

Generation Interconnection Feasibility Study Report Queue Position Y3-033

The Interconnection Customer (IC) has proposed a 150 MWE (19.5 MWC; 150 MW MFO) wind powered generating facility to be located in Kent County, Maryland. PJM studied Y3-033 as a 150 MW injection into the Delmarva Power and Light (DPL) system and evaluated the project for compliance with reliability criteria for summer peak conditions in 2017. The planned in-service date, as stated in the Attachment N, is September 15, 2015.

Point(s) of Interconnection

The Interconnection Customer requested a Primary and Secondary Point of Interconnection (POI) be evaluated for the Y3-033 project. The Primary POI selected was a cut in of the Chestertown-Millington 69 kV circuit. The Secondary POI selected was a cut in of the Churchtown-Townsend 138 kV circuit. The study results are provided in the Transmission Network Impacts section below.

Primary POI Option

Y3-033 will interconnect with the Delmarva Power and Light transmission system at a new 69 kV three (3) breaker ring bus substation to be constructed adjacent to the Chestertown - Millington 69 kV circuit. The Point of Interconnection (POI) will be located at a disconnect switch just beyond the fence line of the new substation.

Attachment Facilities

Transmission Owner Scope of Work

The scope of work and estimated costs for the direct connection facilities is as follows:

Substation Engineering Estimate:

Scope: Construct a 69 kV three-breaker ring bus substation, inclusive of a terminal position for the queue project on the Chestertown - Millington 69 kV line.

Estimate: \$2,000,000

Construction Time: 15 – 18 months, plus any outage delays

Note that it is assumed that the Developer would be responsible for land acquisition for all the new facilities, including the substation. The Developer would also be responsible for the necessary permits to construct these facilities (zoning, storm water management, environmental, etc.) as well as site clearing/grading and entrance road construction. These costs are not included in the \$2.0M estimate.

Transmission Engineering Estimate:

Scope: Cut circuit 6773 and loop into and out of the new substation. Install two (2) self-supporting steel poles with anchor bolt foundations, post construction tangent structures, and short span to DPL substation.

Estimate: \$1,000,000

Construction Time: 12 months

Note: If location of generator is greater than 500 feet from substation, circuit breaker will be necessary

Interconnection Customer 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 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.

The Interconnection Customer will purchase and install all metering instrument transformers as well as construct a metering structure per DPL's specifications. The secondary wiring connections at the instrument transformers will be completed by the interconnection customer's contractors and inspected by DPL, while the secondary wiring work at the metering enclosure will be completed by DPL's meter technicians. The metering control cable and meter cabinets will be supplied by DPL and installed by the interconnection customer's contractors. DPL’s meter technicians will program and install two solid state multi-function meters (Primary & Backup) for the new metering position. Each meter will be equipped with load profile, telemetry, and DNP output. The ownership of metering equipment purchased or installed by the IC shall be transferred to DPL at time of commercial operation, unless the IC asserts its right to install, own and operate the metering system.

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, a line recloser, or other method depending upon the specific circumstances and the evaluation by DPL.
2. It is the Interconnection Customer’s responsibility to send the data that PJM and DPL requires directly to PJM. The Interconnection Customer will grant permission for PJM to send DPL the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator/status, and interval MWH and MVARH.
3. 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.

4. 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.

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, Line with Failed 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)

1. The EDGEMR 5-LINWOOD (DPL - PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) loads from 112.95% to 113.36% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'DP16'. This project contributes approximately 20.39 MW to the thermal violation.

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. The DELCOTAP-MCKLTON (PECO - AE) 230 kV line (from bus 213559 to bus 228401 ckt 1) loads from 115.4% to 115.74% (DC power flow) of its emergency rating (725 MVA) for the bus fault outage of 'CHI230B1/* \$ DELCO \$ CHI230B1 \$ B'. This project contributes approximately 15.11 MW to the thermal violation.

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. The DELCOTAP-MCKLTON (PECO - AE) 230 kV line (from bus 213559 to bus 228401 ckt 1) loads from 115.4% to 115.74% (DC power flow) of its emergency rating (725 MVA) for the line fault with failed breaker contingency outage of 'CHICH045/* \$ DELCO \$ CHICH045 \$ STBK'. This project contributes approximately 15.11 MW to the thermal violation.

