#T37 Hegins 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

– Option #1 (Eldred 230 kV)

The T37 project was studied as a 150 MW Energy (30 MW Capacity) injection into the Eldred 230 kV bus. Project T37 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

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 were identified.

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)

1. The Frackville - Seigfried 230kV line loads from 95.14% to 102.47% (DC power flow) of its emergency rating (616MVA) for the tower line outage of Montour – Susquehanna 230 kV and Susquehanna T10 station – Montour 230 kV lines (1PPL). This project contributes approximately 45.2MW to cause this PJM Planning Reliability Criteria thermal violation.

Short Circuit Analysis

No problems identified.

Steady-State Voltage Requirements
(Evaluation of steady-state voltage and reactive requirements)

Will be performed for the Impact Study.

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

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. The Susquehanna – Jenkins 230kV line loads from **104.50% to 105.62%** [1] of its emergency rating (617MVA) for the tower line outage of Susquehanna – Mountain tap 230 kV and Susquehanna T10 station – Mountain 230 kV line including the Mountain 230/69 kV transformer (UGI-TOWER1). This project contributes approximately **6.9 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) or 5% of the Facility rating is required for cost allocation responsibility.

3. The Oxbow – North Meshoppen 230kV line loads from **161.45% to 163.20%** [1] of its emergency rating (617MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **10.8 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

4. The Nottingham – Peach Bottom Tap – Graceton 230 kV line #220-08 Reactor at Nottingham substation loads from **155.80% to 156.88%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

5. The Nottingham – Peach Bottom Tap 230kV line #220-08 section loads from **155.77% to 156.84%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

6. The Peach Bottom Tap – Graceton 230kV line #220-08 section loads from **155.77% to 156.84%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

7. The Conastone – North Northwest 500kV line [2] loads from **142.41% to 143.43%** [1] of its emergency rating (2901MVA) for the tower line outage of Conastone – Mt Carmel 230 kV – North Northwest 230 and Conastone – Mt Carmel 230 kV lines and Carmel – North Northwest 230 kV lines (CNSTN_NWEST_NNWEST_A). This project contributes approximately **29.6 MW** to this PJM Planning Reliability Criteria thermal violation.

Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

Note 2: Conastone – North Northwest line is not an existing line, it is an upgrade for an earlier queued project.

Note 3: A threshold of 5 MW loading contribution and a threshold of 10% generator DFAX (15 MW) is required for cost allocation responsibility.

8. The North Meshoppen – East Towanda 230kV line loads from **110.63% to 112.16%** [1] of its emergency rating (554MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **8.5 MW** [3] to this PJM Planning Reliability Criteria thermal violation..

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

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. Frackville – Seigfried 230 kV line upgrade.

   The estimated magnitude cost for this upgrade including substation terminal equipment cost is $106,000,000.

   Description of Work:
   In order to provide additional capacity on the Siegfried-Frackville 230kV line, PPL EU is proposing to rebuild the existing single circuit 230kV line line to a future double-circuit (single circuit initial) design 230kV line between the two substations. The new line will be 41 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 be vary when the line is actually built. It should be noted that the above cost assumes the Siegfried-Frackville line cannot be removed

from service for a long duration rebuild. As such, the cost includes construction of temporary transmission facilities that would be removed upon completion of the line.

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)*

2. Susquehanna – Jenkins 230 kV line upgrade.

   The estimated magnitude cost for this upgrade including substation terminal equipment cost is $70,000,000.
   Description of Work:
   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 be vary when the line is actually built.

3. Oxbow – North Meshoppen 230kV line upgrade.

   Penelec Work
   The estimated magnitude cost for this upgrade is **$12,807,000**. Estimated construction time is **36 months**.

   Description of Work:
   Rebuild approximately 10.16 miles of transmission line, replacement of a disconnect switch and substation conductor at Oxbow substation, and replacement of substation conductor and upgrade / replacement of two CT circuits at North Meshoppen substation.

   PPL Work
   Lackawanna – Oxbow 230kV line ugrade.
   The estimated magnitude cost for this upgrade including substation terminal equipment cost is $550,000 in addition to the First Energy upgrade costs.

