#U4-005 Susquehanna 700e/640c 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 U4-005 project was studied as a 700 MW (energy) / 640 MW (Capacity) injection into the Susquehanna North – Lackawanna 500 kV line (***Future PJM Baseline Upgrade line to be built***). The project was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

NETWORK IMPACTS

Generator Deliverability

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

No problems identified.

Multiple Facility Contingencies

(Double Circuit Tower Line contingencies for the full energy output. Stuck Breaker and Bus Fault contingencies will be tested at the Impact Study.)

1. **(PENELEC)** The Oxbow - North Meshoppen 230 kV line (from bus 417 to bus 414 ckt 1) loads from **99.8% to 110.19%** of its emergency rating (617MVA) for the tower line outage ('PJM 69'). This project contributes approximately **75.7 MW** to cause this thermal violation.

   Contingency ('PJM 69') = Outage of the Susquehanna – Sunbury – Juniata 500 kV line with associated Sunbury 500-230 kV transformer.

Contribution to Previously Identified Overloads

(This project contributes greater than the PJM cost allocation threshold loading to the following contingency overloads, i.e. "Network Impacts", identified for either earlier generation or transmission interconnection projects in the PJM Queue)

2. **(PENELEC / PPL)** The Lackawanna - Oxbow 230 kV line loads from **101.80% to 113.01%** of its emergency rating (616MVA) for the single line contingency outage ('PJM69'). This project contributes approximately **69.1 MW** to the thermal violation.

   Contingency ('PJM69') = Outage of the Susquehanna – Sunbury – Juniata 500 kV line with associated Sunbury 500-230 kV transformer.

3. **(PECO / BG&E)** This project contributes approximately **173 MW** to the previously identified thermal overload of the Peach Bottom – Conastone 500 kV

line #2 (new 500 kV line built for RTEP Baseline Upgrade #n0497) for the single line contingency outage ('PJM17').

Contingency (‘PJM17’) = Loss of Peach Bottom – Conastone line #1

4. **(PECO / BG&E**) This project contributes approximately **173.7 MW** to the thermal overload of the Peach Bottom – Conastone 500 kV line #1 for normal system, non- contingency conditions.

5. **(PECO / BG&E)** This project contributes approximately **198.3 MW** to the thermal overload of the Peach Bottom – Conastone 500 kV line #1 for the tower line outage (‘GRCTN_PCHBTM’).

   Contingency (‘GRCTN_PCHBTM’) = Loss of the Graceton – Cooper 230 kV line. Note: Cooper is a new substation to be cut into the Graceton – Peach Bottom Tap – Nottingham 230 kV line #220-08.

Stability Analysis

TBD.
Will be performed for the Queue U4-005 Impact Study.

Short Circuit

No new overduty breakers or contribution of >3% to existing overduty breakers.

NETWORK UPGRADE REQUIREMENTS

(Note: Network Upgrades 1 to 5 correspond to Network Impacts 1 to 5)

New System Reinforcements

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

1. **(PENELEC)** The **Oxbow – North Meshoppen 230kV line 101.19 % overload** requires 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 trap. The total cost of the upgrade is estimated to be **$12,939,000** and it would take **48-60 months** to complete the work.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project will have a % allocation cost responsibility which will be calculated during the Impact Study at this position in the Queue. Later Queue positions may also have a cost allocation and reduce this Queue's responsibility)

2. **(PPL/PENELEC)** The **Lackawanna – Oxbow 230 kV line 112.45% overload** requires the following Penelec and PPL upgrades:

   Penelec:

   The Penelec portion of the upgrade involves the rebuild of 16.5 miles of transmission line as well as substation work at Oxbow. The upgrade of 16.5 miles of transmission line is estimated to cost approximately $19,596,000. This overload also requires the following terminal upgrades at Oxbow substation: replace substation conductor (estimated cost approximately $125,000) and replace a disconnect switch (estimated cost approximately $85,000). The estimated total cost of the Penelec upgrade is **$19,771,000** and it would take **48-60 months** to complete.

