**#U2-048 Cox's Corner-Croydon (Mt. Laurel) 230kV**

# Generation Interconnection

**This analysis was completed to assess the reliability impact for the new generation interconnecting to the PJM system as a capacity resource.**

## Network Impacts

The Queue Project U2-048 was studied as a 640MW (Capacity = 640MW) injection at the Mt Laurel - Burlington11 and Mt Laurel – Camden 230 kV lines in the PSEG area. Project U2-048 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

### Generator Deliverability

*(Single or N-1 contingencies for the Capacity portion only of the interconnection)*

1. **(PECO/PECO)** The Emilie-Neshaminy 138kV 130-25 line loads from 88.3% to 102.1% (DC power flow) of its emergency rating (791MVA) for the single line contingency outage (PE56). This project contributes approximately 109.1MW to cause this thermal violation.

2. **(PECO/PECO)** The Emilie #8 230/138kV transformer loads from 87.79% (DC power flow) to 100.73% of its emergency rating (525MVA) for the single line contingency outage (PE206). This project contributes approximately 67.9MW to cause this thermal violation.

3. **(PECO/PECO)** The Holmsburg-Blue Grass 138kV line loads from 89.3% to 103.9% (DC power flow) of its emergency rating (323MVA) for the single line contingency outage (PE90). This project contributes approximately 46.9MW to cause this thermal violation.

### Multiple Facility Contingency

*(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)*

4. **(PECO/PECO)** The Richmond-Waneeta 230kV 220-35 line loads from 73.45% to 107.05% (DC power flow) of its emergency rating (874MVA) for the tower line outage (37PS_A_U2-040_A). This project contributes approximately 293.7MW to cause this thermal violation.

5. **(PECO/PECO)** The U2-074-Peach Bottom 500kV line loads from 97.82% to 100.15% (DC power flow) of its emergency rating (3112MVA) for the tower line outage (DBL_5NC). This project contributes approximately 72.4MW to cause this thermal violation.

### Short Circuit

6. **(PSEG)** The addition of the U2-048 project increases the short circuit duty of the Salem 500kV 12X circuit breaker from 99.9% to 100.0 % of its 47999.7 ampere rating.

7. **(PSEG)** The addition of the U2-048 project increases the short circuit duty of the Salem 500kV 20X circuit breaker from 99.9% to 100.0 % of its 47999.7 ampere rating.

8. **(PSEG)** The addition of the U2-048 project increases the short circuit duty of the Salem 500kV 32X circuit breaker from 99.9% to 100.0 % of its 47999.7 ampere rating.

## 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)*

9. **(PECO/PECO)** The Emilie-Neshaminy 138kV 130-25 line loads from 102.31% to 116.73% (DC power flow) of its normal rating (550MVA) for non-contingency condition. This project contributes approximately 79.3MW to the thermal violation.

10. **(PENELEC/PENELEC)** The North Meshoppen 230/115kV transformer loads from 180.62% to 185.17% (DC power flow) of its emergency rating (157MVA) for the single line contingency outage (PN47B). This project contributes approximately 7.1MW to the thermal violation.

11. **(PJM500/AP)** The Conastone-North Northwest 500kV circuit 2 line loads from 165.14% to 170.13% (DC power flow) of its emergency rating (2901MVA) for the single line contingency outage (PJM13B_NNWEST_A). This project contributes approximately 144.7MW to the thermal violation.

12. **(PJM500/AP)** The Conastone-North Northwest 500kV circuit 1 line loads from 165.14% to 170.13% (DC power flow) of its emergency rating (2901MVA) for the single line contingency outage (U_queue_reinforcement_60). This project contributes approximately 144.7MW to the thermal violation.

13. **(PJM500/AP)** The Conastone-North Northwest 500kV circuit 1 line loads from 143.49% to 147.68% (DC power flow) of its normal rating (2078MVA) for non-contingency condition. This project contributes approximately 87.0MW to the thermal violation.

