Queue # Q04 - Snake Spring 115 kV

Generation Interconnection

Network Impacts

The **#Q04 project was studied as an injection of 140 MW (28 MW of capacity) into the Snake Spring 115 kV substation.** Project #Q04 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability – at the 28 MW capacity value level

No problems identified.

New System Reinforcements

Multiple Facility Contingency – Reliability Requirements at the 140 MW full output level

NOTE: For Feasibility Studies, only double circuit (tower) outages are evaluated – not line fault and stuck breaker.

1. The Allegheny – Pride 115 kV line is overloaded at around 131% (196.5 MVA) of its emergency rating (150 MVA) for the **tower outage** of the Juniata - Lewisburg 230kV line and the Juniata – Dauphin 230kV line. The Q04 project contributes approximately 59 MW to the contingency facility loading.

   To mitigate this overload condition would require replacement/upgrade of the following:

   - **Reconductor/upgrade of approximately 7 miles of the 11.08 miles of transmission line between Allegheny and Pride substations (estimated to cost approximately $1,550,000)**

2. The Shelocta – Keystone 230 kV line is overloaded at around 105% (897 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata - Lewisburg 230kV line and the Juniata – Dauphin 230kV line. The Q04 project contributes approximately 62 MW to the contingency facility loading.

   To mitigate this overload condition would require replacement/upgrade of the following:

   Shelocta Substation:

   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**

   Keystone Substation:

   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000), and**
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**

3. The Curryville – Saxton 115 kV line is overloaded at around 100% (179 MVA) of its emergency rating (179 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 86 MW to the contingency facility loading.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Saxton substation:
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

Contribution to Previously Identified Overloads

4. The Somerset - Pride 115 kV line is overloaded at around 186% (279 MVA) of its emergency rating (150 MVA) for the **tower outage** of the Juniata - Lewisburg 230kV line and the Juniata – Dauphin 230kV line. The Q04 project contributes approximately 59 MW to the contingency facility loading which was previously identified for project P60.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Somerset substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
   - **Replacement/upgrade of a substation conductor (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a additional substation conductor (estimated to cost approximately $100,000)**

   Reconductor/upgrade of approximately 6.5 miles of the 11.08 miles of transmission line between Somerset and Allegheny substations (estimated to cost approximately $1,700,000)

   Pride substation:
   It is assumed that the new substation will have components that will not be more limiting than the desired rating.

5. The Garrett 115 kV/138kV transformer is overloaded at around 158% (142.2 MVA) of its emergency rating (90 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 27 MW to the contingency facility loading which was previously identified for projects P48 and P60.

To mitigate this overload condition would require replacement/upgrade of the following:
Garrett substation:

- **Replacement/upgrade of the Garrett transformer, its circuit breaker and (estimated to cost approximately $1,750,000)**
- **Replacement/upgrade of the Garrett transformer substation conductor (estimated to cost approximately $100,000)**

6. The Garrett-Garrett 115 kV line is overloaded at around 132% (165 MVA) of its emergency rating (125 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 27 MW to the contingency facility loading.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Garrett substation:

   - **Replacement/upgrade of a wave trap (estimated to cost approximately $115,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of disconnect switch (estimated to cost approximately $75,000)**
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**

   Reconductor/upgrade of approximately 1.9 miles of transmission line between Garrett Tap and Garrett Substation (estimated to cost approximately $570,000)

7. The Saxton – Snake Spring 115 kV line is overloaded at around 155% (192.2 MVA) of its emergency rating (124 MVA) for the **tower outage** of the Muddy Run 220-06 230 kV line and the Muddy Run 220-07 230 kV line. The Q04 project contributes approximately 82 MW to the contingency facility loading which was previously identified for project P60.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Saxton substation:

   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

Reconductor/upgrade of approximately 18.1 miles of transmission line between Saxton and Snake Springs substations (estimated to cost approximately $4,600,000).

