

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 U2-075 project was studied as a 636 MW Capacity injection at the existing Lackawanna 230 kV bus (Option #1) and the future Lackawanna 500 kV bus (Option #2). Queue U2-075 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

Option #1 – Lackawanna 230 kV

NETWORK IMPACTS

Generator Deliverability

(Normal system with all facilities in-service and Single, or N-1, contingencies for the Capacity portion only of the interconnection)

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only. Stuck Breaker and Bus Fault contingencies will also be checked for the Impact Study)

No problems identified.

Short Circuit

1. Queue U2-075 short circuit contribution will cause the **Peckville 230 kV breaker** to interrupt a short circuit value of **106.4%** of its short circuit interrupting rating.

Stability Analysis

Will be performed for the 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)

2. **(PENELEC) The North Meshoppen 230/115 kV transformer #3** loads from **177.56% to 217.91%** of its emergency rating (157 MVA) for the **single line**

contingency outage (PN47B). This project **contributes** approximately **35.7 MW** to the thermal violation.

Contingency **PN47B** = The loss of the North Meshhopen – East Towanda 230 kV line along with tapped North Meshhopen 230/115 kV transformer #4.

3. **(PENELEC) The North Meshhopen 115 kV reactor (ckt id #3) loads from 115.16% to 146.68% of its emergency rating (201 MVA) for the single line contingency outage (PN47B).** The project **contributes** approximately **35.7 MW** to the thermal violation.

Contingency **PN47B** = The loss of the North Meshhopen – East Towanda 230 kV line along with tapped North Meshhopen 230/115 kV transformer #4.

4. **(PPL/PENELEC) The Lackawanna - Oxbow 230kV line loads from 112.45% to 139.49% of its emergency rating (617 MVA) for the single line contingency outage (PJM Jeff-Lack 500).** This project **contributes** approximately **112.9 MW** to the thermal violation.

Contingency **PJM Jeff-Lack 500** = The loss of the Jefferson – Lackawanna 500 kV line.

5. **(PENELEC) The OXBOW-N. MESHPPNY 230kV line loads from 107.84% to 134.42% of its emergency rating (617 MVA) for the single line contingency outage (PJM Jeff-Lack 500).** This project contributes approximately **110 MW** to the thermal violation.

Contingency **PJM Jeff-Lack 500** = The loss of the Jefferson – Lackawanna 500 kV line.

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. Queue U2-075 is 100 % responsible for replacement of the overdutied Peckville 230 kV breaker at the Queue U2-075 position in the PJM Queue. Other later Queue positions may have a cost allocation. The estimated cost to replace the Peckville 230 kV breaker is **\$500,000**. The work can be done in **15 months** or less.

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)

2. **(PENELEC) The North Meshoppen 230/115 kV transformer #3 217.9% overload.** This overload can be alleviated by replacing the transformer and associated equipment (circuit breaker, substation conductor, CT circuits, etc.) The estimated cost for the upgrade is **\$4,000,000**. The estimated time to complete is **24 months**.
3. **(PENELEC) The North Meshoppen 115 kV reactor overload.**

This overload can be alleviated by replacement of North Meshoppen 230/115 kV #3 transformer required for upgrade 2 above.

4. **(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 16.33 miles of transmission line as well as substation work at Oxbow. The 16.33 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 would be replaced with 1590 kcmil ACSR conductors for a rating of 653/793 MVA summer normal/summer emergency. 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 19-mile long transmission line from Lackawanna to Oxbow. Please note that the description of work and the cost estimates are preliminary without any field checks and extensive engineering review and therefore are subject to change. If for some reason FE decides to use a different conductor, PPL EU would have to reevaluate the cost estimate.

The total estimated cost for the PPL portion of the upgrade is \$700,000. The estimated time to complete is 24 months.

The total estimated cost is **\$20,471,000**. Time to construct is **48-60 months**.

5. **(PENELEC) The Oxbow – North Meshoppen 230kV line 107.84 % 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.

Option #2 – Lackawanna 500 kV

NETWORK IMPACTS

Generator Deliverability

(Normal system with all facilities in-service and Single, or N-1, contingencies for the Capacity portion only of the interconnection)

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only. Stuck Breaker and Bus Fault contingencies will also be checked for the Impact Study)

No problems identified.

Short Circuit

No problems identified. Queue U2-075 contributes to breakers found to be overdutied for earlier queue positions; however, U2-075's contribution of fault current is less than the required 3 % threshold for cost allocation.

Stability Analysis

Will be performed for the 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)

None.

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)

None.

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)

None.