Generation Interconnection
Feasibility Study Report
Cedar 230kV

The Interconnection Customer (IC) has proposed a 720 MWE (93 MWC; 720 MW MFO) wind powered generating facility to be located in the Atlantic Ocean approximately 20 miles east of Atlantic City, New Jersey. PJM studied X1-017 as a 720 MW injection into the Atlantic City Electric Company (ACE) system and evaluated the project for compliance with reliability criteria for summer peak conditions in 2015. The planned in-service date, as stated in the Attachment N, is September 30, 2016.

Point(s) of Interconnection

The Interconnection Customer requested a Primary and Secondary Point of Interconnection (POI) be evaluated for the X1-017 project. The Primary POI selected was a direct connection into ACE's Cedar 230kV substation. The Secondary POI selected was a direct connection into ACE's Cardiff 230kVsubstation. The results are provided in the Transmission Network Impacts section below.

Direct Connection Requirements

Primary Option

X1-017 will interconnect with the ACE system at the Cedar 230kV substation via a new line terminal.

Transmission Owner Scope of Direct Connection Work

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

Substation Engineering Estimate:
Scope: Construct a new 230kV line terminal at the existing Cedar 230kV substation.
Estimate: $2,000,000
Construction Time: 24 – 36 months after receipt of a fully executed Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (CSA).

Transmission Engineering Estimate:
Scope: Install underground 230kV cable to a riser pole and set of disconnect switches outside the substation fence.
Estimate: $950,000
Construction Time: 24 – 30 months after receipt of a fully executed Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (CSA).

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

Note: The above costs do not include the Contribution in Aid of Construction (CIAC) tax.

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) 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 Interconnection Customer will be responsible for contributing to future O & M costs associated with the direct connect facilities.

The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. Protective relaying and metering design and installation must comply with PHI's Applicable Standards.

Special Operating Requirements

1. The Company will require the capability to remotely trip the generator from its System Operations facility. Such tripping may be facilitated by either a generator breaker, inverter (if so equipped), or a line recloser, depending upon the specific circumstances and the evaluation of the Company.

2. The Interconnection Customer will grant its permission to PJM for PJM to send the Company the following telemetry data that the Interconnection Customer sends to PJM: real time megawatts, megavars, volts, amperes and status, and interval megawatt-hours, and megavar-hours. For generation larger than 10 MW, a direct telemetry connection to PHI System Operations will be required via a radial connection to PHI's telecommunications system or a rented data circuit, at the Interconnection Customer's cost.

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.

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 request)*

1. The Oystercreek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 1) loads from 71.24% to 109.92% (DC power flow) of its emergency rating (805 MVA) for the tower contingency 'C5_CNJ-DCT-#12'. This project contributes approximately 311.3 MW to the thermal violation.

Multiple Facility Contingency

*(Double Circuit Tower Line, Line with Failed Breaker and, Bus Fault contingencies for the **Full** energy output.*

2. The Van-Larrabee 230 kV line (from bus 206318 to bus 206294 ckt 1) loads from 76.54% to 107.52% (DC power flow) of its emergency rating (805 MVA) for the tower contingency 'C5_CNJ-DCT-#12'. This project contributes approximately 249.98 MW to the thermal violation.

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 Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 126.34% to 126.51% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 30.83 MW to the thermal violation.

2. The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 124.62% to 124.82% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 32.80 MW to the thermal violation.

3. The R11OP2-Q11OP3 230 kV line (from bus 295950 to bus 295019 ckt 1) loads from 101.27% to 102.65% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'B_CNJ2-SX-#37'. This project contributes approximately 11.13 MW to the thermal violation.

4. The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 132.40% to 132.64% (DC power flow) of its emergency rating (914 MVA) for the single contingency 'CHIC125'. This project contributes approximately 13.59 MW to the thermal violation.

5. The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 109.31% to 109.59% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 8.25 MW to the thermal violation.

6. The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 136.84% to 137.06% (DC power flow) of its emergency rating (1037 MVA) for the single contingency 'CHIC125'. This project contributes approximately 13.69 MW to the thermal violation.

7. The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 108.31% to 108.54% (DC power flow) of its normal rating (836 MVA) for non contingency condition. This project contributes approximately 12.99 MW to the thermal violation.

