Generation Interconnection
Feasibility Study Report
Queue Position AB2-133

The Interconnection Customer (IC) has proposed a 75 MW (32 MWC) solar generating facility to be located in Kent County, Maryland. PJM studied the AB2-133 project at both a Primary and Secondary Point of Interconnection. The study results are provided below. The planned in-service date, as requested by the IC during the project kick-off call, is May 1, 2018. It is not likely that this date can be attained due to the need for remaining studies and construction schedules.

Point(s) of Interconnection

The Interconnection Customer requested a Primary and Secondary Point of Interconnection (POI) be evaluated for the AB2-133 project. Both POIs are at the 69 kV transmission level.

Primary Point of Interconnection

PJM studied the AB2-133 project into the Delmarva Power and Light Company (DPL) system as a direct connection into the Chestertown 69 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2020.

Transmission Owner Scope of Attachment Facilities Work

Substation Interconnection Estimate

Scope: Build a new 5th position onto the 69 kV 4 position ring bus at Chestertown Substation. The new position will be connected to a generator. The project will require the addition of a 69 kV breaker, 3 69 kV disconnect switches, 3 CT/VT combination units, and substation bus. The 69 kV ring bus will extend out to the west of the existing yard, and the substation will be expanded to the west by 40 feet. The 6727 line terminal (to future McCleans Substation, currently to Lynch Substation), will need to be rebuilt.

Estimate: $1,767,000
Construction Time: 24 months

Major Equipment Included in Estimate:

- Power Circuit Breaker, 69 kV, 2000A, 40kA, 3 cycle Qty. 1
- Disconnect Switch, 69 kV, 2000A, Manual Wormgear, Arcing Horns Qty. 4
- CT/VT Combination Units, 69 kV Qty. 3
- Disconnect Switch Stand, High, 69 kV, Steel Qty. 4
- Disconnect Switch Stand, Low, 69 kV, Steel Qty. 2
- CT/VT Stand, Single Phase, Low, 69 kV, Steel Qty. 3
- CVT Stand, Single Phase, Low, 69 kV, Steel Qty. 3
- Relay Panel, Transmission Line, FL/BU (20") Qty. 1
- Control Panel, 69 kV Circuit Breaker (10") Qty. 1
- Bus Support Structure, 3 phase, 69 kV, Steel Qty. 3

- Take-off structure, 69 kV Qty. 1

Estimate Assumptions:

- Substation is capable of being expanded 40 feet to the west.
- Completion of the 4 breaker 69 kV ring bus at Chestertown Substation prior to start of the project.

Required Relaying and Communications

New protection relays are required for the new terminal. 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 line terminal will be required for front line and back-up protection.

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 69 kV terminal.

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

Metering

Three phase 69 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. 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 Chestertown 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.

Summer Peak Analysis - 2020

Transmission Network Impacts

Potential transmission network impacts are as follows:

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

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements
(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be performed during later study phases.

Short Circuit

No issues identified.

Stability and Reactive Power Requirement

To be performed during later study phases.

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

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. (DP&L - DP&L) The MASSEY-MASSYREA 69 kV line (from bus 232201 to bus 232810 ckt 1) loads from 55.03% to 133.97% (DC power flow) of its emergency rating (95 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

2. (DP&L - DP&L) The CHESTRTN-MCCLEANS 69 kV line (from bus 232202 to bus 232211 ckt 1) loads from 43.75% to 112.5% (DC power flow) of its emergency rating (48 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 75.0 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811 / CHURCH - CLOUGH - CHESTERTOWN 69
   END

3. (DP&L - DP&L) The OIL_CITY-STEEL138 138 kV line (from bus 232801 to bus 232103 ckt 1) loads from 67.99% to 85.57% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13808'. This project contributes approximately 31.36 MW to the thermal violation.

   CONTINGENCY 'CKT 13808'
   DISCONNECT BUS 232106/MOUNT PLEASANT - MIDDLETOWN - TOWNSEND 138
   DISCONNECT BUS 232804/MIDDLETOWN 138
   END

4. (DP&L - DP&L) The MASSYREA-CHURC_69 69 kV line (from bus 232810 to bus 232203 ckt 1) loads from 55.12% to 172.3% (DC power flow) of its emergency rating (64 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

5. (DP&L - DP&L) The Y3-033 TAP-MASSEY 69 kV line (from bus 915750 to bus 232201 ckt 1) loads from 56.0% to 136.64% (DC power flow) of its emergency rating (93 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

6. (DP&L - DP&L) The Y3-033 TAP-MASSEY 69 kV line (from bus 915750 to bus 232201 ckt 1) loads from 59.44% to 89.44% (DC power flow) of its normal rating (82 MVA) for non-contingency condition. This project contributes approximately 24.6 MW to the thermal violation.

