

Queue # Q24 - Gold-Sabinsville 115 kV
Generation Interconnection

Network Impacts

The #Q24 project was studied as an injection of 101 MW (20.2 MW of capacity) into a tap of the Gold-Sabinsville 115 kV line. Project #Q24 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability – at the 20.2 MW capacity value level

No problems identified.

New System Reinforcements

Multiple Facility Contingency – Reliability Requirements at the 101 MW full output level

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

1. The Mansfield-South Troy 115 kV line is overloaded at around 135% (160.6 MVA) of its emergency rating (119 MVA) for the **tower outage** of the Lackawanna-Mountain 230 kV line and the Lackawanna-Stanton 230 kV line. The Q24 project contributes approximately 45 MW to the contingency facility loading. Overload was originally identified with the 052 project.

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

Mansfield Substation:

- **Replacement/upgrade of CT circuit (estimated to cost approximately \$125,000)**
2. The South Troy-E. Towanda 115 kV line is overloaded at around 121% (144 MVA) of its emergency rating (119 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q24 project contributes approximately 43 MW to the contingency facility loading. Overload was originally identified with the P47 project.

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

Reconductor/upgrade of approximately 19.54 miles of transmission line between South Troy and E. Towanda (estimated to cost approximately \$5,000,000)

Contribution to Previously Identified Overloads

3. The Shelocta-Keystone 230 kV line is overloaded at around 107% (914 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q24 project contributes approximately 14 MW to the contingency facility loading. Overload was originally identified with the P47 project.

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 Keystone and Shelocta (estimated to cost approximately \$1,400,000)

Keystone Substation:

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

4. The Homer City-Shelocta 230 kV line is overloaded at around 104% (881 MVA) of its emergency rating (854 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q24 project contributes approximately 15 MW to the contingency facility loading. Overload was originally identified with the P48 project.

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)**

5. The Niles Valley-Mansfield 115 kV line is overloaded at around 163% (194 MVA) of its emergency rating (119 MVA) for the **tower outage** of the Lackawanna-Mountain 230 kV line and the Lackawanna-Stanton 230 kV line. The Q24 project contributes approximately 48 MW to the contingency facility loading. Overload was originally identified with the O59 project.

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

Mansfield Substation:

- **Replacement/upgrade of two CT circuits (estimated to cost approximately \$250,000)**

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

Niles Valley Substation:

- **Replacement/upgrade of a CT circuit (estimated to cost approximately \$125,000)**
- **Replacement/upgrade of line/wave trap (estimated to cost approximately \$115,000)**

6. The Sabinsville-N36 Tap 115 kV line is overloaded at around 154% (245 MVA) of its emergency rating (159 MVA) for the **tower outage** of the Lackawanna-Mountain 230 kV line and the Lackawanna-Stanton 230 kV line. The Q24 project contributes approximately 49 MW to the contingency facility loading. Overload was originally identified with the O52 project.

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

Sabinsville Substation:

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

Reconductor/upgrade of approximately 10.55 miles of the 12.3 miles of transmission line between Sabinsville and Gold (estimated to cost approximately \$2,750,000)

7. The Sabinsville-Niles Valley 115 kV line is overloaded at around 144% (229 MVA) of its emergency rating (159 MVA) for the **tower outage** of the Lackawanna-Mountain 230 kV line and the Lackawanna-Stanton 230 kV line. The Q24 project contributes approximately 48 MW to the contingency facility loading. Overload originally identified with O59 project.

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

Niles Valley Substation:

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

Reconductor/upgrade of approximately 13.22 miles of transmission line between Niles Valley and Sabinsville (estimated to cost approximately \$4,000,000)

Sabinsville Substation:

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

Contribution to Previously Identified System Reinforcements

To be determined in the System Impact Study.

Short Circuit

FirstEnergy completed a screening analysis of the Penelec 115kV circuit breaker interrupting duties in the area. This screening found that the Q24 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 Q24) of potential congestion issues (operational restrictions) that may occur and affect the Q24 project's ability to operate at full output for certain system conditions. **The upgrades listed below are not required reliability upgrades for the Queue Q24 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 Q24 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 Q24) at 100% energy output and Peak summer loading (80/20 load forecast).

Q24 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 Q24 generation to below its 100% energy output.

None.

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 Q24) at 100% energy output and Peak summer loading (80/20 load forecast).

Q24 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 Q24 generation to below its 100% energy output.