8. The Red Oak A Bus-Raritan River 230 kV line (from bus 206314 to bus 206305 ckt 1) loads from 110.41% to 111.43% (DC power flow) of its emergency rating (1068 MVA) for the single contingency 'B_CNJ2-SX-#36'. This project contributes approximately 10.85 MW to the thermal violation.

9. The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 110.80% to 111.07% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 8.25 MW to the thermal violation.

10. The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 107.29% to 108.44% (DC power flow) of its emergency rating (2901 MVA) for the tower contingency 'CNSTN_NWESTA'. This project contributes approximately 206.81 MW to the thermal violation.

11. The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 100.86% to 101.02% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 23.49 MW to the thermal violation.

12. The Q11OP3-Red Oak B Bus 230 kV line (from bus 295019 to bus 206315 ckt 1) loads from 101.26% to 102.64% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'B_CNJ2-SX-#37'. This project contributes approximately 11.13 MW to the thermal violation.

13. The Red Oak B Bus-Raritan River 230 kV line (from bus 206315 to bus 206305 ckt 1) loads from 115.64% to 116.67% (DC power flow) of its emergency rating (1068 MVA) for the single contingency 'B_CNJ2-SX-#37'. This project contributes approximately 10.91 MW to the thermal violation.

14. The R11 B-Red Oak A Bus 230 kV line (from bus 295951 to bus 206314 ckt 1) loads from 102.69% to 104.06% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'B_CNJ2-SX-#36'. This project contributes approximately 11.03 MW to the thermal violation.

15. The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 111.46% to 111.62% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 6.32 MW to the thermal violation.

Short Circuit

No overstressed breakers were identified.

System Protection

Costs determined by PHI System Protection as a result of the short circuit analysis will be provided in the System Impact Study Report.

Stability and Low Voltage Ride Through Analysis

The analysis will commence during the System Impact Study phase of the project.

Other Charges

It is anticipated that the Interconnection Customer will be charged for ongoing operation and maintenance of the attachment facilities. The methodology of calculating this charge is still under development.

New System Reinforcements

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

1. To mitigate the Oystercreek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 1) overload will require reconductoring the circuit using 1590 ACSS conductor (11.1 miles). It will also require upgrading drop loops and limiting substation conductors, breaker relay and metering equipment, replacement of disconnect switch with one rated for 3000 Amp, replacement of wave trap with one rated for 3000A. The estimated cost to perform this work is **$21.2M**.

2. To mitigate the Van-Larrabee 230 kV line (from bus 206318 to bus 206294 ckt 1) overload will require reconductoring the circuit using 1590 ACSS conductor (7.5 miles). It will also require upgrading drop loops and limiting substation conductor, replacement of wave trap with one rated at 3000A, and upgrading breaker relay and metering equipment. The estimated cost to perform this work is **$14.7M.**

Contribution to Previously Identified System Reinforcements

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. Costs provided in this section are the **total** costs of the reinforcement. Cost allocations will be provided in the System Impact Study report.)*

1&2. To mitigate the Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) overloads will require the following:

BGE Portion

- At Conastone - construct a new 4000A two (2) breaker bay (breakers D, F) with two 63kA breakers. The work will also include line termination structures, allowance for a second line, and the relocation of the 500kV capacitor bank. The estimated cost to perform this work is **$14M** and will take **36 months** to complete.
- Construct a new 500kV line rated for a minimum of 2939/3733 SN/SE from Conastone to Peach Bottom. Build 9.6 miles of 500kV line from Conastone to the Pennsylvania line (BGE portion). The work will require the purchase of 150' of right-of-way. The estimated cost to perform this work is **$46.8M** and will take **5-7 years** to complete.

PECO Portion

- Replace the existing Peach Bottom to Conastone 500kV line (5012) terminal equipment at the Peach Bottom substation to match the conductor summer normal and emergency rating of 2920/3707 MVA. The estimated cost to perform this work is **$5M** and will take **3 years** to complete.
- Build a new second Peach Bottom to Conastone 500kV line on separate towers from the existing 5012 line with a minimum summer emergency rating of 3510 MVA (PECO Portion). The estimated cost to perform this work is **$20M** and will take **5 years** to complete. Right-of-way costs are not included.

3&12. To mitigate the R11OP2 - Q11 OP3 and the Q11OP3 - Red Oak B overloads will require replacement of 1.1 miles of 1590 Kcmil 45/7 ACSR with 1590 Kcmil 54/19 ACSS/AW on the 230kV line G1047 (between South River Junction and Red Oak B). The estimated cost to perform this work is **$947,000**.

