Generation Interconnection
Feasibility Study Report
Queue Position W4-015

The Interconnection Customer (IC) has proposed a 340 MWE (340 MWC) natural gas fueled combined cycle generating facility consisting of a single steam turbine and combustion turbine in a 1X1 configuration. The project is to be located in Gloucester County, New Jersey on the same site as prior queue project Q90. PJM studied W4-015 as a 340 MW injection into the Atlantic City Electric system at the Mickleton 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, 2015.

Point of Interconnection

W4-015 will interconnect with the Atlantic City Electric transmission system at the Mickleton 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:

Substation Engineering Estimate:
Scope: Construct a new 230kV terminal at Mickleton Substation
Estimate: $3,274,000
Construction Time: 24 – 36 months

Transmission Engineering Estimate:
Scope: Install a self-supporting 230kV steel pole with a concrete foundation, motor operated disconnects and a short span to PHI substation
Estimate: $375,000
Construction Time: 24 months.
Note: If location of generator is greater than 500 feet from substation, circuit breaker will be necessary

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. 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.

Protective relaying and metering design and installation must comply with PHI'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. PHI 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 PHI all telemetry that the Interconnection Customer sends to PJM. In addition, a direct data line will be required to send PHI the telemetry data. The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each PHI 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). See "New System Reinforcements" section below for reinforcements.*

1. (PSEG) The Eagle Point-Gloucester 230 kV line (from bus 219120 to bus 219110 ckt 1) loads from 99.15% to 110.97% (DC power flow) of its normal rating (651 MVA) for non contingency condition. This project contributes approximately 76.92 MW to the thermal violation.

2. (PSEG) The Deptford-Eagle Point 230 kV line (from bus 219109 to bus 219120 ckt 1) loads from 89.28% to 100.95% (DC power flow) of its emergency rating (740 MVA) for the single contingency 'CHIC125'. This project contributes approximately 86.38 MW to the thermal violation.

3. (AE/PSEG) The Monroe-New Freedom 230 kV line (from bus 228402 to bus 219100 ckt 1) loads from 66.18% to 82.43% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'PS18'. This project contributes approximately 130.86 MW to the thermal violation.

4. (PSEG) The Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) loads from 99.53% to 108.48% (DC power flow) of its normal rating (265 MVA) for non contingency condition. This project contributes approximately 23.71 MW to the thermal violation.

5. (PECO) The Ridley Tap-Macdade 230 kV line (from bus 213925 to bus 213775 ckt 1) loads from 99.66% to 99.93% (DC power flow) of its emergency rating (1432 MVA) for the single contingency '220-23'. This project contributes approximately 24.48 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. See "New System Reinforcements" section below for reinforcements.*

6. (PSEG) The Deptford-Eagle Point 230 kV line (from bus 219109 to bus 219120 ckt 1) loads from 92.11% to 108.91% (DC power flow) of its emergency rating (740 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 124.60 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) See "Contribution to Previously Identified System Reinforcements" section below for reinforcements.

1. (PSEG) The Thorofare-Deptford 230 kV line (from bus 219121 to bus 219109 ckt 1) loads from 103.80% to 120.6% (DC power flow) of its emergency rating (740 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 124.60 MW to the thermal violation.

2. (PSEG) The Thorofare-Deptford 230 kV line (from bus 219121 to bus 219109 ckt 1) loads from 101.37% to 113.04% (DC power flow) of its emergency rating (740 MVA) for the single contingency 'CHIC125'. This project contributes approximately 86.38 MW to the thermal violation.

3. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 145.09% to 146.19% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 33.46 MW to the thermal violation.

4. (BG&E) The BAGLEY13-Raphael Road 230 kV line (from bus 220999 to bus 220980 ckt 1) loads from 150.07% to 150.48% (DC power flow) of its emergency rating (674 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 21.70 MW to the thermal violation.

5. (AE) The Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 2) loads from 123.32% to 141.44% (DC power flow) of its emergency rating (446 MVA) for the single contingency 'MICK-MON1'. This project contributes approximately 80.92 MW to the thermal violation.

6. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 118.42% to 119.0% (DC power flow) of its emergency rating (1072 MVA) for the single contingency 'PJM17'. This project contributes approximately 38.12 MW to the thermal violation.

7. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 126.20% to 126.85% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.20 MW to the thermal violation.

8. (PSEG) The Eagle Point-Gloucester 230 kV line (from bus 219120 to bus 219110 ckt 1) loads from 116.17% to 132.93% (DC power flow) of its emergency rating (740 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 124.23 MW to the thermal violation.

9. (PSEG) The Eagle Point-Gloucester 230 kV line (from bus 219120 to bus 219110 ckt 1) loads from 113.27% to 124.89% (DC power flow) of its emergency rating (740 MVA) for the single contingency 'CHIC125'. This project contributes approximately 86.01 MW to the thermal violation.

10. (DP&L) The Glasgow-Cecil 138 kV line (from bus 231124 to bus 231130 ckt 1) loads from 113.82% to 114.66% (DC power flow) of its emergency rating (234 MVA) for the single contingency 'CHIC125'. This project contributes approximately 12.21 MW to the thermal violation.

11. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 143.06% to 143.73% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 116.97 MW to the thermal violation.

12. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 144.15% to 144.96% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 125.72 MW to the thermal violation.

13. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 145.36% to 167.32% (DC power flow) of its emergency rating (566 MVA) for the tower contingency 'AE1TOWER'. This project contributes approximately 124.60 MW to the thermal violation.

14. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 142.26% to 157.52% (DC power flow) of its emergency rating (566 MVA) for the single contingency 'CHIC125'. This project contributes approximately 86.38 MW to the thermal violation.

15. (AE/PSEG) The Mickleton-Thorofare 230 kV line (from bus 228401 to bus 219121 ckt 1) loads from 135.50% to 152.63% (DC power flow) of its normal rating (451 MVA) for non contingency condition. This project contributes approximately 77.29 MW to the thermal violation.

16. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 114.62% to 115.47% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 33.46 MW to the thermal violation.

17. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 114.61% to 115.45% (DC power flow) of its emergency rating (627 MVA) for the

single contingency 'PJM17'. This project contributes approximately 33.46 MW to the thermal violation.

18. (PECO) The Printz-Ridley Tap 230 kV line (from bus 213912 to bus 213925 ckt 1) loads from 106.68% to 106.96% (DC power flow) of its emergency rating (1505 MVA) for the single contingency '220-23'. This project contributes approximately 26.13 MW to the thermal violation.

19. (BG&E) The Graceton-BAGLEY13 230 kV line (from bus 220964 to bus 220999 ckt 1) loads from 133.44% to 133.79% (DC power flow) of its emergency rating (802 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 21.70 MW to the thermal violation.

20. (PSEG) The Gloucester-Gloucester 230/138 kV transformer (from bus 219110 to bus 219117 ckt 1) loads from 111.28% to 119.28% (DC power flow) of its emergency rating (341 MVA) for the single contingency 'PJM89_A'. This project contributes approximately 27.29 MW to the thermal violation.

21. (AE) The Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 1) loads from 123.32% to 141.44% (DC power flow) of its emergency rating (446 MVA) for the single contingency 'MICK-MON2'. This project contributes approximately 80.92 MW to the thermal violation.

22. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 101.00% to 101.61% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.13 MW to the thermal violation.

23. (PSEG) The Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) loads from 111.97% to 120.04% (DC power flow) of its emergency rating (338 MVA) for the single contingency 'PJM89_A'. This project contributes approximately 27.29 MW to the thermal violation.

24. (PSEG) The Gloucester-Cuthbert Blvd. 138 kV line (from bus 219117 to bus 219108 ckt 1) loads from 107.24% to 116.91% (DC power flow) of its normal rating (245 MVA) for non contingency condition. This project contributes approximately 23.71 MW to the thermal violation.

25. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 148.17% to 149.26% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 33.46 MW to the thermal violation.

Short Circuit

W4-015 contributes to the following previously over-dutied breakers and is expected to have cost allocation for their replacement:

BUS_NO	BUS	BREAKER
228401	MICKLETON 230kV	PCB U
228401	MICKLETON 230kV	PCB V

Cost estimates to replace these breakers will be provided in future reports.

Stability Analysis

Will be performed during the System Impact Study phase of W4-015.

