Generation Interconnection
Feasibility Study Report
W3-174

The Interconnection Customer (IC) has proposed a 193.5 MWE (193.5 MWC) natural gas fueled single combustion turbine generating facility. The project is to be located in Pennsville, New Jersey. PJM studied W3-174 as a 193.5 MW injection into the Atlantic City Electric system at the Churchtown 230kV substation. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2014. The proposed in-service date, as stated in Attachment N, is June 1, 2013.

Point of Interconnection

W3-174 will interconnect with the Atlantic City Electric transmission system at the Churchtown 230kV substation.

Direct Connection Requirements

Transmission Owner Scope of Direct Connection Work

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

1) Add a 230kV terminal at the Churchtown 230kV ring bus. The estimated cost to perform this work is **$3,000,000** and will take **18-24 months** to complete.

2) Construct a 0.6 mile 230 kV line (overhead and underground) from W3-174 to the Churchtown substation. The estimated cost to perform this work is **$2,000,000** and will take **30-36 months** to complete. The estimate does not include environmental or Rights Of Way costs.

Note: Additional costs upon further engineering review may result. Additionally, Contribution in Aid of Construction (CIAC) tax will be included upon further study.

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. IC will interconnect W3-174 with the ACE system via a 230kV circuit from their facility to the Churchtown 230kV substation. The above cost does not include construction of that line. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. At this time, route selection, line design, right-of-way acquisition, and construction of such lines will be entirely the responsibility of the Interconnection Customer.

Protective relaying and metering design and installation must comply with ACE'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. ACE will require the capability to remotely trip the generator from its System Operations facility. The interconnected customer will grant its permission for PJM to send ACE all telemetry that the Interconnection Customer sends to PJM. The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each ACE 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)*

1. (AE) The Pedricktown-Bridgeport 230 kV line (from bus 228312 to bus 228313 ckt 1) loads from 39.44% to 67.37% (DC power flow) of its emergency rating (552 MVA) for the single contingency 'CHUR-ORCH'. This project contributes approximately 154.18 MW to the thermal violation.

2. (AE) The Bridgeport-Mickleton 230 kV line (from bus 228313 to bus 228401 ckt 1) loads from 53.78% to 72.9% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'CHUR-ORCH'. This project contributes approximately 153.93 MW to the thermal violation.

3. (AE) The Bridgeport-Mickleton 230 kV line (from bus 228313 to bus 228401 ckt 1) loads from 61.89% to 75.7% (DC power flow) of its normal rating (650 MVA) for non contingency condition. This project contributes approximately 89.79 MW to the thermal violation.

4. (PSEG) The Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) loads from 88.82% to 92.78% (DC power flow) of its normal rating (265 MVA) for non contingency condition. This project contributes approximately 10.49 MW to the thermal violation.

5. (AE) The Churchtown-Deepwater 69 kV line (from bus 228319 to bus 228323 ckt 1) loads from 81.46% to 96.23% (DC power flow) of its emergency rating (294 MVA) for the single contingency 'MICK-BRIDG'. This project contributes approximately 43.41 MW to the thermal violation.

6. (AE) The Chambers-Pedricktown 230 kV line (from bus 228311 to bus 228312 ckt 1) loads from 19.69% to 47.65% (DC power flow) of its emergency rating (552 MVA) for the single contingency 'CHUR-ORCH'. This project contributes approximately 154.30 MW to the thermal violation.

7. (PSEG) The Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) loads from 95.63% to 99.91% (DC power flow) of its normal rating (245 MVA) for non contingency condition. This project contributes approximately 10.49 MW to the thermal violation.

8. (AE) The Churchtown-Churchtown 230/69 kV transformer (from bus 228310 to bus 228319 ckt 1) loads from 86.65% to 101.12% (DC power flow) of its emergency rating (300 MVA) for the single contingency 'MICK-BRIDG'. This project contributes approximately 43.41 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.*

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. (PSEG) The Thorofare-Deptford 230 kV line (from bus 219121 to bus 219109 ckt 1) loads from 102.09% to 102.87% (DC power flow) of its emergency rating (740 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 37.06 MW to the thermal violation.

2. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 152.20% to 152.79% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.47 MW to the thermal violation.