4. To mitigate the Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) overload will require the following: reconductor the aerial portion (2.23 miles) of the line with 2-2000 kcmil AAC 127 Str (Cowslip) with emergency rating of 4130; remove the existing two UG cables (2-3-1x3000 KCMIL CU HPOFP) and replace with two dielectric (XLPE - cross link polyethelene) cables. The estimated cost to perform this work is **$15,000,000** and will take **3 years** to complete.

5. To mitigate the Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) overload will require rebuilding the circuit (1.85 miles) to the PA border. The estimated cost to perform this work is **$7.5M** and will take **54 months** to complete including anticipated CPCN time.

6&7. To mitigate the Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) overloads will require creating an express circuit from Camden to Richmond. This overload has been identified in RTEP 2016. Should X1-017 need the reinforcement prior to 2016 it would need to be advanced.

8&13. To mitigate the Red Oak A Bus-Raritan River and the Red Oak B Bus-Raritan River 230 kV line overloads will require reconductoring of the double circuit tower line from 1590 Kcmil 45/7 ACSR (2.6 mile) to 1590 Kcmil 54/19 ACSS/AW – Bundled (2.6 mile) for 1642/1850 MVA summer normal/emergency ratings. It also requires replacement of bundled drop loop conductors at Raritan River substation and at Red Oak A and B substations. The estimated cost to perform this work is **$8,331,000**.

9. To mitigate the Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) overload will require reconductoring Line 220-08 from PB Tap to Cooper Substation to get a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. The estimated cost to perform this work is **$1.0M** and will require **24 months** to complete.

10&11. To mitigate the Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) overloads will require upgrading the Conastone bay with two (2) 4000A breakers, four (4) 4000A breaker disconnects and one (1) 4000 A line switch. The estimated cost to perform this work is **$3M** and will take **24-36 months** to complete.

14. To mitigate the R11 B-Red Oak A Bus 230 kV line (from bus 295951 to bus 206314 ckt 1) overload will require reconductoring the line from 1590 Kcmil 45/7 ACSR (1.91 mile DCT) to 1590 Kcmil 54/19 ACSS/AW-Bundled (1.71 mile DCT) for 869/1068 MVA summer normal/emergency ratings. The reinforcement also requires replacement of bundled drop loop conductors at South River substation. The estimated cost to perform this work is **$640,000**.

15. To mitigate the North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) overload will require reconductoring the line with 2,167 ACSR. There will also be substation terminal cost upgrades associated with the reinforcement. The total cost estimate of the reinforcement is approximately **$23.6M**, and the time estimate for completion is **6 years**.

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. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 132.97% to 134.34% (DC power flow) of its emergency rating (2815 MVA) for the operational contingency 'PJM67'. This project contributes approximately 238.69 MW to the thermal violation.

2. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 133.58% to 135.22% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 253.92 MW to the thermal violation.

3. (AE) The Motts #2-Chestnut Neck Alternate 69 kV line (from bus 228007 to bus 228026 ckt 1) loads from 28.94% to 113.49% (DC power flow) of its emergency rating (94 MVA) for the operational contingency 'B_CNJ2-SX-#34'. This project contributes approximately 79.47 MW to the thermal violation.

4. (PSEG) The Aldene 2-Springfield Rd. 230 kV line (from bus 218345 to bus 216911 ckt 1) loads from 195.31% to 195.69% (DC power flow) of its emergency rating (330 MVA) for the operational contingency 'ALD_ESSEXA'. This project contributes approximately 16.92 MW to the thermal violation.

5. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 118.98% to 119.92% (DC power flow) of its emergency rating (627 MVA) for the operational contingency 'PJM17'. This project contributes approximately 63.91 MW to the thermal violation.

6. (PJM) The R11OP2-Q11OP3 230 kV line (from bus 295950 to bus 295019 ckt 1) loads from 105.02% to 106.75% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 86.16 MW to the thermal violation.

7. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 148.65% to 150.25% (DC power flow) of its emergency rating (914 MVA) for the operational contingency 'CHIC125'. This project contributes approximately 105.18 MW to the thermal violation.

8. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 107.38% to 109.1% (DC power flow) of its normal rating (760 MVA) for non contingency condition. This project contributes approximately 99.81 MW to the thermal violation.

9. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 120.71% to 121.34% (DC power flow) of its emergency rating (485 MVA) for the operational contingency 'PJM17'. This project contributes approximately 40.59 MW to the thermal violation.

10. (AE) The Chestnut Neck Alternate-Moss Moss 69 kV line (from bus 228026 to bus 228032 ckt 1) loads from 29.89% to 117.22% (DC power flow) of its emergency rating (91 MVA) for the operational contingency 'B_CNJ2-SX-#34'. This project contributes approximately 79.47 MW to the thermal violation.

11. (AE/PJM) The Cedar-Oyster Creek 230 kV line (from bus 227955 to bus 206302 ckt 1) loads from 71.57% to 125.76% (DC power flow) of its emergency rating (800 MVA) for the operational contingency 'PJM89_A'. This project contributes approximately 443.33 MW to the thermal violation.

12. (AE/PJM) The Cedar-Oyster Creek 230 kV line (from bus 227955 to bus 206302 ckt 1) loads from 62.06% to 128.97% (DC power flow) of its normal rating (650 MVA) for non contingency condition. This project contributes approximately 444.23 MW to the thermal violation.

13. (AE) The B L England-Merion 138 kV line (from bus 228110 to bus 228197 ckt 1) loads from 119.85% to 121.93% (DC power flow) of its emergency rating (219 MVA) for the operational contingency 'ENG-CORSON'. This project contributes approximately 28.23 MW to the thermal violation.

14. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 155.68% to 156.89% (DC power flow) of its emergency rating (485 MVA) for the

operational contingency 'PJM17'. This project contributes approximately 63.91 MW to the thermal violation.

15. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 160.70% to 162.33% (DC power flow) of its emergency rating (1037 MVA) for the operational contingency 'CHIC125'. This project contributes approximately 106.00 MW to the thermal violation.

16. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 130.81% to 132.73% (DC power flow) of its normal rating (836 MVA) for non contingency condition. This project contributes approximately 100.56 MW to the thermal violation.

17. (AE) The Sherman-Sherman #1 69 kV line (from bus 228226 to bus 228256 ckt 1) loads from 100.92% to 101.83% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'SHERM 1 XFR'. This project contributes approximately 6.10 MW to the thermal violation.

18. (PJM) The Red Oak A Bus-Raritan River 230 kV line (from bus 206314 to bus 206305 ckt 1) loads from 112.76% to 114.03% (DC power flow) of its emergency rating (1068 MVA) for the operational contingency 'B_CNJ2-SX-#36'. This project contributes approximately 83.98 MW to the thermal violation.

19. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 130.04% to 130.68% (DC power flow) of its emergency rating (617 MVA) for the operational contingency 'PJM17'. This project contributes approximately 37.51 MW to the thermal violation.

20. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 155.07% to 156.28% (DC power flow) of its emergency rating (485 MVA) for the operational contingency 'PJM17'. This project contributes approximately 63.91 MW to the thermal violation.

21. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 104.34% to 105.6% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 181.83 MW to the thermal violation.

22. (PJM) The Q11OP3-Red Oak B Bus 230 kV line (from bus 295019 to bus 206315 ckt 1) loads from 105.01% to 106.74% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 86.16 MW to the thermal violation.

23. (PJM) The Red Oak B Bus-Raritan River 230 kV line (from bus 206315 to bus 206305 ckt 1) loads from 118.01% to 119.28% (DC power flow) of its emergency rating (1068 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 84.46 MW to the thermal violation.

24. (PJM) The R11 B-Red Oak A Bus 230 kV line (from bus 295951 to bus 206314 ckt 1) loads from 106.40% to 108.12% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#36'. This project contributes approximately 85.41 MW to the thermal violation.

25. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 106.68% to 106.85% (DC power flow) of its emergency rating (728 MVA) for the operational contingency 'PP1EB'. This project contributes approximately 47.31 MW to the thermal violation.

26. (PJM) The Oyster Creek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 1) loads from 102.88% to 153.19% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#30'. This project contributes approximately 405.94 MW to the thermal violation.

27. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 123.41% to 124.62% (DC power flow) of its emergency rating (1072 MVA) for the operational contingency 'PJM17'. This project contributes approximately 80.00 MW to the thermal violation.

28. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 119.16% to 120.09% (DC power flow) of its emergency rating (627 MVA) for the operational contingency 'PJM17'. This project contributes approximately 63.91 MW to the thermal violation.

29. (AE) The Moss Moss-Lewis 69 kV line (from bus 228032 to bus 227948 ckt 1) loads from 16.50% to 103.83% (DC power flow) of its emergency rating (91 MVA) for the operational contingency 'B_CNJ2-SX-#34'. This project contributes approximately 79.47 MW to the thermal violation.

30. (PJM) The Larrabee-Atlantic 230 kV line (from bus 206294 to bus 206286 ckt 1) loads from 89.68% to 91.51% (DC power flow) of its emergency rating (842 MVA) for the operational contingency 'B_CNJ2-SX-#7'. This project contributes approximately 95.13 MW to the thermal violation.

31. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 127.81% to 128.19% (DC power flow) of its emergency rating (621 MVA) for the operational contingency 'PP1EB'. This project contributes approximately 48.95 MW to the thermal violation.

32. (AE) The B L England-Middle Tap 138 kV line (from bus 228110 to bus 228111 ckt 1) loads from 122.98% to 125.39% (DC power flow) of its emergency rating (219 MVA) for the operational contingency 'ENG-MERION'. This project contributes approximately 32.65 MW to the thermal violation.

33. (PJM) The Oyster Creek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 2) loads from 102.89% to 153.21% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#29'. This project contributes approximately 406.01 MW to the thermal violation.

Secondary Option

X1-017 was studied as a 720 MW injection into the Cardiff 230kV substation.

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. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 126.82% to 127.0% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 31.79 MW to the thermal violation.

2. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 125.17% to 125.39% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 33.94 MW to the thermal violation.

3. (AE) The Union-Lincoln 138 kV line (from bus 228210 to bus 228709 ckt 1) loads from 107.68% to 110.29% (DC power flow) of its emergency rating (292 MVA) for the tower contingency 'AE2TOWER'. This project contributes approximately 47.30 MW to the thermal violation.

4. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 111.33% to 111.48% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 6.42 MW to the thermal violation.

5. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 132.40% to 132.72% (DC power flow) of its emergency rating (914 MVA) for the single contingency 'CHIC125'. This project contributes approximately 17.85 MW to the thermal violation.

6. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 1) loads from 134.61% to 134.77% (DC power flow) of its emergency rating (700 MVA) for the single contingency 'GLO_CUTH_NEW'. This project contributes approximately 7.03 MW to the thermal violation.

7. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 2) loads from 174.10% to 174.34% (DC power flow) of its emergency rating (500 MVA) for the single contingency 'CAM_CUTH'. This project contributes approximately 7.32 MW to the thermal violation.

8. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 110.23% to 110.52% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 8.65 MW to the thermal violation.

9. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 136.83% to 137.12% (DC power flow) of its emergency rating (1037 MVA) for the single contingency 'CHIC125'. This project contributes approximately 18.45 MW to the thermal violation.

10. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 108.31% to 108.62% (DC power flow) of its normal rating (836 MVA) for non contingency condition. This project contributes approximately 17.12 MW to the thermal violation.

11. (AE) The Lewis-Moss Moss 69 kV line (from bus 227948 to bus 228032 ckt 1) loads from 105.37% to 110.16% (DC power flow) of its emergency rating (91 MVA) for the tower contingency 'AE3TOWER'. This project contributes approximately 26.99 MW to the thermal violation.

12. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 111.72% to 112.01% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 8.65 MW to the thermal violation.

13. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 105.77% to 106.94% (DC power flow) of its emergency rating (2901 MVA) for the tower contingency 'CNSTN_NWESTA'. This project contributes approximately 210.42 MW to the thermal violation.

14. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 100.90% to 101.07% (DC power flow) of its normal rating (2338 MVA) for non

contingency condition. This project contributes approximately 23.93 MW to the thermal violation.

15. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 2) loads from 187.77% to 188.0% (DC power flow) of its emergency rating (500 MVA) for the single contingency 'GLO_CUTH'. This project contributes approximately 7.03 MW to the thermal violation.

16. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 1) loads from 128.40% to 128.58% (DC power flow) of its emergency rating (700 MVA) for the single contingency 'CAM_CUTH_NEW'. This project contributes approximately 7.76 MW to the thermal violation.