14. **(PJM500/AP)** The Conastone-North Northwest 500kV circuit 2 line loads from 143.49% to 147.68% (DC power flow) of its normal rating (2078MVA) for non-contingency condition. This project contributes approximately 87.0MW to the thermal violation.

15. **(PJM500/PJM500)** The Peach Bottom-Conastone 500kV circuit 1 line loads from 143.69% to 147.43% (DC power flow) of its emergency rating (2598MVA) for the tower line outage (CONAS_PB_CKT3_4). This project contributes approximately 97.2MW to the thermal violation.

16. **(PJM500/PJM500)** The Peach Bottom-Conastone 500kV circuit 3 line has a loading increase of 2.5% (DC power flow) of its emergency rating (3734MVA) for the tower line outage (CONAS_PB). This project contributes approximately 97.2MW to cause this thermal violation.

17. **(PJM500/PJM500)** The Peach Bottom-Conastone 500kV circuit 4 line has a loading increase of 2.5% (DC power flow) of its emergency rating (3734MVA) for the tower line outage (CONAS_PB). This project contributes approximately 97.2MW to cause this thermal violation.

18. **(PJM500/PJM500)** The Peach Bottom-Conastone 500kV circuit 2 line has a loading increase of 2.5% (DC power flow) of its emergency rating (3734MVA) for the tower line outage (CONAS_PB_CKT3_4). This project contributes approximately 97.2MW to cause this thermal violation.

## New System Reinforcements

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

1. The overload on the Emilie-Neshaminy 138kV 130-25 line can be alleviated by replacing relay equipment. The estimated cost is **$400,000.** The estimated time to complete is 24months. **This upgrade also mitigates #6.**

2. The overload on the Emilie #8 230/138kV transformer can be alleviated by adding a third transformer at Emilie. The installation will also require construction of new bus positions at the 230kV and 138kV substations and relay modifications. The estimated cost is **$4,500,000.** The estimated time to complete is 36 months.

3. The overload on the Holmsburg-Blue Grass 138kV circuit can be alleviated by reconductoring the 2.7 mile long line. The estimated cost is **$2,000,000.** The estimated to to complete is 30 months.

4. The overload on the Richmond-Waneeta 230kV 220-35 line can be alleviated by reconductoring the 2.25 mile long aerial section of the line. The estimated cost is **$2,000,000.** The estimated time to complete is 30 months.

5. The U2-074-Peach Bottom line overload can be alleviated by replacing relay equipment on the Peach Bottom terminal. The estimated cost is **400,000.** The estimated time to complete is 24 months.

6. The overdutied condition of the Salem 500kV 12X circuit breaker can be alleviated by replacing it with a breaker of higher rating. The estimated cost is **$1,000,000.**

7. The overdutied condition of the Salem 500kV 20X circuit breaker can be alleviated by replacing it with a breaker of higher rating. The estimated cost is **$1,000,000.**

8. The overdutied condition of the Salem 500kV 32X circuit breaker can be alleviated by replacing it with a breaker of higher rating. The estimated cost is **$1,000,000.**

## Contribution to Previously Identified System Reinforcements

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

10. The overload on the North Meshoppen #3 230/115kV transformer can be alleviated by Rearrange the North Meshoppen 230 kV bus to prevent the loss of 230-115 kV transformer along with the loss of North Meshoppen-East Towanda 230 kV line. This will require re-configuration of the North Meshoppen 230 kV station to a ring bus and will also require the addition of two 230 kV breakers. The estimated cost for the upgrade is **$1,500,000**. The estimated time to complete is 42 months.

11. The Conastone-North Northwest 500kV line overload can be alleviated by the following upgrade:

    2 new single circuit line with the following assumptions:
    A new 200 ft. wide ROW paralleling the existing Conastone to Northwest ROW
    Total ROW length = 19.6 miles
    3 - bundle 1,590 kcm conductor
    North Northwest substation is located 4 miles north of Northwest substation

    Additional substation work to include:
    Expand NNW substation to accommodate 2 new lines for **$10M**
    Expand Conastone substation to accommodate 2 new lines for **$8M**

    The total estimated cost of this upgrade, which includes breakers and terminations, is **$220M**. The upgrade will take approximately **10 years** to complete. **This upgrade also mitigates Network Impact number 12, 13, and 14**.