   Description of Work:
   In order to provide additional capacity on the North Meshoppen – Lackawanna 230 kV line, PPL EU is proposing to re-conductor 0.18 miles of existing 1033 kcmil line. The new line will be 1590 Kcmil equivalent ACCC (composite core) conductor. The 230 kV lines will be rated for summer normal/emergency of 653/793 MVA respectively or higher. This rebuild will also require substation

terminal modifications at PPL EU's Lackawanna substation. The rebuild will be 0.18 miles long and will travel the existing right of way.

4. Nottingham Reactor (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:

   The estimated magnitude cost for this upgrade is **$200,000**. Estimated construction time is **12 months**.

   Description of Work:
   Replace the line reactor with a higher rated reactor.

5. Nottingham – Peach Bottom Tap (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:

   The estimated magnitude cost for this upgrade is **$40,000,000**. Estimated construction time is **48 months**.

   Description of Work:
   Rebuild the Nottingham to Peach Bottom Tap portion of the 230 kV line to meet high capacity requirements. Includes $20,000,000 for a new river crossing.

6. Peach Bottom Tap – Graceton (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:

   a) PECO Energy Portion
      (Peach Bottom Tap to the Pennsylvania / Maryland Border)

      The estimated magnitude cost for this upgrade is **$61,000,000**. Estimated construction time is **48 months**.

      Description of Work:
      Relocate the PECO Energy portion of this line to underground to facilitate the construction of the additional 500 kV lines between Peach Bottom and Conastone that are required for Queue S105 and previous projects. Note: 220-08 line is an offsite source for Peach Bottom Nuclear Generating Station and its integrity must be maintained.

   b) BG&E Portion
      (Pennsylvania / Maryland Border to Graceton)

The estimated magnitude cost for this upgrade is **$20,000,000**. Estimated construction time is **48 months**.

Description of Work:
Rebuild the 13.6 mile BG&E portion of the Peach Bottom Tap to Graceton line section as a high capacity 230 kV line (Normal Rating = 1243MVA; Emergency Rating = 1411MVA) @ $1.5M per mile.

c) Rebuild the 220-08 line crossing of the Susquehanna River (Pennsylvania / Maryland Border)

The estimated magnitude cost for this upgrade is **$20,000,000**.

7. Conastone – North Northwest 500 kV line upgrade.

The estimated cost to build a second Conastone – North Northwest 500 kV line is **$118,600,000** and it will take **96 to 120 months** to construct.

Description of Work:
Construct a second Conastone to North Northwest line parallel to the proposed first Conastone to North Northwest line on the same Right of Way. Total length is approximately 19.6 miles. Conductor will be a 3 - bundle 1,590 kcm ACSR. Estimated cost is $109,000,000. In addition, one new 500 kV breaker bay will be required at Conastone ($3,200,000) and two new 500 kV breaker bays will be required at North Northwest ($6,400,000).

Note:
The T37 queue project may have additional impacts and therefore additional cost allocation for the reinforcements associated with the installation of North North West substation which taps the existing Kemptown - Conastone 500 kV line, and the first North Northwest 500 kV line which were required for earlier queued projects. If applicable, the exact cost allocation and schedule will be included in the Impact study report.

8. North Meshoppen – East Towanda 230 kV line upgrade.

The estimated magnitude cost for this upgrade is **$16,915,000**. Estimated construction time is **36 months**.

Description of Work:
Reconductor approximately 21.66 miles of 230 kV transmission line between North Meshoppen and East Towanda substations. Terminal upgrades at East Towanda substation: (1) Replace substation conductor and line trap, and (2) Replace three CT circuits.