3. (BG&E) The BAGLEY13-Raphael Road 230 kV line (from bus 220999 to bus 220980 ckt 1) loads from 152.77% to 152.98% (DC power flow) of its emergency rating (674 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 12.24 MW to the thermal violation.

4. (AE) The Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 2) loads from 110.83% to 115.55% (DC power flow) of its emergency rating (446 MVA) for the single contingency 'PS18'. This project contributes approximately 21.07 MW to the thermal violation.

5. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 128.41% to 128.74% (DC power flow) of its emergency rating (1072 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.95 MW to the thermal violation.

6. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 131.53% to 131.9% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 12.11 MW to the thermal violation.

7. (PSEG) The Eagle Point-Gloucester 230 kV line (from bus 219120 to bus 219110 ckt 1) loads from 114.37% to 115.12% (DC power flow) of its emergency rating (740 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 36.85 MW to the thermal violation.

8. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 143.98% to 144.06% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 67.33 MW to the thermal violation.

9. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 145.98% to 146.11% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 72.37 MW to the thermal violation.

10. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 143.11% to 144.14% (DC power flow) of its emergency rating (566 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 37.06 MW to the thermal violation.

11. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 120.02% to 125.58% (DC power flow) of its normal rating (451 MVA) for non contingency condition. This project contributes approximately 25.07 MW to the thermal violation.

12. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 120.11% to 120.57% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.47 MW to the thermal violation.

13. (JCP&L) The Larrabee-U2-049 TAP 230 kV line (from bus 206294 to bus 292970 ckt 1) loads from 115.77% to 116.01% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'PJM_NEWFREEDM_WINDSOR'. This project contributes approximately 11.99 MW to the thermal violation.

14. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 120.09% to 120.55% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.47 MW to the thermal violation.

15. (BG&E) The Graceton-BAGLEY13 230 kV line (from bus 220964 to bus 220999 ckt 1) loads from 135.72% to 135.89% (DC power flow) of its emergency rating (802 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 12.24 MW to the thermal violation.

16. (PSEG) The Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) loads from 100.67% to 104.4% (DC power flow) of its emergency rating (341 MVA) for the

single contingency 'PJM_NEWFREEDM_WINDSOR'. This project contributes approximately 12.73 MW to the thermal violation.

17. (AE) The Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 1) loads from 110.83% to 115.55% (DC power flow) of its emergency rating (446 MVA) for the single contingency 'PS18'. This project contributes approximately 21.07 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 105.87% to 106.22% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 10.39 MW to the thermal violation.

19. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 155.27% to 155.87% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.47 MW to the thermal violation.

20. (PSEG) The Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) loads from 101.26% to 105.03% (DC power flow) of its emergency rating (338 MVA) for the single contingency 'PJM89_A'. This project contributes approximately 12.73 MW to the thermal violation.

Transmission Owner Identified Overloads

21. W3-174 contributes 5 MWs to the overload of the emergency rating of the (ACE) BLE-Scull 138kV line (from bus 228119 to bus 227906).

Short Circuit

The following breakers were found overstressed as a result of the addition of the W3-174 project:

11 overstressed 69kV circuit breakers (Churchtown: CB 'D' @ 108.6%; Deepwater: CB 6602 @ 116.2%, CB 6603 @ 114.6%, CB 6605 @ 104.4%, CB 6606 @ 103.3%, CB 6607 @ 115.4%, CB 6609 @ 115.4%, CB 6612 @ 103.6%, CB 6624 @ 110.5%, CB 6628 @ 114.1%, CB 6683 @ 101.1%)

The estimated cost to replace these breakers is **$5,250,000** and will take **24-36 months** to complete.

Stability Analysis

Will be performed during the System Impact Study phase of W3-174.

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 (AE) Pedricktown-Bridgeport 230 kV line (from bus 228312 to bus 228313 ckt 1) overload will require at Pedricktown substation the upgrade of the Bridgeport 230 kV 1590 AL strand bus to 2-1590 AL. The estimated cost to perform this work is $20,000 and will take 18 to 24 months to complete.