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

4. (DPL - PECO) The CLAY-LINWOOD (DPL - PECO) 230 kV line (from bus 231000 to bus 213750 ckt 1) loads from 119.24% to 119.78% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'LINWO225/* \$ DELCO \$ LINWO225 \$ STBK'. This project contributes approximately 27.03 MW to the thermal violation.

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

5. The EDGEMR 5-LINWOOD (DPL - PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) loads from 121.51% to 122.02% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'LINWO115/* \$ DELCO \$ LINWO115 \$ STBK'. This project contributes approximately 25.35 MW to the thermal violation.

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

6. The EDGEMR 5-CLAY (DPL - DPL) 230 kV line (from bus 231001 to bus 231000 ckt 1) loads from 123.0% to 123.49% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'LINWO225/* \$ DELCO \$ LINWO225 \$ STBK'. This project contributes approximately 24.06 MW to the thermal violation.

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

7. The CTYSTLTP-NAAMANS (DPL - DPL) 69 kV line (from bus 231213 to bus 231211 ckt 1) loads from 134.81% to 135.7% (DC power flow) of its emergency rating (119 MVA) for the tower line contingency outage of 'DBL_5NC'. This project contributes approximately 6.49 MW to the thermal violation.

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

Short Circuit

No overstressed breakers were identified.

Stability and Low Voltage Ride Through Analysis

Will be performed during the System Impact study phase of the project.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. Cost allocation for these overloads will be provided in the System Impact Study Report.

1&5. To mitigate the EDGEMR 5-LINWOOD (DPL & PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) overloads will require the following:

DPL portion

Reconductor the circuit along with some pole replacement. The estimated cost to perform this work is **\$9,700,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3570)

PECO portion

Reconductor 0.53 miles of the circuit. The estimated cost to perform this work is **\$4.1M** and will take **4 years** to complete. This cost does not include the time or cost to purchase right-of-way and/or permits to construct if required. The time estimate does not include consideration of line outage availability.

2&3. To mitigate the DELCOTAP-MCKLTON (PECO-ACE) 230 kV line (from bus 213559 to bus 228401 ckt 1) overloads will require the following:

PECO portion

PECO's rating exceeds the line loading so therefore no reinforcement is required.

ACE portion

Upgrade the 2-954 AL 230kV strand bus at Mickleton to 2-1590 AL. The estimated cost to perform this work is **\$74,000** and will take **6-12 months** to complete.

4. To mitigate the CLAY_230-LINWOOD (DPL & PECO) 230 kV line (from bus 231000 to bus 213750 ckt 1) overload will require the following:

DPL portion

Reconductor the circuit along with some pole replacement. The estimated cost to perform this work is **\$1,400,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3568)

PECO portion

Reconductor 0.53 miles of the circuit. The estimated cost to perform this work is **\$4.1M** and will take **4 years** to complete. This cost does not include the time or cost to purchase right-of-way and/or permits to construct if required. The time estimate does not include consideration of line outage availability.

6. To mitigate the EDGEMR 5-CLAY (DPL-DPL) 230 kV line (from bus 231001 to bus 231000 ckt 1) overload will require reconductoring the circuit with some pole replacement. The estimated cost to perform this work is **\$8,500,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3571)
7. To mitigate the CTYSTLTP-NAAMANS (DPL-DPL) 69 kV line (from bus 231213 to bus 231211 ckt 1) overload will require rebuilding the Citysteel Tap-Naamans 69 kV circuit with some pole replacement. The estimated cost to perform this work is **\$1,000,000** and will take **30 months** to complete.

Potential Congestion due to Local Energy Deliverability

(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

These are **not** required reliability upgrades.

1. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 102.77% to 103.05% (DC power flow) of its normal rating (831 MVA) for **non-contingency** condition. This project contributes approximately 14.42 MW to the thermal violation.
2. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 2) loads from 107.77% to 108.07% (DC power flow) of its normal rating (831 MVA) for **non-contingency** condition. This project contributes approximately 15.11 MW to the thermal violation.
3. The X4-020 TAP-3 MILE I (PJM500 - PJM500) 500 kV line (from bus 912130 to bus 200016 ckt 1) loads from 95.38% to 95.65% (DC power flow) of its emergency rating (2598 MVA) for the single line contingency outage of 'PJM17'. This project contributes approximately 43.33 MW to the thermal violation.