7. (DP&L - DP&L) The AB2-036 TAP-OIL_CITY 138 kV line (from bus 923950 to bus 232801 ckt 1) loads from 68.09% to 86.28% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13808'. This project contributes approximately 31.36 MW to the thermal violation.

   CONTINGENCY 'CKT 13808'
   DISCONNECT BUS 232106/MOUNT PLEASANT - MIDDLETOWN - TOWNSEND 138
   DISCONNECT BUS 232804/MIDDLETOWN 138
   END

Delmarva Power and Light Costs

Cost estimates will further be refined as a part of the Impact Study and Facilities Study for this project. The Interconnection Customer will be responsible for all costs incurred by DPL in connection with the AB2-133 project. Such costs may include, but are not limited to, any transmission system assets currently in DPL's rate base that are prematurely retired due to the AB2-133 project. PJM shall work with DPL to identify these retirement costs and any additional expenses. DPL reserves the right to reassess issues presented in this document and, upon appropriate justification, submit additional costs related to the AB2-133 project.

Secondary Point of Interconnection

PJM studied the AB2-133 project into the Delmarva Power and Light Company (DPL) system at a tap of the Chestertown-Clough 69 kV circuit and evaluated it for compliance with reliability criteria for summer peak conditions in 2020.

Summer Peak Analysis - 2020

Transmission Network Impacts

Potential transmission network impacts are as follows:

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

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. (DP&L - DP&L) The MASSEY-MASSYREA 69 kV line (from bus 232201 to bus 232810 ckt 1) loads from 55.13% to 134.07% (DC power flow) of its emergency rating (95 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

2. (DP&L - DP&L) The CHESTRTN-MCCLEANS 69 kV line (from bus 232202 to bus 232211 ckt 1) loads from 43.75% to 112.5% (DC power flow) of its emergency rating (48 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 75.0 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811 / CHURCH - CLOUGH - CHESTERTOWN 69
   END

3. (DP&L - DP&L) The OIL_CITY-STEEL138 138 kV line (from bus 232801 to bus 232103 ckt 1) loads from 67.76% to 86.4% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13833'. This project contributes approximately 31.36 MW to the thermal violation.

   CONTINGENCY 'CKT 13833'
   OPEN LINE FROM BUS 232100 TO BUS 232107 CIRCUIT 1/CHURCH - TOWNSEND 138
   END

4. (DP&L - DP&L) The MASSYREA-CHURC_69 69 kV line (from bus 232810 to bus 232203 ckt 1) loads from 55.11% to 172.29% (DC power flow) of its emergency rating (64 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

5. (DP&L - DP&L) The CLOUGH-CHURC_69 69 kV line (from bus 232811 to bus 232203 ckt 1) loads from .52% to 87.05% (DC power flow) of its normal rating (71 MVA) for non-contingency condition. This project contributes approximately 62.06 MW to the thermal violation.

6. (DP&L - DP&L) The Y3-033 TAP-MASSEY 69 kV line (from bus 915750 to bus 232201 ckt 1) loads from 55.99% to 136.63% (DC power flow) of its emergency rating (93 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 74.99 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

7. (DP&L - DP&L) The AB2-036 TAP-OIL_CITY 138 kV line (from bus 923950 to bus 232801 ckt 1) loads from 68.13% to 87.46% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13833'. This project contributes approximately 31.36 MW to the thermal violation.

   CONTINGENCY 'CKT 13833'
   OPEN LINE FROM BUS 232100 TO BUS 232107 CIRCUIT 1/CHURCH - TOWNSEND 138
   END

8. (DP&L - DP&L) The AB2-133 TAP-CHESTRTN 69 kV line (from bus 924800 to bus 232202 ckt 1) loads from .28% to 103.89% (DC power flow) of its emergency rating (72 MVA) for the single line contingency outage of 'CKT 6773'. This project contributes approximately 75.0 MW to the thermal violation.

   CONTINGENCY 'CKT 6773'
   DISCONNECT BUS 232811/ CHURCH - CLOUGH - CHESTERTOWN 69
   END

9. (DP&L - DP&L) The AB2-133 TAP-CLOUGH 69 kV line (from bus 924800 to bus 232811 ckt 1) loads from 6.85% to 93.05% (DC power flow) of its normal rating (72 MVA) for non-contingency condition. This project contributes approximately 62.06 MW to the thermal violation.