8. The Allegheny – P60Tap 115 kV line is overloaded at around 137% (205.5 MVA) of its emergency rating (150 MVA) for the **tower outage** of the Juniata - Lewisburg 230kV line and the Juniata – Dauphin 230kV line. The Q04 project contributes approximately 59 MW to the contingency facility loading which was previously identified for project P60.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Reconductor/upgrade of approximately 5 miles of the 21.76 miles of transmission line between Allegheny and Bedford North substations (estimated to cost approximately $1,300,000)

9. The Claysburg – Summit 115 kV line is overloaded at around 129% (188.3 MVA) of its emergency rating (146 MVA) for the **tower outage** of the Muddy Run 220-06 230 kV line and the Muddy Run 220-07 230 kV line. The Q04 project contributes approximately 50 MW to the contingency facility loading which was previously identified for project P60.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Claysburg substation:
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
   - **Replacement of a disconnect switch (estimated to cost approximately $75,000)**

   Summit substation:
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**

10. The Scalp Level – Hooversville 115 kV line is overloaded at around 109% (195.1 MVA) of its emergency rating (179 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 24 MW to the contingency facility loading which was previously identified for project P60.

    To mitigate this overload condition would require replacement/upgrade of the following:

    Hooversville substation:
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

- **Replacement/upgrade of CT circuit (estimated to cost approximately $125,000)**

11. The Scalp Level – Rachel H 115 kV line is overloaded at around 103% (184.4 MVA) of its emergency rating (179 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 24 MW to the contingency facility loading which was previously identified for project P60.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Rachel Hill substation:
    - **Replacement/upgrade of a CT circuit (estimated to cost approximately $125,000)**
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

12. The Shelocta – Homer City 230 kV line is overloaded at around 102% (871.1 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata - Lewisburg 230kV line and the Juniata – Dauphin 230kV line. The Q04 project contributes approximately 50 MW to the contingency facility loading which was previously identified for project P48.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Shelocta substation:
    - **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**

13. The Rockwood – Penn Mar 115 kV line is overloaded at around 101% (144.4 MVA) of its emergency rating (143 MVA) for the **tower outage** of the Homer City - Quemahoning 230kV line and the Seward – Tower 230kV line. The Q04 project contributes approximately 27 MW to the contingency facility loading which was previously identified for project P60.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Penn Mar substation:
    - **Replacement/upgrade of circuit breaker (estimated to cost approximately $225,000)**

Contribution to Previously Identified System Reinforcements
To be determined in the System Impact Study.

Short Circuit

FirstEnergy completed a screening analysis of the Penelec 115 kV circuit breaker interrupting duties in the area. This screening found that the Q04 project contributed partially or fully to 18 breakers exceeding the screening criteria and therefore possibly exceeding their fault interrupting capability.

Detailed studies will be performed during the System Impact Study and the results will be included in the System Impact Study report.

Potential Congestion Issues

PJM and FirstEnergy also studied the delivery of the energy portion of this interconnection request. The following analysis has been performed to inform the Interconnection Customer (Queue Q04) of potential congestion issues (operational restrictions) that may occur and affect the Q04 project's ability to operate at full output for certain system conditions. **The upgrades listed below are not required reliability upgrades for the Queue Q04 interconnection.** Please note that the number of facilities identified below as requiring upgrades is quite extensive – with a number of these facilities requiring reconductoring/rebuilding of transmission lines. Some of the reconductoring/rebuilding projects can be done in a "short" time frame while others are quite extensive and will require a "long" time to complete. In general, the time necessary to design and rebuild an extensive facility upgrade will take approximately 2-3 years to complete. If the Q04 Interconnection Customer wants to pursue construction of any of these upgrades, a separate "Transmission Interconnection" request must be submitted and the upgrades must be performed as merchant transmission projects.

Category A – Transmission System Impacts (Facilities monitored and operated by PJM)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q04) at 100% energy output and Peak summer loading (80/20 load forecast).

Q04 Operational considerations: The facilities below (potentially overloaded) are monitored and operated by PJM. PJM rules and methods for readjusting pre-contingency (N-1) dispatch will be followed if this system condition occurs. This may or may not cause curtailment of Q04 generation to below its 100% energy output.