2. To mitigate the (AE) Bridgeport-Mickleton 230 kV line (from bus 228313 to bus 228401 ckt 1) overload will require the installation of a second 230/69kV transformer at Churchtown and convert the 69kV system to a ring bus. The estimated cost to perform this work is $8,600,000 and will take 24 to 36 months to complete.

3. To mitigate the (AE) Bridgeport-Mickleton 230 kV line (from bus 228313 to bus 228401 ckt 1) overload will require the installation of a second 230/69kV transformer at Churchtown and convert the 69kV system to a ring bus. The estimated cost to perform this work is $8,600,000 and will take 24 to 36 months to complete.

4. To mitigate the (PSEG) Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) overload will require an upgrade to the transformer. The estimated cost to perform this work is $13,400,000 and will take 36 months to complete.

5. To mitigate the (AE) Churchtown-Deepwater 69 kV line (from bus 228319 to bus 228323 ckt 1) overload will require the upgrade of the circuit to 3500 amps minimum. The estimated cost to perform this work is $1,600,000 and will take 30-36 months to complete not including environmental or Rights Of Way costs.

6. To mitigate the (AE) Chambers-Pedricktown 230 kV line (from bus 228311 to bus 228312 ckt 1) overload will require the installation of a second 230/69kV transformer at Churchtown and convert the 69kV system to a ring bus. The estimated cost to perform this work is $8,600,000 and will take 24 to 36 months to complete.

7. To mitigate the (PSEG) Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) overload will require reconductoring the existing circuit. The estimated cost to perform this work is **$20,000,000** and will take **24 months** to complete.

8. To mitigate the (AE) Churchtown-Churchtown 230/69 kV transformer (from bus 228310 to bus 228319 ckt 1) overload will require the installation of a second 230/69kV transformer at Churchtown and convert the 69kV system to a ring bus. The estimated cost to perform this work is $8,600,000 and will take 24 to 36 months to complete.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.

1. To mitigate the (PSEG) Thorofare-Deptford 230 kV line (from bus 219121 to bus 219109 ckt 1) overload will require reconductoring the existing circuit. The estimated cost to perform this work is **$2,000,000** and will take **24 months** to complete.

2. To mitigate the (PECO/BG&E) Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) overloads will require the following:

   PECO portion: Reconductor Line 220-93 from Cooper Substation to Graceton Substation to get a minimum summer emergency rating of 725 MVA. The line is approximately 4 miles long. This cost is for the PECO portion only. The estimated cost to perform this work is **$2,800,000** and will require **24 months** to complete.

   BGE Portion: Rebuild Cooper to Graceton 230 kV line 1.85 miles to PA border. New rating is 648N/802E MVA. The estimated cost to perform this work is **$7,500,000** and will require **54 months** to complete.

3. To mitigate the (BG&E) BAGLEY13-Raphael Road 230 kV line (from bus 220999 to bus 220980 ckt 1) overload will require the Graceton station to add 6-230kV breakers with an estimated cost of $**10,000,000** and Raphael Road station to add 6-230kV breakers at an estimated cost of **$10,000,000**. It also requires rebuilding Graceton to Raphael Rd to double circuit 2-conductor bundled with an estimated cost of **$30,000,000**. This work would take an estimate of 2-3 years for the substation work concurrently with 5-6 years for the line work.

4. To mitigate the (AE) Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 2) overload will require the reconductoring of the #2 Mickleton-Monroe 230kV line with an ACSS/TW conductor. The estimated cost to perform this work is **$7,000,000** and will take **30 months** to complete following the receipt of a fully executed ISA and CSA.

5. To mitigate the (PJM/METED) Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) overload will require the addition of a second 500/230kV transformer at TMI as well as transmission line upgrades between the 230kV and 500kV substations. The estimated cost to perform this work is **$15,000,000** and will take **36 months** to complete.

6. To mitigate the (PL/BG&E) Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) overload is as follows:

   PPL Portion: PPL has recently submitted plans to PJM to rebuild the Otter Creek - Conastone 230kV line as part of a modernization project (submitted to PJM as supplemental project S0233). This project is tentatively scheduled to be complete by May 2013 (prior to the IPP's 2014 requested in-service date). The magnitude cost estimate to rebuild PPL's portion of the Otter Creek - Conastone 230kV line is **$0**.