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

2. To mitigate the Deptford-Eagle Point 230 kV line (from bus 219109 to bus 219120 ckt 1) overload will require reconductoring the line and replacement of a wave trap and disconnect switches. The estimated cost to perform this work is **$1,340, 000.** This reinforcement also addresses the overload in line item 6 below.

3. To mitigate the MONROE-NEW FRDM 230kV (from bus 228402 to bus 219100 ckt 1) line overload will require a rebuild and reconductoring of the 6.91 mile Monroe-New Freedom 230 kV line with a bundled conductor. The estimated cost to perform this work is $**16,600,000** and will take **36 months** to complete.

4. To mitigate the 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 Ridley Tap-Macdade 230 kV line (from bus 213925 to bus 213775 ckt 1) overload will require the replacement of terminal equipment. The estimated cost to perform this work is **$5,000,000** and will take **30 months** to complete.

6. See line item #2 above for reinforcement.

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 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. See line item #1 above for reinforcement.

3. To mitigate the Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) overload will require rebuilding the circuit to the Pennsylvania border (approximately 1.85 miles). The estimated cost to perform this work is **$7,500,000** and will take **54 months** to complete.

4. To mitigate the BAGLEY13-Raphael Road 230 kV line (from bus 220999 to bus 220980 ckt 1) overload will require: 1) at Graceton substation add six (6) 230kV breakers with an estimated cost of $**10,000,000** and; 2) at Raphael Road substation add six (6) 230kV breakers at an estimated cost of **$10,000,000**. It also requires rebuilding the Graceton to Raphael Rd circuit to a double circuit 2-conductor bundled configuration at an estimated cost of **$30,000,000**. The estimated time to complete this work is **2-3 years** for the substation work concurrently with **5-6 years** for the line work.

5. To mitigate the Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 2) overload will require reconductoring 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.

6. To mitigate the Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) transformer overload would 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.

7. To mitigate the Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) overload will require the following:

   <u>PPL Portion:</u>
   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.

   <u>BGE Portion:</u>
   Rebuild the Otter Creek to Conastone 230kV circuit (2302) to the Pennsylvania border, a distance of approximately 4.7 miles. The estimated cost to perform this work is **$19,000,000** and will take **60 months** to complete.

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

9. See line item #8 above for reinforcement.

10. To mitigate the Glasgow-Cecil 138 kV line (from bus 231124 to bus 231130 ckt 1) overload will require rerating the conductor to 1214A. The estimated cost to perform this work is **$1,400,000** and will take **30-36 months** to complete.

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

    PECO Portion:
    PECO builds 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 take **60 months** to complete.

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

12. See line item #11 above for reinforcement.

13. To mitigate the 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 rating. The estimated cost to perform the work is **$3,500,000** and will take approximately **24 – 36 months** to complete.

14. See line item #13 above for reinforcement.

15. See line item #13 above for reinforcement.

16. To mitigate the Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) overload will require the replacement of the 220-08 line 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 take **24 months** to complete.

17. To mitigate to Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) overload will require reconductoring the 220-08 line 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 take **48 months** to complete.

18. To mitigate the Printz-Ridley Tap 230 kV line (from bus 213912 to bus 213925 ckt 1) overload will require reconductoring the Printz to Ridley portion of the 220-46 line (3.15 miles on railroad right of way) with ACSS/TW conductor and replace terminal equipment at Printz and Ridley. The estimated cost is **$7,700,000,** and it will take **36 months** to complete.

19. To mitigate the Graceton-BAGLEY13 230 kV line (from bus 220964 to bus 220999 ckt 1) overload will require: See line item #4 above for reinforcement.

20. To mitigate the 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.

21. To mitigate the Mickleton-Monroe 230 kV line (from bus 228401 to bus 228402 ckt 1) overload will require reconductoring 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.

22. To mitigate the Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) overload will require to following:

    PPL portion:
    Rebuild the Manor-Graceton 230kV Susquehanna River crossing with new 1590 kcmil 45/7 ACSR. The estimated cost to perform this work is **$1,000,000**.

    BGE portion:
    Remove sag limitation rate to 550 MVA from Graceton to PA line. The estimated cost t perform this work is **$500,000** and will take **3 years** to complete. A CPCN is likely to be required. The length of this line section is 1.4 miles.

23. To mitigate the 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.

24. See item #23 above for reinforcement.

25. To mitigate the Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) overload will require the reconductoring of the 220-08 line 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.

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