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:

1. Contribution of **86.8 MW** overloads the Queue Q28 (option #1 – Frackville) 230 kV line from **95.9% to 114.97%** of its emergency rating (455 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).
2. Contribution of **86.3 MW** overloads the Frackville H3 - Frackville 230 kV line from **98.66% to 117.64%** of its emergency rating (455 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).
3. Contribution of **53.7 MW** further overloads the Frackville – Siegfried 230 kV from **106.95% to 115.67%** of its emergency rating (616 MVA) for the outage of Sunbury – Juniata 500 kV line (Cont Id. PJM69).
4. Contribution of 9.7 MW further overloads the N. Meshoppen – Oxbow 230 kV line from **166.28% to 168.22%** of its normal rating (499 MVA) for a base case outage.
5. Contribution of **9.7 MW** further overloads the Lackawanna – Oxbow 230 kV line from **166.1% to 168.06%** of its normal rating (499 MVA) for a base case outage.
6. Contribution of **25.5 MW** further overloads the Conastone – North Northwest 500 kV line from **169.69% to 170.92%** of its normal rating (2078 MVA) for a base case outage.
7. Contribution of **30.4 MW** further overloads the Peach Bottom – Conastone 500 kV circuit #1 from **159.52% to 160.69%** of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV circuit #2 (Cont Id. PJM17_2).
8. Contribution of **7.4 MW** further overloads the Northwest 311 – Granite1 230 kV line from **168.03% to 169.18%** its emergency rating (641 MVA) for the outage of Kemptown – North Northwest 500 kV line (Cont Id. PJM13B_NNWEST_B).
9. Contribution of **11.4 MW** further overloads the N. Meshoppen – E. Towanda 230 kV line from **105.35% to 107.42%** its emergency rating (554 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).
10. Contribution of **26.4 MW** further overloads the Conastone – North Northwest 500 kV line from **131.36% to 132.27%** its emergency rating (2901 MVA) for the outage of Conastone 230/500 kV transformer (Cont Id. PJM19).

Network Impacts

– Option #2 (Eldred – Pine Grove 69 kV #2 Line)

The T37 project was studied as a 150 MW Energy (30 MW Capacity) injection into the Eldred – Pine Grove 69 kV #2 line. Project T37 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

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 were identified.

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)

1. The Frackville - Siegfried 230kV line loads from **95.14% to 102.47%** of its emergency rating (616MVA) for the tower line outage of Montour – Susquehanna 230 kV line and the Susquehanna T10 Station – Montour 230 kV line (1PPL). This project contributes approximately **45.2 MW** to cause this PJM Planning Reliability Criteria thermal violation.

Short Circuit Analysis

No problems identified.

Steady-State Voltage Requirements
(Evaluation of steady-state voltage and reactive requirements)

Will be performed for the Impact Study.

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

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. The Susquehanna – Jenkins 230kV line loads from **104.50% to 105.62%** [1] of its emergency rating (617MVA) for the tower line outage of Susquehanna – Mountain tap 230 kV line and the Susquehanna T10 station – Mountain 230 kV line including the Mountain 230/69 kV transformer (UGI-TOWER1). This project contributes approximately **6.9MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) or 5% of Facility Rating is required for cost allocation responsibility.

3. The Oxbow – North Meshoppen 230kV line loads from **161.45% to 163.20%** [1] of its emergency rating (617MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **10.8MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

4. The Nottingham – Peach Bottom Tap – Graceton 230kV line Reactor at the Nottingham terminal loads from **155.81% to 156.88%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV Circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

5. The Nottingham – Peach Bottom Tap 230kV line section loads from **155.77% to 156.84%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

6. The Peach Bottom Tap - Graceton 230kV line section loads from **155.77% to 156.84%** [1] of its emergency rating (627MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **6.7 MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

7. The Conastone – North Northwest 500kV line [2] loads from **142.41% to 143.43%** [1] of its emergency rating (2901MVA) for the tower line outage of the Conastone – Mt Carmel 230 kV line and the Mt Carmel – North Northwest 230 line and the Conastone – Mt Carmel 230 kV lines and Mt Carmel – North Northwest 230 kV lines (CNSTN_NWEST_NNWEST_A). This project contributes approximately **29.6MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – North Northwest line is not an existing line, it is an upgrade for an earlier queued project.

Note 3: A threshold of 5 MW loading contribution and a threshold of 10% generator DFAX (15 MW) is required for cost allocation responsibility.