4. The MILLNGTN-CHURC (DPL - DPL) 69 kV line (from bus 232811 to bus 232203 ckt 1) loads from 63.24% to 111.6% (DC power flow) of its normal rating (71 MVA) for **non-contingency** condition. This project contributes approximately 124.13 MW to the thermal violation.
5. The CHICHST1-EDDYSTN4 (PECO - PECO) 230 kV line (from bus 213489 to bus 213588 ckt 1) loads from 112.53% to 112.87% (DC power flow) of its emergency rating (863 MVA) for the single line contingency outage of '220-04/* \$ DELCO \$ 220-04 \$ L'. This project contributes approximately 18.35 MW to the thermal violation.
6. The Y3-033 TAP-MILLNGTN (DPL - DPL) 69 kV line (from bus 915100 to bus 232811 ckt 1) loads from 54.31% to 118.1% (DC power flow) of its normal rating (72 MVA) for **non-contingency** condition. This project contributes approximately 124.13 MW to the thermal violation.
7. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 131.0% to 131.47% (DC power flow) of its emergency rating (984 MVA) for the single line contingency outage of '220-39/* \$ DELCO \$ 220-39 \$ L'. This project contributes approximately 28.39 MW to the thermal violation.
8. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 2) loads from 131.45% to 131.92% (DC power flow) of its emergency rating (984 MVA) for the single line contingency outage of '220-43/* \$ DELCO \$ 220-43 \$ L'. This project contributes approximately 28.49 MW to the thermal violation.

Secondary POI Option

PJM studied Y3-033 as a 150 MW injection at a tap of the DPL Church-Townsend 138 kV circuit.

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, Line with Failed 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)

1. The EDGEMR 5-LINWOOD (DPL - PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) loads from 112.95% to 113.35% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'DP16'. This project contributes approximately 19.77 MW to the thermal violation.

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. The DELCOTAP-MCKLTON (PECO - AE) 230 kV line (from bus 213559 to bus 228401 ckt 1) loads from 115.4% to 115.75% (DC power flow) of its emergency rating (725 MVA) for the bus fault outage of 'CHI230B1/* \$ DELCO \$ CHI230B1 \$ B'. This project contributes approximately 15.5 MW to the thermal violation.

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. The DELCOTAP-MCKLTON (PECO - AE) 230 kV line (from bus 213559 to bus 228401 ckt 1) loads from 115.4% to 115.75% (DC power flow) of its emergency rating (725 MVA) for the line fault with failed breaker contingency outage of 'CHICH045/* \$ DELCO \$ CHICH045 \$ STBK'. This project contributes approximately 15.5 MW to the thermal violation.

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

4. The CLAY-LINWOOD (DPL - PECO) 230 kV line (from bus 231000 to bus 213750 ckt 1) loads from 119.24% to 119.79% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'LINWO225/* \$ DELCO \$ LINWO225 \$ STBK'. This project contributes approximately 27.41 MW to the thermal violation.

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

5. The EDGEMR 5-LINWOOD (DPL - PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) loads from 121.51% to 122.03% (DC power flow) of its emergency rating (805 MVA) for the line fault with failed breaker contingency outage of 'LINWO115/* \$ DELCO \$ LINWO115 \$ STBK'. This project contributes approximately 25.65 MW to the thermal violation.

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

6. The EDGEMR 5-CLAY (DPL - DPL) 230 kV line (from bus 231001 to bus 231000 ckt 1) loads from 123.0% to 123.49% (DC power flow) of its emergency rating (805 MVA) for the line fault

with failed breaker contingency outage of 'LINWO225/* \$ DELCO \$ LINWO225 \$ STBK'. This project contributes approximately 24.13 MW to the thermal violation.

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

7. The CTYSTLTP-NAAMANS (DPL - DPL) 69 kV line (from bus 231213 to bus 231211 ckt 1) loads from 134.81% to 135.74% (DC power flow) of its emergency rating (119 MVA) for the tower line contingency outage of 'DBL_5NC'. This project contributes approximately 6.8 MW to the thermal violation.

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

Short Circuit

No overstressed breakers were identified.