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. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 114.64% to 114.72% (DC power flow) of its emergency rating (941 MVA) for the operational contingency 'PP1EC'. This project contributes approximately 58.77 MW to the thermal violation.

2. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 132.99% to 134.4% (DC power flow) of its emergency rating (2815 MVA) for the operational contingency 'PJM67'. This project contributes approximately 246.15 MW to the thermal violation.

3. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 133.61% to 135.31% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 262.78 MW to the thermal violation.

4. (AE/PSEG) The Mickleton-Deptford 230 kV line (from bus 228401 to bus 219109 ckt 2) loads from 145.35% to 145.95% (DC power flow) of its emergency rating (1000 MVA) for the operational contingency 'PS6A'. This project contributes approximately 39.59 MW to the thermal violation.

5. (PJM) The Red Oak B Bus-Raritan River 230 kV line (from bus 206315 to bus 206305 ckt 1) loads from 117.98% to 118.69% (DC power flow) of its emergency rating (1068 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 46.62 MW to the thermal violation.

6. (PSEG) The Aldene 2-Springfield Rd. 230 kV line (from bus 218345 to bus 216911 ckt 1) loads from 195.29% to 195.68% (DC power flow) of its emergency rating (330 MVA) for the operational contingency 'ALD_ESSEXA'. This project contributes approximately 17.11 MW to the thermal violation.

7. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 135.27% to 135.84% (DC power flow) of its emergency rating (1000 MVA) for the operational contingency 'PS17B'. This project contributes approximately 37.66 MW to the thermal violation.

8. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 130.02% to 130.12% (DC power flow) of its emergency rating (819 MVA) for the operational contingency 'PP1EC'. This project contributes approximately 58.08 MW to the thermal violation.

9. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 119.01% to 120.01% (DC power flow) of its emergency rating (627 MVA) for the operational contingency 'PJM17'. This project contributes approximately 66.97 MW to the thermal violation.

10. (PJM) The R11OP2-Q11OP3 230 kV line (from bus 295950 to bus 295019 ckt 1) loads from 104.99% to 105.95% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 48.33 MW to the thermal violation.

11. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 127.29% to 127.7% (DC power flow) of its emergency rating (621 MVA) for the operational contingency 'PP1EB'. This project contributes approximately 49.69 MW to the thermal violation.

12. (AE) The Vineland G-10-Central North 69 kV line (from bus 228705 to bus 228714 ckt 1) loads from 119.09% to 120.29% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'SHERM-BUT'. This project contributes approximately 7.99 MW to the thermal violation.

13. (BG&E) The EMORY GRV230-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 100.97% to 101.0% (DC power flow) of its emergency rating (1800 MVA) for the operational contingency 'BG_CKT2310A'. This project contributes approximately 42.85 MW to the thermal violation.

14. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 148.65% to 150.78% (DC power flow) of its emergency rating (914 MVA) for the operational contingency 'CHIC125'. This project contributes approximately 138.23 MW to the thermal violation.

15. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 107.38% to 109.65% (DC power flow) of its normal rating (760 MVA) for non contingency condition. This project contributes approximately 128.02 MW to the thermal violation.

16. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 1) loads from 143.40% to 144.63% (DC power flow) of its emergency rating (700 MVA) for the operational contingency 'GLO_CUTH_NEW'. This project contributes approximately 54.43 MW to the thermal violation.

17. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 1) loads from 122.75% to 123.8% (DC power flow) of its normal rating (500 MVA) for non contingency condition. This project contributes approximately 33.28 MW to the thermal violation.

18. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 119.52% to 119.94% (DC power flow) of its emergency rating (485 MVA) for the operational contingency 'PJM17'. This project contributes approximately 39.82 MW to the thermal violation.

19. (AE) The Oldman-Five Points 69 kV line (from bus 228327 to bus 228336 ckt 1) loads from 104.00% to 104.87% (DC power flow) of its emergency rating (94 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 5.10 MW to the thermal violation.

20. (PSEG) The Eagle Point-Cloucester 230 kV line (from bus 219120 to bus 219110 ckt 2) loads from 157.97% to 158.65% (DC power flow) of its emergency rating (1000 MVA) for the operational contingency 'PS18'. This project contributes approximately 43.19 MW to the thermal violation.

21. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 119.19% to 120.18% (DC power flow) of its emergency rating (627 MVA) for the operational contingency 'PJM17'. This project contributes approximately 66.97 MW to the thermal violation.

22. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 2) loads from 186.90% to 188.7% (DC power flow) of its emergency rating (500 MVA) for the operational contingency 'CAM_CUTH'. This project contributes approximately 56.66 MW to the thermal violation.

23. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 2) loads from 123.23% to 124.45% (DC power flow) of its normal rating (380 MVA) for non contingency condition. This project contributes approximately 29.28 MW to the thermal violation.

24. (AE) The Pennsgrove-Oldman 69 kV line (from bus 228328 to bus 228327 ckt 1) loads from 130.45% to 131.55% (DC power flow) of its emergency rating (75 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 5.10 MW to the thermal violation.

25. (AE) The B L England-Merion 138 kV line (from bus 228110 to bus 228197 ckt 1) loads from 119.85% to 123.5% (DC power flow) of its emergency rating (219 MVA) for the operational contingency 'ENG-CORSON'. This project contributes approximately 49.54 MW to the thermal violation.

26. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 155.73% to 157.01% (DC power flow) of its emergency rating (485 MVA) for the operational contingency 'PJM17'. This project contributes approximately 66.97 MW to the thermal violation.

27. (AE) The Carneys Point Tap-Pennsgrove 69 kV line (from bus 228320 to bus 228328 ckt 1) loads from 133.53% to 134.6% (DC power flow) of its emergency rating (77 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 5.10 MW to the thermal violation.

28. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 160.69% to 162.89% (DC power flow) of its emergency rating (1037 MVA) for the operational contingency 'CHIC125'. This project contributes approximately 142.84 MW to the thermal violation.

29. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 130.81% to 133.34% (DC power flow) of its normal rating (836 MVA) for non contingency condition. This project contributes approximately 132.54 MW to the thermal violation.

30. (AE) The Sherman-Sherman #1 69 kV line (from bus 228226 to bus 228256 ckt 1) loads from 100.87% to 102.53% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'SHERM 1 XFR'. This project contributes approximately 11.12 MW to the thermal violation.

31. (BG&E) The EMORY GRV230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 100.96% to 100.98% (DC power flow) of its emergency rating (1800 MVA) for the operational contingency 'BG_CKT2322A'. This project contributes approximately 42.70 MW to the thermal violation.

32. (AE) The Lewis-Moss Moss 69 kV line (from bus 227948 to bus 228032 ckt 1) loads from 99.79% to 105.75% (DC power flow) of its emergency rating (91 MVA) for the operational contingency 'CARD-CEDAR'. This project contributes approximately 33.60 MW to the thermal violation.

33. (PJM) The Red Oak A Bus-Raritan River 230 kV line (from bus 206314 to bus 206305 ckt 1) loads from 112.73% to 113.43% (DC power flow) of its emergency rating (1068 MVA) for the operational contingency 'B_CNJ2-SX-#36'. This project contributes approximately 46.36 MW to the thermal violation.

34. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 129.11% to 129.62% (DC power flow) of its emergency rating (617 MVA) for the operational contingency 'PJM17'. This project contributes approximately 37.24 MW to the thermal violation.

35. (AE) The Deepwater-Beckett 69 kV line (from bus 228323 to bus 228321 ckt 1) loads from 116.81% to 117.77% (DC power flow) of its emergency rating (97 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 5.76 MW to the thermal violation.

36. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 155.11% to 156.39% (DC power flow) of its emergency rating (485 MVA) for the operational contingency 'PJM17'. This project contributes approximately 66.97 MW to the thermal violation.

37. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 104.36% to 105.64% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 185.29 MW to the thermal violation.

38. (AE) The Deepwater-Carneys Point Tap 69 kV line (from bus 228323 to bus 228320 ckt 1) loads from 109.38% to 110.26% (DC power flow) of its emergency rating (94 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 5.10 MW to the thermal violation.

39. (PSEG) The Thorofare-Eagle Point 230 kV line (from bus 219121 to bus 219120 ckt 1) loads from 130.07% to 130.64% (DC power flow) of its emergency rating (1000 MVA) for the operational contingency 'PS17B'. This project contributes approximately 37.63 MW to the thermal violation.

40. (AE) The Sherman-Carlls Corner 69 kV line (from bus 228226 to bus 228252 ckt 1) loads from 110.14% to 111.89% (DC power flow) of its emergency rating (56 MVA) for the operational contingency 'NEWPRT-USLC'. This project contributes approximately 6.06 MW to the thermal violation.

