#T162 Lock Haven 155 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 T162 project was studied as a 115 MW (net Energy and Capacity) injection into the Lock Haven – Flemington 69 kV line. Project T162 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

NETWORK IMPACTS

Local Transmission System Impacts

(Normal system conditions with all facilities in service, and contingency analysis per documented PPL EU Reliability Criteria, generally FERC Form 715, for Transmission Owner's underlying system)

1. With the injection of 115 MW, the Lock Haven-Flemington 69 kV line will load above the 100% of its summer normal rating. The Lock Haven-Flemington 69 kV line presently has a summer normal rating of 97 MVA. To eliminate the overload, this line will be reconductored with higher capacity conductors having a summer normal rating of 134 MVA.

2. Three 69 kV circuit breakers, six breaker disconnect switches and two line disconnect switches in the Lock Haven 69 kV substation will be loaded above their 100% rating.

3. **(Optional) If Queue T162 generation wants to operate with an alternate feed…….**

   With the injection of 115 MW, the Lock Haven-Renovo 69 kV line will load above the 100% of its summer normal rating. The Lock Haven-Renovo 69 kV line presently has a summer normal rating of 97 MVA. To eliminate the overload, this line will be reconductored with higher capacity conductors having a summer normal rating of 134 MVA.

4. For the contingency loss of a tower on the Lycoming-Lock Haven #3 69kV Line and the Lycoming-Lock Haven #4 69kV Line, the Lycoming-Lock Haven #1 69kV Line and the Lycoming-Lock Haven #2 69kV Line will load their Jersey Shore-Lock Haven section of both lines to greater than the 100% of their summer emergency rating.

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 with generation at maximum energy output. Note: Stuck breaker and bus fault contingency analysis was not performed for the Feasibility Study, but will be completed for the Impact Study)

No problems identified.

Short Circuit Analysis

No 230 kV and above circuit breaker problems were found by PJM. PPL EU will perform short circuit analysis for the 69 kV system during the Impact Study. Please note that the results from the short circuit analysis may necessitate additional system modifications.

Steady-State Voltage Requirements

(Evaluation of steady-state voltage and reactive requirements)

Will be performed for the Impact Study. Please note that the results from the steady-state voltage requirements analysis may necessitate additional system modifications.

Stability and Reactive Power Requirement

Will be performed for the Impact Study. Please note that the results from the stability and reactive power requirements analysis may necessitate additional system modifications.

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)

5. **(PPL/PENELEC)** The Lackawanna - Oxbow 230 kV line loads from **190.13% to 192.00%** of its **normal rating** (499 MVA) **for non-contingency conditions**. This project contributes approximately **9.3 MW** to the thermal violation.

6. **(PENELEC)** The Oxbow – North Meshoppen 230 kV line loads from **189.97% to 191.84%** of its **normal rating** (499 MVA) **for non-contingency condition**s. This project contributes approximately **9.3 MW** to the thermal violation.

7. **(PPL)** The Frackville – Siegfried 230 kV line loads from **102.67% to 106.17%** of its **emergency rating** (616 MVA) for the **tower line outage** (1PPL). This project contributes approximately **21.5 MW** to the thermal violation.

NETWORK UPGRADE REQUIREMENTS

New System Reinforcements - Local Transmission System

1. Upgrade for the normal system overload of the Lock Haven – Flemington 69 kV line section from Lock Haven to the T162 tap.

   Estimated cost is **$1,087,600;** and construction time of **24 - 30 months**.

   Upgrade description: Reconductor 3.2 miles of the Lock Haven – Flemington 69kV line using 713 Kcmil ACCC (All conductor composite core) conductor. This conductor is equivalent in weight and diameter to the existing 556 ACSR conductor. The Lock Haven – Flemington 69kV line will have the conductor replaced between Lock Haven and the interconnection customer.

2. Upgrade for the normal system overload of three 69 kV circuit breakers, six breaker disconnect switches, two line disconnect switches, and sections of bus work in the Lock Haven 69 kV substation.

   Estimated cost is **$1,047,000;** and construction time of **24 - 30 months**.

   Upgrade description: Replace three 69 kV, 600 amp, circuit breakers and ten switches with breakers and switches rated 1200 amps. Replace select sections 69 kV bus work with bus capable of 1200 amps.

3. **(OPTIONAL UPGRADE)** of the normal system overload of the Lock Haven – Renovo 69 kV line section from Lock Haven to the T162 tap Upgrade.