8. The North Meshoppen – East Towanda 230kV line loads from **110.63% to 112.16%** [1] of its emergency rating (554MVA) for the tower line outage of Conastone – Peach Bottom 500 kV circuits #1 and #2 (CONAS_PB) [2]. This project contributes approximately **8.5MW** [3] to this PJM Planning Reliability Criteria thermal violation.

   Note 1: A threshold of 1% loading contribution is required for cost allocation responsibility.

   Note 2: Conastone – Peach Bottom circuit #2 is not an existing line, it is an upgrade for an earlier queued project.

   Note 3: A threshold of 5 MW loading contribution and a threshold of 5% generator DFAX (7.5 MW) is required for cost allocation responsibility.

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. Frackville – Seigfried 230 kV line upgrade.

   The estimated magnitude cost for this upgrade including substation terminal equipment cost is $106,000,000.

   Description of Work:
   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 future double-circuit (single circuit initial) design 230kV line between the two substations. The new line will be 41 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 be vary when the line is actually built. It should be noted that the above cost assumes the Siegfried-Frackville line cannot be removed from service for a long duration rebuild. As such, the cost includes construction of temporary transmission facilities that would be removed upon completion of the line.

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)*

2. Susquehanna – Jenkins 230 kV line upgrade.

   The estimated magnitude cost for this upgrade including substation terminal equipment cost is **$70,000,000**.

   Description of Work:
   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 be vary when the line is actually built.

3. Oxbow – North Meshoppen 230kV line upgrade.

   Penelec Work
   The estimated magnitude cost for this upgrade is **$12,807,000**. Estimated construction time is **36 months**.

   Description of Work:
   Rebuild approximately 10.16 miles of transmission line, replacement of a disconnect switch and substation conductor at Oxbow substation, and replacement of substation conductor and upgrade / replacement of two CT circuits at North Meshoppen substation.

   PPL Work
   Lackawanna – Oxbow 230kV line ugrade.
   The estimated magnitude cost for this upgrade including substation terminal equipment cost is $550,000 in addition to the First Energy upgrade costs.

   Description of Work:
   In order to provide additional capacity on the North Meshoppen – Lackawanna 230 kV line, PPL EU is proposing to re-conductor 0.18 miles of existing 1033 kcmil line. The new line will be 1590 Kcmil equivalent ACCC (composite core) conductor. The 230 kV lines will be rated for summer normal/emergency of 653/793 MVA respectively or higher. This rebuild will also require substation terminal modifications at PPL EU's Lackawanna substation. The rebuild will be 0.18 miles long and will travel the existing right of way.

4. Nottingham Reactor (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:
   The estimated magnitude cost for this upgrade is **$200,000**. Estimated construction time is **12 months**.

   Description of Work:
   Replace the line reactor with a higher rated reactor.

5. Nottingham – Peach Bottom Tap (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:

   The estimated magnitude cost for this upgrade is **$20,000,000**. Estimated construction time is **48 months**.

   Description of Work:
   Rebuild the Nottingham to Peach Bottom Tap portion of the 230 kV line to meet high capacity requirements.

6. Peach Bottom Tap – Graceton (piece of the Nottingham – Peach Bottom Tap – Graceton three terminal 230 kV line #220-08) upgrade:

   d) PECO Energy Portion
      (Peach Bottom Tap to the Pennsylvania / Maryland Border)

      The estimated magnitude cost for this upgrade is **$61,000,000**. Estimated construction time is **48 months**.

      Description of Work:
      Relocate the PECO Energy portion of this line to underground to facilitate the construction of the additional 500 kV lines between Peach Bottom and Conastone that are required for Queue S105 and previous projects. Note: 220-08 line is an offsite source for Peach Bottom Nuclear Generating Station and its integrity must be maintained.

   e) BG&E Portion
      (Pennsylvania / Maryland Border to Graceton)

      The estimated magnitude cost for this upgrade is **$20,500,000**. Estimated construction time is **48 months**.

