land purchase for the substation is not included.
- A 3.0 acre, relatively square lot is available for use.
- Site clearing and grading performed by Developer.
- Lightning protection (lightning masts) are not required.

Required Relaying and Communications

New protection relays are required for the new terminals.

An SEL-487 will be required for primary protection and an SEL-387 will be required for back-up protection. One 20” relay panel for each generator terminal will be required for front line and back-up protection.

New protection relays are required for the new line terminals. An SEL-421 will be required for primary protection and an SEL-311C will be required for back-up protection. A 20" relay panel will be required for each transmission line (2 total).

An SEL-451 relay on a 20" breaker control panel will be required for the control and operation of each new 138 kV circuit breaker.

The project will require re-wiring and adjustment of existing relay schemes to accommodate the new 138 kV substation.

The cost of the required relay and communications is included in the Substation Interconnection Estimate.

Metering

Three phase 138 kV revenue metering points will need to be established. DPL will purchase and install all metering instrument transformers as well as construct a metering structure. The secondary wiring connections at the instrument transformers will be completed by DPL's metering technicians. The metering control cable and meter cabinets will be supplied and installed by DPL. DPL will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined in the construction phase. DPL will provide both the Primary and the Backup meters. DPL's meter technicians will program and install the Primary & Backup solid state multi-function meters for each new metering position. Each meter will be equipped with load profile, telemetry, and DNP outputs. The IC will be provided with one meter DNP output for each meter. DPL will own the metering equipment for the interconnection point, unless the IC asserts its right to install, own, and operate the metering system.

The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each Company metering position to facilitate remote interrogation and data collection.

It is the IC's responsibility to send the data that PJM and DPL requires directly to PJM. The IC will grant permission for PJM to send DPL the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

The estimate for DPL to design, purchase, and install metering as specified in the aforementioned scope for metering is included in the Substation Interconnection Estimate.

Interconnection Customer Scope of Work

The Interconnection Customer is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report, and is 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.

Network Impacts

The Queue Project AB2-036 was evaluated as a 92.0 MW (Capacity 34.9 MW) injection into Church-Steele 138kV substation in the DPL area. Project AB2-036 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-036 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Generator Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

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

Steady-State Voltage Requirements

No issues identified

Short Circuit

No issues identified

Stability and Reactive Power Requirement
No issues identified

Delivery of Energy Portion of Interconnection Request

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

1. (PECO - PECO) The LINWOOD-CHICHST1 230 kV line (from bus 213750 to bus 213489 ckt 1) loads from 93.41% to 94.34% (AC power flow) of its emergency rating (1593 MVA) for the single line contingency outage of '220-39'. This project contributes approximately 17.52 MW to the thermal violation.

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CONTINGENCY '220-39'                                    /* $ DELCO $ 220-39 $ L
  TRIP BRANCH FROM BUS 213490 TO BUS 213750 CKT 1               /*
  END
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2. (PECO - PECO) The LINWOOD-CHICHST2 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 93.41% to 94.35% (AC power flow) of its emergency rating (1593 MVA) for the single line contingency outage of '220-43/* $ DELCO $ 220-43 $ L'. This project contributes approximately 17.5 MW to the thermal violation.

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CONTINGENCY '220-43/* $ DELCO $ 220-43 $ L'
  TRIP BRANCH FROM BUS 213489 TO BUS 213750 CKT 1               /*
  END/*         $ DELCO $ 220-43 $ L
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Light Load Analysis - 2020

Not required

System Reinforcements

None

Attachment 1: Single Line Diagram

AB2-036
Church – Steele 138 kV
New 138 kV Substation