   Estimated cost is **$1,087,600;** and construction time of **24 - 30 months**.

   Upgrade description: Reconductor 3.2 miles of the Lock Haven – Renovo 69kV line using 713 Kcmil ACCC (Al conductor composite core) conductor. This conductor is equivalent in weight and diameter to the existing 556 ACSR

conductor. The Lock Haven – Ronovo 69kV line will have the conductor replaced between Lock Haven and the interconnection customer.

4. Upgrade for the tower line outage overload of the Jersey Shore-Lock Haven sections of the Lycoming-Lock Haven #1 and the Lycoming-Lock Haven #2 69kV Lines.

   Estimated cost is **$0 to $135,600 (See description below);** and construction time is minimal as compared to the other work required.

   Upgrade description: To mitigate the above contingency overload will require reconductoring portions of the above Lycoming-Lock Haven #1 and #2 69kV lines. This upgrade requirement was identified by PPL EU prior to the T162 project submittal, and is scheduled to be completed by May 2015. The reconductoring of the Lycoming-Lock Haven #1 and #2 69kV lines will have $0 cost impact on this project if the schedule is unchanged. If the schedule for the reconductoring of the Lycoming-Lock Haven #1 and #2 69kV lines is moved up to meet the T162 in-service date, an alternate special protection scheme (SPS) will be installed at Lock Haven. The SPS will monitor the loading on the Lycoming-Lock Haven #1 and #2 69kV lines. In the event that either of these lines are overloaded (caused only by the tower outage described above), a "trip" command will be sent to T162's 69kV breakers to open. The cost of the SPS is **$135,600**. This cost will be the responsibility of the T162 Interconnection Customer if PPL EU's May 2015 schedule is changed.

New System Reinforcements - Other Network Impacts

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

None identified as being required.

Contribution to Previously Identified System Reinforcements

(This project contributes to the Network Impact causing the need for these Network Upgrades. This project will be allocated a cost to be determined during the Impact Study)

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.*

5. Upgrade for previously overloaded Lackawanna - Oxbow 230 kV line.

A) PPL portion of the Lackawanna – Oxbow 230 kV line:

PPL EU owns approximately 0.18 miles of this 19 mile line. **Total cost of the PPL upgrade is $700,000**; Queue T162's cost allocation will be determined during the Impact Study, if required. Estimated required lead time for construction is **24 months.**

Upgrade description: 1033.5 kcmil ACSR terminal conductors at Lackawanna 230 kV Substation can be replaced with 1590 kcmil ACSR conductors for a new rating of 653/793 MVA summer normal/summer emergency.

B) First Energy portion of the Lackawanna – Oxbow 230 kV line:

Total cost of the First Energy upgrade is $19,771,000; Queue T162's cost allocation will be determined during the Impact Study, if required. Estimated required lead time for construction is **48-60 months.**

Upgrade description: Rebuild approximately 16.33 miles of transmission line to support new bundled conductor.

6. Upgrade for previously overloaded Oxbow – North Meshoppen 230 kV line**.**

Total cost of the upgrade is $12,597,000; Queue T162's cost allocation will be determined during the Impact Study, if required. Estimated required lead time for construction is **48-60 months.**

Upgrade description: Rebuild approximately 10.16 miles of transmission line to support new bundled conductor. In addition, North Meshoppen substation would require the upgrade or replacement of two CT circuits and replacement of substation conductor.

7. Upgrade for previously overloaded Frackville – Siegfried 230 kV line.

   Total cost of the upgrade is $106,000,000; Queue T162's cost allocation will be determined during the Impact Study, if required. Estimated required lead time for construction is **48 months.**

Upgrade description: In order to provide additional capacity on the Siegfried-Frackville 230kV line, PPL EU is proposing to rebuild the existing single circuit 230kV line to a double-circuit 230kV line between the two substations. The new line will be 41 miles long and will travel the existing right of way. The 230kV lines will be constructed with 1590 Kcmil ACSR conductors for a 653/793 MVA, summer normal/emergency ratings. The ratings are based on the conductor ratings and may be lower when the line is actually built.

POTENTIAL ISSUES

Delivery of the Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below may result in operational restrictions to the project under study or other PJM generation. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request. **These are not required reliability upgrades.**

As a result of the aggregate energy resources in the area, the following violations were identified:

No problems identified.