   PPL:

   The PPL portion of the upgrade requires that the existing 1033.3 kcmil ACSR conductors be replaced with 1590 kcmil ACSR conductors for a rating of 653/793 MVA summer normal/summer emergency at an estimated cost of **$700,000**. Terminal equipment at Lackawanna 230kV substation would also be replaced with higher ratings than the conductor. PPL EU owns approximately 0.2 miles of this 17-mile long transmission line from Lackawanna to Oxbow. The PPL work will take about **24 months**. Please note that the description of work and the cost/time estimates are preliminary without any field checks and extensive

engineering review and therefore are subject to change. If for some reason First Energy decides to use a different conductor, PPL EU would have to re-evaluate the cost estimate.

3. **4. and 5 (PECO / BG&E)** Overload of existing Peach Bottom – Conastone 500 kV line #1 and new Peach Bottom – Conastone 500 kV line #2 (RTEP baseline upgrade b0497).

   The total estimated cost to mitigate the overload of Peach Bottom – Conastone 500 kV circuits #1 and #2 is **$448,500,000**. The estimated time to complete the work is **84 months**.

   Queue U4-005 will have a cost allocation toward this upgrade. A number of earlier Queues and possibly some later Queues will also have a cost allocation. Also, there may be a more cost effective upgrade to solve these Queue (i.e. overload of PB – Conastone circuits #1 and #2) and RTEP baseline overloads (i.e. PB – Conastone circuit #2) which will be investigated further during the Queue U4-005 Impact Study.

   PECO Energy Scope of Work:

   The total estimated cost for PECO Energy work is $117,500,000, and includes the following:

   Relocate Peach Bottom to Graceton 220-08 line to underground (7.4 miles total length @ $4M/mile) to facilitate construction of additional 500kV lines in the Conastone to Peach Bottom right of way. The underground line will require parallel pipe type cables to achieve a rating of 800 MVA and will cost $61,000,000 and take 36 months to complete. Please note that 220-08 line is an offsite source for Peach Bottom generating 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, $1,500,000 and 6 months.

   Construct a new double circuit 500 kV line in the north side of the 300 foot wide Peach Bottom to Maryland state line right of way, approximately $17,000,000 (6.25 mile PECO portion @ $2.7M/mile) and 30 months to complete after the removal of the existing tower line.

   Remove existing 5012 line towers to clear the south side of the right of way for new higher capacity 500 kV lines, $1,500,000 (6.25 mile PECO portion) and 6 months.
   Construct a second new double circuit 500 kV line in the south side of the Peach Bottom to Maryland state line right of way, approximately $17,000,000 (6.25

mile PECO portion @ $2.7M/mile) 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, $3,000,000 and 18 months to complete.

Expand 500 kV substations (north and south) at Peach Bottom to accommodate three additional 500 kV lines, approximately $18,000,000 ($6M per new line) and 30 months to complete. Please note that the substation work may have to be coordinated with refueling outages at Peach Bottom and that the overall project (generation and new lines) may overstress (cause to be overdutied) several 500 kV circuit breakers.

BGE Scope of Work:

The following estimates are to build two 500 kV double circuit 500 kV lines from Conastone - MD border with PA including terminations at Conastone at Conastone Substation.

There are two components of BG&E work; Conastone Substation and Conastone – Peach Bottom transmission line work. The total estimated cost for BG&E work is $331,000,000.

The major components of this project include:
Conastone Substation: 3 - 4 years to complete $39,000,000 add 5% per year inflation beyond 2012.

- 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 $ 292,000,000.

- 2 - Double Circuit 500 kV OH lines from Conastone - Graceton - MD line ($136M)
- 2 - UG 230 kV circuits from Conastone - Graceton ($122.4M)*
- 1 - UG 230 kV circuit from Graceton - MD line ($20.4M)
- 1 - UG 115 kV circuit from Graceton - Five Forks ($9.0M)
- Acquire additional 50 ft. wide R/W Graceton - MD line ($2.2M)

- Remove existing OH lines/structures ($2.0M)

* assumes RTEP project b0497 to install a second Conastone - Graceton 230 kV circuit is completed.