15. The Peach Bottom – Conastone 500kV overload can be alleviated by a large upgrade which was originally proposed in the R queue, but has since grown and expanded:

    BG&E portion of the Conastone – Peach Bottom line:
    Conastone Substation - **3 - 4 years** to complete – total estimate for this work is $**39M**
    • Rebuild 3 existing bays to 4000A (also add breaker in one of the existing bays)
    • Build new 4000A bay and install 3 breakers
    • Relocate Hunterstown 500kV line
    • Replace 4 inch bus with 5 inch

Transmission Line Component - **7 years** to build after notice to proceed - total estimate for this work is **$320.2M**
• 2 - Double Circuit 500 kV OH lines from Conastone - Graceton - MD line
• 2 - UG 230 kV circuits from Conastone - Graceton *
• 3 - UG 230 kV circuits from Graceton - MD line
• 1 - UG 115 kV circuit from Graceton - Five Forks
• Acquire additional 50 ft. wide R/W Graceton - MD line
• Remove existing OH lines/structures

* assumes RTEP project b0497 Install a second Conastone - Graceton 230 kV circuit

PECO portion of the Conastone – Peach Bottom line:
Assumes 500 kV lines with ratings equal to the rating of the 4 inch diameter aluminum bus work at Peach Bottom, i.e. 3366 MVA normal and 4183 MVA emergency are able to be built.

• Relocate Peach Bottom to Graceton 220-08 line to underground to facilitate construction of additional 500kV lines in the Conastone to Peach Bottom right of way. The estimated cost to perform this work is **$29.6M**

• The underground line will require parallel pipe type cables to achieve a rating of 800MVA. The estimated cost to perform this work is **$61M** and **36 months** to complete.

Note: the 220-08 line is an offsite source for the Peach Bottom Atomic Power Station and its integrity must be maintained.

• Remove existing 220-08 line towers to clear the north side of the right of way for 500kV construction. The estimated cost to perform this work is **$1.5M** and **6 months** to complete.

• Construct new double circuit 500kV line on the north side of the 300 foot wide Peach Bottom to Maryland state line right of way. The estimated cost to perform this work is **$17M** and **30 months** to complete after the removal of the existing 230 kV tower line.

• Remove existing 5012 line towers to clear the south side of the right of way for new higher capacity 500kV lines. The estimated cost to perform this work is **$1.5M** and **6 months** to complete.

• Construct second new double circuit 500kV line on the south side of the Peach Bottom to Maryland state line right of way. The estimated cost to perform this work is **$17M** and **30 months** to complete after the removal of the existing 500 kV tower line.

• Upgrade 5012 line substation equipment to achieve the new higher rating. The estimated cost to perform this work is **$3M** and **18 months** to complete.

• Expand the 500kV substations (North and South) at Peach Bottom to accommodate three additional 500kV lines. The estimated cost to perform this work is **$18M** ($6M per new line) and **30 months** to complete.

• Build a third new (fourth overall) 500kV overhead line for an estimated cost of $15.0M. The Peach Bottom 500kV substation also needs to be expanded for an estimated cost of $10M. The total estimated cost of this portion of the upgrade is **$25.0M** and the time estimate to build the upgrade is **8 years**.

Note: The substation work may have to be coordinated with refueling outages at the Peach Bottom Atomic Power Station and that the overall project may overstress several 500 kV circuit breakers.

These estimates do not include the cost for the new right-of-way required to build the new lines. It should be noted that this right-of-way could be very difficult or even impossible to acquire. If the proper right-of-way is not available this project would be essentially infeasible based on the current system model.

**This upgrade also mitigates Network Impact number 16, 17 and 18**.