Stability and Low Voltage Ride Through Analysis

Will be performed during the System Impact study phase of the project.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. Cost allocation for these overloads will be provided in the System Impact Study Report.

- 1&5. To mitigate the EDGEMR 5-LINWOOD (DPL & PECO) 230 kV line (from bus 231001 to bus 213750 ckt 1) overloads will require the following:

DPL portion

Reconductor the circuit along with some pole replacement. The estimated cost to perform this work is **\$9,700,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3570)

PECO portion

Reconductor 0.53 miles of the circuit. The estimated cost to perform this work is **\$4.1M** and will take **4 years** to complete. This cost does not include the time or cost to purchase right-of-way and/or permits to construct if required. The time estimate does not include consideration of line outage availability.

- 2&3. To mitigate the DELCOTAP-MCKLTON (PECO-ACE) 230 kV line (from bus 213559 to bus 228401 ckt 1) overloads will require the following:

PECO portion

PECO's rating exceeds the line loading so therefore no reinforcement is required.

ACE portion

Upgrade the 2-954 AL 230kV strand bus at Mickleton to 2-1590 AL. The estimated cost to perform this work is **\$74,000** and will take **6-12 months** to complete.

4. To mitigate the CLAY_230-LINWOOD (DPL & PECO) 230 kV line (from bus 231000 to bus 213750 ckt 1) overload will require the following:

DPL portion

Reconductor the circuit along with some pole replacement. The estimated cost to perform this work is **\$1,400,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3568)

PECO portion

Reconductor 0.53 miles of the circuit. The estimated cost to perform this work is **\$4.1M** and will take **4 years** to complete. This cost does not include the time or cost to purchase right-of-way and/or permits to construct if required. The time estimate does not include consideration of line outage availability.

6. To mitigate the EDGEMR 5-CLAY (DPL-DPL) 230 kV line (from bus 231001 to bus 231000 ckt 1) overload will require reconductoring the circuit with some pole replacement. The estimated cost to perform this work is **\$8,500,000** and will take **36 months** to complete. (PJM Network Upgrade Number n3571)
7. To mitigate the CTYSTLTP-NAAMANS (DPL-DPL) 69 kV line (from bus 231213 to bus 231211 ckt 1) overload will require rebuilding the Citysteel Tap-Naamans 69 kV circuit with some pole replacement. The estimated cost to perform this work is **\$1,000,000** and will take **30 months** to complete.

Potential Congestion due to Local Energy Deliverability

(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely

overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

These are *not* required reliability upgrades.

1. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 102.77% to 103.06% (DC power flow) of its normal rating (831 MVA) for **non-contingency** condition. This project contributes approximately 14.61 MW to the thermal violation.
2. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 2) loads from 107.77% to 108.07% (DC power flow) of its normal rating (831 MVA) for **non-contingency** condition. This project contributes approximately 15.31 MW to the thermal violation.
3. The X4-020 TAP-3 MILE I (PJM500 - PJM500) 500 kV line (from bus 912130 to bus 200016 ckt 1) loads from 95.38% to 95.65% (DC power flow) of its emergency rating (2598 MVA) for the single line contingency outage of 'PJM17'. This project contributes approximately 42.71 MW to the thermal violation.
4. The CHICHST1-EDDYSTN4 (PECO - PECO) 230 kV line (from bus 213489 to bus 213588 ckt 1) loads from 112.53% to 112.87% (DC power flow) of its emergency rating (863 MVA) for the single line contingency outage of '220-04/* \$ DELCO \$ 220-04 \$ L'. This project contributes approximately 18.41 MW to the thermal violation.
5. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 131.0% to 131.47% (DC power flow) of its emergency rating (984 MVA) for the single line contingency outage of '220-39/* \$ DELCO \$ 220-39 \$ L'. This project contributes approximately 28.77 MW to the thermal violation.
6. The LINWOOD-CHICHST2 (PECO - PECO) 230 kV line (from bus 213750 to bus 213490 ckt 2) loads from 131.45% to 131.93% (DC power flow) of its emergency rating (984 MVA) for the single line contingency outage of '220-43/* \$ DELCO \$ 220-43 \$ L'. This project contributes approximately 28.87 MW to the thermal violation.