      Description of Work:

Rebuild the 13.6 mile BG&E portion of the Peach Bottom Tap to Graceton line section as a high capacity 230 kV line (Normal Rating = 1243MVA; Emergency Rating = 1411MVA) @ $1.5M per mile.

f) Rebuild the 220-08 line crossing of the Susquehanna River (Pennsylvania / Maryland Border)

The estimated magnitude cost for this upgrade is **$20,000,000**.

7. Conastone – North Northwest 500 kV line upgrade.

The estimated cost to build a second Conastone – North Northwest 500 kV line is **$118,600,000** and it will take **96 to 120 months** to construct.

Description of Work:
Construct a second Conastone to North Northwest line parallel to the proposed first Conastone to North Northwest line on the same Right of Way. Total length is approximately 19.6 miles. Conductor will be a 3 - bundle 1,590 kcm ACSR. Estimated cost is $109,000,000. In addition, one new 500 kV breaker bay will be required at Conastone ($3,200,000) and two new 500 kV breaker bays will be required at North Northwest ($6,400,000).

Note:
The T37 queue project may have additional impacts and therefore additional cost allocation for the reinforcements associated with the installation of North North West substation which taps the existing Kemptown - Conastone 500 kV line, and the first North Northwest 500 kV line which were required for earlier queued projects. If applicable, the exact cost allocation and schedule will be included in the Impact study report.

8. North Meshoppen – East Towanda 230 kV line upgrade.

The estimated magnitude cost for this upgrade is **$16,915,000**. Estimated construction time is **36 months**.

Description of Work:
Reconductor approximately 21.66 miles of 230 kV transmission line between North Meshoppen and East Towanda substations. Terminal upgrades at East Towanda substation: (1) Replace substation conductor and line trap, and (2) Replace three CT circuits.

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:

1. Contribution of **86.8 MW** overloads the Queue Q28 (option #1) – Frackville 230 kV line from **95.9% to 114.89%** of its emergency rating (455 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).
2. Contribution of **86 MW** overloads the Frackville H3 - Frackville 230 kV line from **98.66% to 117.55%** of its emergency rating (455 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).
3. Contribution of **53.6 MW** further overloads the Frackville – Siegfried 230 kV from **106.95% to 115.67%** of its emergency rating (616 MVA) for the outage of Sunbury – Juniata 500 kV line (Cont Id. PJM69).
4. Contribution of **9.7 MW** further overloads the N. Meshoppen – Oxbow 230 kV from **166.28% to 168.22%** of its normal rating (499 MVA) for a base case outage.
5. Contribution of **14.5 MW** further overloads the N. Meshoppen – Oxbow 230 kV from **151.06% to 153.41%** of its emergency rating (617 MVA) for the outage of Sunbury – Juniata 500 kV line (Cont Id. PJM69).
6. Contribution of **9.7 MW** further overloads the Lackawanna – Oxbow 230 kV from **166.28% to 168.22%** of its normal rating (499 MVA) for a base case outage.
7. Contribution of **25.5 MW** further overloads the Conastone – North Northwest 500 kV from **169.56% to 170.92%** of its normal rating (2078 MVA) for a base case outage.
8. Contribution of **30.4 MW** further overloads the Peach Bottom – Conastone 500 kV circuit #1 from **159.52% to 160.69%** of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV circuit #2 (Cont Id. PJM17_2).
9. Contribution of **7.4 MW** further overloads the Northwest West 311 – Granite1 230 kV from **168.03% to 169.18%** its emergency rating (641 MVA) for the outage of Kemptown – North Northwest 500 kV line (Cont Id. PJM13B_NNWEST_B).
10. Contribution of **11.4 MW** further overloads the N. Meshoppen – E. Towanda 230 kV from **105.35% to 107.42%** its emergency rating (554 MVA) for the outage of Sunbury to Juniata 500 kV line and Sunbury to Susquehanna 500 kV line (Cont Id. PJM69).

11. Contribution of **26.4 MW** further overloads the Conastone – North Northwest 5000 kV from **131.36% to 132.27%** its emergency rating (2901 MVA) for the outage of Conastone 230/500 kV ransformer. (Cont Id. PJM19).