BGE Portion: rebuild the Otter Creek to Conastone 230 kV 4.7 mile line (2302) to PA border. New rating is 648N/802E MVA. The estimated cost to perform this work is **$19,000,000** and will require **60 months** to complete.

7. To mitigate the (PSEG) Eagle Point-Gloucester 230 kV line (from bus 219120 to bus 219110 ckt 1) overload will require replacement of three (3) wavetraps and three (3) disconnect switches. The estimated cost to perform this work is **$500,000** and will take **24 months** to complete.

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

   PECO Portion: build a new 2nd PB-Conastone 500 kV line with a minimum normal and emergency rating of 2,920 / 3,707 MVA, respectively. The line is approximately 6 miles long. Replace the 5012 terminal equipment at PB substation to achieve the conductor normal and emergency rating of 2,920 / 3,707 MVA, respectively. This cost is for the PECO portion only, and does not include right-of-way costs for new line**.** The estimated cost to perform this work is **$25,000,000** and will require **60 months** to complete.

   BGE Portion: build a new 500 kV line adjacent to circuit 5012 from Conastone to PA line. The estimated cost to perform this work is **$56,700,000** and will require **7 years** to complete.

9. To mitigate the Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) overload will require (see item #9 above for reinforcement).

10. To mitigate the (AE/PSEG) Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) overload will require the rebuild of 1.69 miles of circuit with a conductor that has capability of at least 2500 A emergency. The estimated cost to perform this work is **$3,500,000** and will take **24 – 36 months** to complete.

11. To mitigate the (AE/PSEG) Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) overload will require the rebuild of 1.69 miles of circuit with a conductor that has capability of at least 2500 A emergency. The estimated cost to perform this work is **$3,500,000** and will take **24 – 36 months** to complete.

12. To mitigate the (PECO) Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) overload will require the replacement of the line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 741 MVA. The estimated cost to perform this work is **$1,700,000** and will require **24 months** to complete.

13. To mitigate the (JCP&L) Larrabee-U2-049 TAP 230 kV line (from bus 206294 to bus 292970 ckt 1) overload will require the reconductoring of the Larrabee-Atlantic 230kV line. The estimated cost to perform this work is $7,420,000. Once reconductored, the rating of the line would be SN: 946 and SE: 1043 MVA.

14. To mitigate the (PECO) Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) overload will require reconductoring line 220-08 from Nottingham Reactor to PB

Tap to get a minimum summer emergency rating of 741 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is **$10,000,000** and will require **48 months** to complete.

15. To mitigate the (BG&E) Graceton-BAGLEY13 230 kV line (from bus 220964 to bus 220999 ckt 1) overload will require the Graceton station to add 6-230kV breakers with an estimated cost of $**10,000,000** and Raphael Road station to add 6-230kV breakers at an estimated cost of **$10,000,000**. It also requires rebuilding Graceton to Raphael Rd to double circuit 2-conductor bundled with an estimated cost of **$30,000,000**. This work would take an estimate of **2-3 years** for the substation work concurrently with **5-6 years** for the line work.

16. To mitigate the (PSEG) Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) overload will require an upgrade to the transformer. The estimated cost to perform this work is $13,400,000 and will take 36 months to complete.

17. To mitigate the (AE) Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 1) overload will require the reconductoring of the #1 Mickleton-Monroe 230kV line with an ACSS/TW conductor. The estimated cost to perform this work is **$7,000,000** and will take **30 months** to complete.

18. To mitigate the (PL/BG&E) Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) overload will require the following: There are substation limitations at Graceton that will be removed with project b0497.

19. To mitigate the (PECO) 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 **$1,000,000** and will require **24 months** to complete.

20. To mitigate the (PSEG) Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) overload will require reconductoring the existing circuit. The estimated cost to perform this work is **$20,000,000** and will take **24 months** to complete.

21. To mitigate the #1 BLE-Scull 138 kV line section overload will require a rebuild and reconductor of the #1 BLE-Scull 138 kV line with a larger conductor. The estimated cost to perform this work is **$2,000,000** and will take **30 months** to complete from the time "Notice to Proceed" is given after the ISA and CSA are executed.

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.

None