1. The Keystone 500/230 kV #4 transformer loads to approximately 122% (567 MVA) of its emergency rating (465 MVA) for the outage of the Keystone 500/230 kV #3 transformer. The energy portion of #Q04 contributes approximately 36 MW to this **contingency** condition which was previously identified as a potential congestion issue for the energy portion of the P22, P28, P45A, P47, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   Keystone Substation:

   - **Replacement/upgrade of the 500/230 kV transformer to one of a larger size. (estimated to cost approximately $5,500,000)**

2. The Keystone 500/230 kV #3 transformer loads to approximately 120% (565.2 MVA) of its emergency rating (471 MVA) for the outage of the Keystone 500/230 kV #4 transformer. The energy portion of #Q04 contributes approximately 36 MW to this **contingency** condition which was previously identified as a potential congestion issue for the energy portion of the P22, P28, P45A, P47, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Keystone Substation:
   - **Replacement/upgrade of the 500/230 kV transformer to one of a larger size. (estimated to cost approximately $5,500,000)**

3. The energy portion of #Q04 contributes approximately 52 MW (115% of 854 MVA) to the **contingency** overload on the Homer City-Shelocta 230 kV line (854 MVA) for the outage of the Handsome Lake-Wayne 345 kV line which was previously identified as a potential congestion issue for the energy portion of the O56, O72, P22, P28, P45A, P47, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Shelocta Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**

   Reconductor/upgrade of approximately 10.73 miles of transmission line between Homer City and Shelocta (estimated to cost approximately $4,800,000)

   Homer City Substation:
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a circuit breaker (estimated to cost approximately $300,000)**

4. The Keystone-Shelocta 230 kV line loads to approximately 112% (956.5 MVA) of its emergency rating (854 MVA) for the outage of the Handsome Lake-Wayne 345 kV line. The energy portion of #Q04 contributes approximately 50 MW to this **contingency** condition which was previously identified as a potential congestion issue for the energy portion of the P28, P45A, P47, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Shelocta Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**

Reconductor/upgrade of approximately 2.26 miles of transmission line between Shelocta and Keystone substations (estimated to cost approximately $1,400,000), and

Keystone Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**
- **Replacement/upgrade of 2 CT circuits (estimated to cost approximately $140,000)**

5. The energy portion of #Q04 contributes approximately 27 MW (111%) to the **contingency** overload on the Raystown-Altoona 230 kV line (554 MVA) for the outage of the Keystone-Shelocta-Homer City 230 kV line which was previously identified as a potential congestion issue for the energy portion of the O72, P01, P22, P45A, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Altoona Substation:

   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $125,000)**

6. The energy portion of #Q04 contributes approximately 28 MW (115% of 554 MVA) to the **contingency** overload on the Raystown-Lewistown 230 kV line (554 MVA) for the outage of the Keystone-Shelocta-Homer City 230 kV line which was previously identified as a potential congestion issue for the energy portion of the O72, P45A, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Lewistown Substation:

   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement of a circuit breaker (estimated to cost approximately $425,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

   Reconductor/upgrade of approximately 27.37 miles of transmission line between Lewistown and Raystown (estimated to cost approximately $13,685,000)

7. The Johnstown-N39 Tap 230 kV line loads to approximately 101% (623 MVA) of its emergency rating (617 MVA) for the outage of the Keystone-Shelocta-Homer City 230 kV line. The energy portion of #Q04 contributes approximately 12 MW to this **contingency** overload condition.

   To mitigate this overload condition would require replacement/upgrade of the following:

   Reconductor/upgrade of approximately 20 miles of the 36.22 miles of transmission line between Johnstown and Altoona (estimated to cost approximately $10,000,000)

8. The Lewistown-Juniata 230 kV line loads to approximately 100% (617 MVA) of its emergency rating (617 MVA) for the outage of the Keystone-Shelocta-Homer City 230 kV line. The energy portion of #Q04 contributes approximately 23 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the O38, O72, P45A, P47, P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Reconductor/upgrade of approximately 24.69 miles of transmission line between Lewistown and Juniata (estimated to cost approximately $12,345,000)

Category B – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q04) at 100% energy output and Peak summer loading (80/20 load forecast).

Q04 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q04 generation to below its 100% energy output.

9. The energy portion of #Q04 contributes approximately 58 MW (to 239 MW or 208%) to the **normal** overload on the Somerset – Pride 115 kV line (normal rating 115 MVA) which was previously identified as a potential congestion issue for the energy portion of the P48 and P60 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Somerset Substation:
   - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
- **Replacement/upgrade of a CT circuit (estimated to cost approximately $125,000)**
- **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**

Reconductor/upgrade of approximately 6.6 miles of transmission line between Somerset and Pride Substations (estimated to cost approximately $1,700,000)

10. The energy portion of #Q04 contributes approximately 65 MW (or 185%) to the **normal** overload on the Saxton – Snake Spring 115 kV line (normal rating 90 MVA) which was previously identified as a potential congestion issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Saxton Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $75,000)**
    - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
    - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000**

