#U1-086 Eldred 150 MW

Generator Interconnection

This analysis was completed to assess the reliability impact for a new generator interconnecting to the PJM System as a Capacity Resource.

Network Impacts

The queue project U1-086 was studied as a 150MW (capacity) injection into the Eldred 230 kV bus. U1-086 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

NETWORK IMPACTS

Generator Deliverability

(Normal system, and Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. The Sunbury – Eldred 230 kV line is overloaded from 82% to 113% of its emergency rating (455 MVA) for the outage of Eldred – Frackville 230 kV line. The U1-86 contributes approximately **145 MW** to cause the thermal violation.

2. The Eldred – Frackville 230 kV line is overloaded from 86% to 118% of its emergency rating (455 MVA) for the outage of Sunbury – Eldred 230 kV line. The U1-86 contributes approximately **139 MW** to cause the 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)

No impacts identified.

Short Circuit Analysis

No problems identified.

Stability Analysis

Will be performed for the U1-086 Impact Study.

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)

3. The Susquehanna – Jenkins 230 kV line is overloaded from 108.16% to 109.44% of its emergency rating (617 MVA) for the double circuit outage of the

Susquehanna - Mountain and Susquehanna T10 – Mountain 230 kV lines, including Mountain 230-69 kV transformer T1. The U1-86 contributes approximately **7.9 MW** to the thermal violation.

4. The Lackawanna-Oxbow 230kV line loads from 139.95% to 141.52% of its emergency rating (617MVA) for the tower outage of the following lines: Harwood – East Palmerton and Harwood Siegfried 230 kV lines: Harwood 230-69 kV transformer #5 and East Palmerton transformer #2 (Contingency: 4PPL). This project contributes approximately **9.7 MW** to the thermal violation.

5. The Oxbow-North Meshoppen 230kV line loads from 139.95% to 141.52% of its emergency rating (617MVA) for the tower outage of the following lines: Harwood 230-69 kV transformer #5 and East Palmerton transformer #2 (Contingency: 4PPL). This project contributes approximately **9.7 MW** to the thermal violation.

6. The Peach Bottom-Conastone 500kV circuit 3 line loads from 249.14% to 250.20% of its emergency rating (2598MVA) for the tower outage of Peach Bottom – Conastone 500 kV circuits 1 and 2 (Contingency: CONAS_PB). This project contributes approximately **27.7 MW** to the thermal violation.

General Notes pertaining to cost allocation rules for overloads: (also see the PJM Tariff and Manual 14)

The first project to cause an overload has cost responsibility.

If this Queue is not the first project to cause the overload, a threshold of;

a) 1% increase in overloaded facility loading must be caused by the this Queue generation, ***and***
b) This Queue's MW contribution of 5.0 MWor greater are both required for cost allocation responsibility.

And

If not the first project to cause the overload but both conditions above are met, then a threshold of
Either of the following are also required for cost allocation responsibility;

a) a 5% generator DFAX (5 MW for a generation request size of 100 MW),* ***or***
(b) This Queue's generation must cause an increase of 5% to the overloaded facility loading

** DFAX may not be equal to this Queue's contribution divided by generator MW size in some cases.*

NETWORK UPGRADE REQUIREMENTS

New System Reinforcements

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

1. Sunbury – Eldred 230 kV line upgrade - The estimated magnitude cost for this upgrade including substation terminal equipment cost is **$63,975,000**.

   In order to provide additional capacity on the Sunbury – Eldred 230 kV line, PPL EU is proposing to rebuild the 25 mile circuit with 1590 kcmil ACSR 45/7 conductor. The description of work and the cost estimates are preliminary without any field checks and engineering review and therefore are subject to change.

2. Eldred – Frackville 230 kV line upgrade - The estimated magnitude cost for this upgrade including substation terminal equipment cost is **$32,150,000**.

   In order to provide additional capacity on the Eldred – Frackville 230 kV line, PPL EU is proposing to rebuild the 12 mile circuit with 1590 kcmil ACSR 45/7 conductor. The description of work and the cost estimates are preliminary without any field checks and engineering review and therefore are subject to change.

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)

3. Susquehanna – Jenkins 230 kV line upgrade - The estimated magnitude cost for this upgrade including substation terminal equipment cost is **$70,000,000**.

   In order to provide additional capacity on the Susquehanna – Jenkins 230kV line, PPL EU is proposing to rebuild the existing single circuit 230kV line to a future double-circuit (single circuit initial) design 230kV line between the two substations. The new line will be 26 miles long and will follow the existing right of way. The 230kV line will be constructed with 1590 kcmil ACSR conductor for a 653/793 MVA summer normal/emergency rating. The circuit capacity is based on the conductor size and may vary when the line is actually built. The description of work and the cost estimates are preliminary without any field checks and engineering review and therefore are subject to change.

4. The Lackawanna – Oxbow 230kV line: The Penelec portion of the upgrade involves the rebuild of 16.33 miles of transmission line as well as substation work at the Oxbow facility. The estimated cost of the Penelec upgrade is **$19,771,000** and it would take **4-5 years** to complete. PPL owns the Lackawanna substation.

PPL is assuming that terminal upgrade work would be required at the Lackawanna substation. The estimated cost for the terminal upgrade is **$500,000**.

5. The Oxbow – N. Meshopen 230kV line overload require the rebuild of approximately 10.16 miles of transmission line This overload also requires the replacement of a disconnect switch and replacement of substation conductor at Oxbow substation. North Meshoppen substation requires the upgrade/replacement of two (2) CT circuits, substation conductor, and a line/wave trap. The total cost of the upgrade is estimated to be **$12,939,000** and it would take **4-5 years** to complete the work.

6. 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 $**39,000,000.**

   • 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 **$320,200,000**

   • 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 **$29,600,000.**
   • The underground line will require parallel pipe type cables to achieve a rating of 800MVA. The estimated cost to perform this work is **$61,000,000** 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 **$1,500,000** 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
$17,000,000 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 **$1,500,000** 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 **$17,000,000** 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 **$3,000,000** 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 **$18,000,000** ($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 **$25,000,000** and the time estimate to build the upgrade is **8 years**.

These Peach Bottom – Conastone overload 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.

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.