41. (PJM) The Q11OP3-Red Oak B Bus 230 kV line (from bus 295019 to bus 206315 ckt 1) loads from 104.99% to 105.95% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#37'. This project contributes approximately 48.33 MW to the thermal violation.

42. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 2) loads from 200.08% to 201.8% (DC power flow) of its emergency rating (500 MVA) for the operational contingency 'GLO_CUTH'. This project contributes approximately 54.43 MW to the thermal violation.

43. (PSEG) The Cloucester-Cuthbert Blvd. 230 kV line (from bus 219110 to bus 219108 ckt 2) loads from 161.56% to 162.95% (DC power flow) of its normal rating (380 MVA) for non contingency condition. This project contributes approximately 33.28 MW to the thermal violation.

44. (PSEG) The Cloucester-Camden 230 kV line (from bus 219110 to bus 219125 ckt 1) loads from 106.75% to 107.7% (DC power flow) of its emergency rating (700 MVA) for the operational contingency 'GLO_CUTH'. This project contributes approximately 41.88 MW to the thermal violation.

45. (PSEG) The Cloucester-Camden 230 kV line (from bus 219110 to bus 219125 ckt 1) loads from 111.03% to 112.03% (DC power flow) of its normal rating (500 MVA) for non contingency condition. This project contributes approximately 31.64 MW to the thermal violation.

46. (PJM) The R11 B-Red Oak A Bus 230 kV line (from bus 295951 to bus 206314 ckt 1) loads from 106.37% to 107.33% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#36'. This project contributes approximately 47.78 MW to the thermal violation.

47. (PSEG) The Deptford-Eagle Point 230 kV line (from bus 219109 to bus 219120 ckt 2) loads from 133.31% to 133.92% (DC power flow) of its emergency rating (1000 MVA) for the operational contingency 'PS6A'. This project contributes approximately 39.58 MW to the thermal violation.

48. (AE) The Butler-Vineland Cogeneration Llp 69 kV line (from bus 228703 to bus 228713 ckt 1) loads from 104.81% to 105.32% (DC power flow) of its emergency rating (133 MVA) for the operational contingency 'CENT-G10'. This project contributes approximately 9.63 MW to the thermal violation.

49. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 106.45% to 106.57% (DC power flow) of its emergency rating (728 MVA) for the operational contingency 'PP1EB'. This project contributes approximately 48.04 MW to the thermal violation.

50. (AE) The Vineland Cogeneration Llp-Central 69 kV line (from bus 228713 to bus 228704 ckt 1) loads from 104.80% to 105.31% (DC power flow) of its emergency rating (133 MVA) for the operational contingency 'CENT-G10'. This project contributes approximately 9.63 MW to the thermal violation.

51. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 1) loads from 138.09% to 139.45% (DC power flow) of its emergency rating (700 MVA) for the operational contingency 'CAM_CUTH_NEW'. This project contributes approximately 60.08 MW to the thermal violation.

52. (PSEG) The Cuthbert Blvd.-Camden 230 kV line (from bus 219108 to bus 219125 ckt 1) loads from 119.97% to 121.15% (DC power flow) of its normal rating (500 MVA) for non contingency condition. This project contributes approximately 37.27 MW to the thermal violation.

53. (PJM) The Oyster Creek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 1) loads from 102.87% to 106.45% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#30'. This project contributes approximately 184.00 MW to the thermal violation.

54. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 125.02% to 126.26% (DC power flow) of its emergency rating (1072 MVA) for the operational contingency 'PJM17'. This project contributes approximately 82.35 MW to the thermal violation.

55. (AE) The B L England-Middle Tap 138 kV line (from bus 228110 to bus 228111 ckt 1) loads from 122.98% to 127.21% (DC power flow) of its emergency rating (219 MVA) for the operational contingency 'ENG-MERION'. This project contributes approximately 57.29 MW to the thermal violation.

56. (PJM) The Oyster Creek-Manitou 230 kV line (from bus 206302 to bus 206297 ckt 2) loads from 102.89% to 106.47% (DC power flow) of its emergency rating (805 MVA) for the operational contingency 'B_CNJ2-SX-#29'. This project contributes approximately 184.03 MW to the thermal violation.