    Reconductor/upgrade of approximately 18.1 miles of transmission line between Saxton and Snake Springs substations (estimated to cost approximately $5,430,000)

11. The Saxton – Snake Spring 115 kV line loads to approximately 156% (193.4 MVA) of its emergency rating (124 MVA) for the outage of the N39 Tap – Johnstown 230 kV line. The energy portion of #Q04 contributes approximately 66 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P48 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Saxton Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $75,000)**
    - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
    - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
    - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

Reconductor/upgrade of approximately 18.1 miles of transmission line between Saxton and Snake Springs substations (estimated to cost approximately $5,430,000)

12. The energy portion of #Q04 contributes approximately 58 MW (185%) to the **normal** overload on the Allegheny-P60 Tap 115 kV line (normal rating 115 MVA). **NOTE:** Overloading of the Allegheny-P60 Tap 115 kV Line was previously identified as a potential congestion issue under both **normal** and **contingency** conditions for the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Allegheny Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**

    Reconductor/upgrade of approximately 3 miles of transmission line between Allegheny and P60 (estimated to cost approximately $630,000)

13. The energy portion of #Q04 contributes approximately 59 MW (167% of its 150 MVA rating) to the **contingency** overload on the Allegheny-P60 Tap 115 kV line (150 MVA) for the outage of the Altoona-Raystown-Lewistown 230 kV line which was previously identified as a potential congestion issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Allegheny Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**

    Reconductor/upgrade of approximately 3 miles of transmission line between Allegheny and P60 (estimated to cost approximately $630,000)

14. The energy portion of #Q04 contributes approximately 58 MW to the **normal** overload on the Allegheny-Pride 115 kV line (normal rating 115 MVA). **NOTE:** Overloading of the Allegheny-Pride 115 kV Line was previously identified as a potential congestion issue under both **normal** and **contingency** conditions for the P60 project.
    To mitigate this overload condition would require replacement/upgrade of the following:
    Allegheny Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

    Reconductor/upgrade of approximately 7 miles of transmission line between Allegheny and Pride (estimated to cost approximately $1,550,000)

15. The energy portion of #Q04 contributes approximately 18 MW to the **normal** overload on the Garrett 138/115 kV transformer (normal rating 63 MVA) which was previously identified as a potential congestion issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    <u>Garrett Substation:</u>
    Replacement/upgrade of circuit breaker and transformer (estimated to cost approximately $1,750,000)

16. The energy portion of #Q04 contributes approximately 23 MW (133% of the 125 MVA rating) to the **contingency** overload on the Garrett-Garrett 115 kV line (125 MVA) for the outage of the Homer City-Shelocta-Keystone 230 kV line which was previously identified as a potential congestion issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Garrett Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

    Reconductor/upgrade of approximately 1.9 miles of transmission line between Garrett Tap and Garrett substation (estimated to cost approximately $570,000)

17. The energy portion of #Q04 contributes approximately 8 MW (106 MW or 117%) to the **normal** overload on the Glory-Dixonville 115 kV line (normal rating 90 MVA). **NOTE:** Overloading of the Glory-Dixonville 115 kV Line was previously identified as a potential congestion issue under **contingency** conditions for the energy portion of the O56, O72, P01, P22, P28, P48 and P60 projects.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Glory Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

18. The energy portion of #Q04 contributes approximately 13 MW (184 MVA or 1485) to the **contingency** overload on the Glory-Dixonville 115 kV line (124 MVA) for the outage of the Homer City-Shelocta-Keystone 230 kV line which was previously identified as a potential congestion issue for the energy portion of the O56, O72, P01, P22, P28, P48 and P60 projects.

To mitigate this overload condition would require replacement/upgrade of the following:
Glory substation:

- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
- **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

19. The Rockwood-Penn-Mar 115 kV line loads to approximately 114% (163 MVA) of its emergency rating (143 MVA) for the outage of the Keystone-Shelocta-Homer City 230 kV line. The energy portion of #Q04 contributes approximately 18 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P48 and P60 projects.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Penn Mar Substation:

    - **Replacement/upgrade of circuit breaker (estimated to cost approximately $225,000)**
    - **Replacement/upgrade of CT circuit (estimated to cost approximately $125,000)**

    Rockwood Substation:

    - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**

20. The energy portion of #Q04 contributes approximately 16 MW (108%) to the **contingency** overload on the Summit-Westfall 115 kV line (229 MVA) for the outage of the Johnstown-N39 Tap 230 kV line which was previously identified as a potential congestion issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Summit substation:

    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**

    Westfall substation:

    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**

21. The Altoona-AH26 Tap 46 kV line loads to 113% of its emergency rating (31 MVA) for the outage of the Lewistown-Raystown 230 kV line. Q04 contributes approximately 2.8

MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P48 project.

To mitigate this overload condition would require replacement of 1.24 of the 2.34 miles of transmission line (estimated to cost approximately $225,000)

22. The Bedford North-P48 115 kV line loads to 229% of its emergency rating (150 MVA) for the outage of the Pride-Somerset 115 kV line. The energy portion of #Q04 contributes approximately 11.5 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P48 and P60 projects.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Bedford North substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
    - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**
    - **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**
    - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
    - **Replacement/upgrade of circuit breaker (estimated to cost approximately $300,000)**

    Upgrade/replacement of 12 miles of the 21.76 miles of transmission line conductor between Bedford North and Allegheny substations. Transmission line from Bedford North to P48 (approximately 12 miles) - approximately $3,000,000

23. The Saxton 115-23 kV transformer #6 loads to 148.7% of its emergency rating (29.7 MVA) for the outage of the Curryville-Saxton 115 kV line. The energy portion of #Q04 contributes approximately 15.9 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P60 project.
    To mitigate this overload condition would require replacement of the 115-23 kV transformer to a larger size (estimated to be approximately $1,300,000).

Category C – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec). These contingency overloads were not possible prior to the Queue Q04 project. The identified contingency overloads are caused directly by Q04 and are likely to cause Q04 curtailment to less than 100% energy output during summer and possibly winter operation.

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q04) at 100% energy output and Peak summer loading (80/20 load forecast).

Q04 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q04 generation to below its 100% energy output.

24. The energy portion of #Q04 contributes approximately 59 MW (to 186%) to the previously identified **contingency** overload on the Somerset – Pride 115 kV line (150 MVA) for the outage of the Altoona-Raystown-Lewistown 230 kV line. **NOTE:** Overloading of the Somerset-Pride 115 kV Line was previously identified as both a **normal** overload issue and as a **Multiple Facility Contingency** issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Somerset substation:
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
    - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
    - **Replacement/upgrade of a CT circuit (estimated to cost approximately $125,000)**
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**
    - **Replacement/upgrade of a circuit breaker (estimated to cost approximately $300,000)**

    Reconductor/upgrade of approximately 6.6 miles of transmission line (estimated to cost approximately $1,700,000)

25. The Allegheny-Pride 115 kV line loads to approximately 138% (207 MVA) of its emergency rating (150 MVA) for the outage of the Altoona-Raystown-Lewistown 230 kV line. The energy portion of #Q04 contributes approximately 47 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement/upgrade of the following:

    - **Reconductor/upgrade of approximately 7 miles of the 11.08 miles of transmission line between Allegheny and Pride substations (estimated to cost approximately $1,550,000)**

26. The energy portion of #Q04 contributes approximately 50 MW to the **normal** overload on the Claysburg-Summit 115 kV line (normal rating 125 MVA). **NOTE:** Overloading of the Claysburg-Summit 115 kV Line was previously identified as a **Multiple Facility Contingency** issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Claysburg Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

    Reconductor/upgrade of approximately 12.13miles of transmission line between Claysburg and Summit (estimated to cost approximately $3,650,000)

    Summit Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
    - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

27. The energy portion of #Q04 contributes approximately 50 MW (to 160% or 233 MW) to the **contingency** overload on the Claysburg-Summit 115 kV line (146 MVA) for the outage of the Johnstown-N39 Tap 230 kV line. **NOTE:** Overloading of the Claysburg-Summit 115 kV Line was previously identified as a **Multiple Facility Contingency** issue for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Claysburg Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $150,000)**
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**

    Summit Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**
    - **Replacement/upgrade of a line/wave trap (estimated to cost approximately $115,000)**
    - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

28. The energy portion of #Q04 contributes approximately 18 MW to the **normal** overload on the Garrett-Garrett 115 kV line (normal rating 90 MVA). **NOTE:** Overloading of the Garrett-Garrett 115 kV Line was previously identified as a potential congestion issue under **contingency** conditions for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Garrett Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

    Reconductor/upgrade of approximately 1.9 miles of transmission line between Garrett Tap and Garrett substation (estimated to cost approximately $570,000)

29. The Summit-Westfall 115 kV line loads to approximately 105% (184.8 MVA) of its normal rating (176 MVA). The energy portion of #Q04 contributes approximately 12 MW to this **normal** overload condition. **NOTE:** Overloading of the Summit-Westfall 115 kV Line was previously identified as a potential congestion issue under **contingency** conditions for the energy portion of the P60 project.

    To mitigate this overload condition would require replacement/upgrade of the following:
    Summit Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**

    Westfall Substation:
    - **Replacement/upgrade of substation conductor (estimated to cost approximately $100,000)**

30. The ABW Tap-Warrior Ridge 46 kV line loads to 105% of its emergency rating (63 MVA) for the outage of the Altoona-Raystown 230 kV line. Q04 contributes approximately 3 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of 2.63 miles of transmission line conductor (estimated to cost approximately $473, 000)

31. The Bellwood-Tipton 46 kV line loads to 103% of its emergency rating (31 MVA) for the outage of the Altoona-N39 230 kV line. Q04 contributes approximately 1.1 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of 3.23 miles of transmission line (estimated to cost approximately $580,000)

32. The Beth33-CC Prison 46 kV line loads to 118% of its emergency rating (24 MVA) for the outage of the Wilmore Jct 115 kV lines. Q04 contributes approximately 2.1 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of 0.121 miles of transmission line (estimated to cost approximately $23,000)

33. The CC Prison-SGR Tap 46 kV line loads to 105% of its emergency rating (24.2 MVA) for the outage of the Wilmore Jct 115 kV lines. Q04 contributes approximately 1.94 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of 1.724 miles of transmission line (estimated to cost approximately $315,000)

34. The Claysburg-HCR Tap 46 kV line loads to 170% of its emergency rating (42 MVA) for the outage of the Altoona-N39 230 kV line. Q04 contributes approximately 4.3 MW to this **contingency** overload condition. Penelec is responsible for upgrade of a portion of the line that requires upgrade without the generation addition, and the developer is responsible for the remainder.

    To mitigate this overload condition would require replacement of 2.92 miles of transmission line (estimated to cost approximately $530,000)

35. The Claysburg 115-46 kV transformer #1 loads to 130% of its emergency rating (39 MVA) for the outage of the Allegheny-Pride 115 kV line. Q04 contributes approximately 3.9 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of the transformer (estimated to cost approximately $1,200,000)

36. The Claysburg-Curryville 115 kV line loads to 216% of its emergency rating (184 MVA) for the outage of the Pride-Somerset 115 kV line. Q04 contributes approximately 128 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement/upgrade of the following:

    <u>Curryville Substation:</u>

    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
    - **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**

    Replacement/upgrade of 6.51 miles of transmission line (estimated to cost approximately $2,000,000)

Claysburg Substation:

- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
- **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**
- **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
- **Replacement/upgrade of circuit breaker (estimated to cost approximately $300,000)**
- **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

37. The Hollidaysburg-PC CAR S 46 kV line loads to 105.9% of its emergency rating (42 MVA) for the outage of the Altoona-N39 230 kV line. Q04 contributes approximately 2.5 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement of 0.570 miles of transmission line (estimated to cost approximately $105,000)

38. The Hooversville-Somerset 115 kV line loads to 106% of its emergency rating (179 MVA) for the outage of the Garrett 115-138 kV transformer. Q04 contributes approximately 28.6 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement/upgrade of the following:

    Hooversville Substation:

    - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

39. The Curryville-Saxton 115 kV line loads to 229% of its emergency rating (179 MVA) for the outage of the Pride-Somerset 115 kV line. Q04 contributes approximately 140 MW to this **contingency** overload condition.

    To mitigate this overload condition would require replacement/upgrade of the following:

    Saxton Substation:

    - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
    - **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**
    - **Replacement/upgrade of CT circuit (estimated to cost approximately $100,000)**
    - **Replacement/upgrade of circuit breaker (estimated to cost approximately $300,000)**

- **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**

Replacement/upgrade of 6.17 miles of transmission line (estimated to cost approximately $1,850,000)

<u>Curryville substation:</u>

- **Replacement/upgrade of disconnect switch (estimated to cost approximately $90,000)**