1. The Sabinsville-N36 Tap 115 kV line loads to approximately 112% (145.6 MVA) of its normal rating (130 MVA) under base case (normal rating) conditions. The energy portion of Q24 contributes approximately 40 MW to this condition. Overload originally identified with O52 project.

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

Sabinsville Substation:

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

N36 Substation:

- **It is assumed that this substation will not have components that will cause a new loadability limit.**

2. The Sabinsville-N36 Tap 115 kV line loads to approximately 107% (170 MVA) of its emergency rating (159 MVA) for the 7PPL contingency. The energy portion of Q24 contributes approximately 41 MW to this condition. Overload originally identified with O52 project.

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

Sabinsville Substation:

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

N36 Substation:

- **It is assumed that this substation will not have components that will cause a new loadability limit.**

3. The Niles Valley-Mansfield 115 kV line loads to approximately 103% (122.6 MVA) of its emergency rating (119 MVA) for the 7PPL contingency. The energy portion of Q24

contributes approximately 38 MW to this condition. Overload originally identified with O59 project.

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

Mansfield Substation:

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

Niles Valley Substation:

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

4. The Sabinsville-Niles Valley 115 kV line loads to approximately 102% (132.6 MVA) of its normal rating (130 MVA) under base case (normal rating) conditions. The energy portion of Q24 contributes approximately 39 MW to this condition. Overload originally identified with O59 project.

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

Sabinsville Substation:

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

5. The Potter-O52 115 kV line loads to 171% (263 MVA) of its emergency rating (225 MVA) for the outage of the Niles Valley-Sabinsville –N36 115 kV line. Q24 contributes approximately 100 MW to this condition. Overload originally identified with P47 project.

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

Reconductor/upgrade of approximately 12 miles of the 16.11 miles of transmission line between Potter and Gold (estimated to cost approximately \$3,000,000)

O52 Substation:

- It is assumed that the new equipment to be installed will not be a limiting component.

6. The Gold-N36 115 kV line loads to 123% (280 MVA) of its emergency rating (226 MVA) for the outage of the Niles Valley-Sabinsville –N36 115 kV line. Q24 contributes approximately 95 MW to this condition. Overload originally identified with O59 project.

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

Reconductor/upgrade of approximately 1.75 miles of the 12.3 miles of transmission line between Gold and Sabinsville (estimated to cost approximately \$500,000)

N36 Substation:

- **It is assumed that the new equipment to be installed will not be a limiting component.**
7. The Mansfield 115-34.5 kV transformer loads to 255% (64 MVA) of its emergency rating (25.1 MVA) for the outage of the P47-South Troy 115 kV line. Q24 contributes approximately 10 MW to this condition. Overload originally identified with P47 project.

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

Mansfield Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor (estimated to cost approximately \$1,500,000)**
8. The Mansfield-P47 115 kV line loads to 218% (259 MVA) of its emergency rating (119 MVA) for the outage of the Farmers Valley –Potter 115 kV line. Q24 contributes approximately 95 MW to this condition. Overload originally identified with O59 project.

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

Mansfield Substation:

- **Replacement/upgrade of 2 CT circuits (estimated to cost approximately \$250,000)**
- **Replacement/upgrade of a disconnect switch (estimated to cost approximately \$80,000)**
- **Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)**

P47 Substation:

It is assumed that the new equipment to be installed will not be a limiting component

Reconductor/upgrade of approximately 1 mile of the 17.46 miles of transmission line between Mansfield and South Troy (estimated to cost approximately \$275,000)

9. The Niles Valley-Mansfield 115 kV line loads to 179% (213 MVA) of its emergency rating (119 MVA) for the outage of the Glade-Warren 230 kV line. Q24 contributes approximately 45 MW to this condition. Overload originally identified with O59 project.

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

Mansfield Substation:

- Replacement/upgrade of 2 CT circuits (estimated to cost approximately \$250,000)
- Replacement/upgrade of a disconnect switch (estimated to cost approximately \$80,000)
- Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)
- Replacement/upgrade of a line/wave trap (estimated to cost approximately \$115,000)

Niles Valley Substation:

- Replacement/upgrade of a CT circuit (estimated to cost approximately \$125,000), and
- Replacement/upgrade of a line/wave trap (estimated to cost approximately \$115,000)

10. The P47-South Troy 115 kV line loads to 175% (250 MVA) of its emergency rating (143 MVA) for the outage of the Glade-Warren 230 kV line. Q24 contributes approximately 40 MW to this condition. Overload originally identified with O59 project.

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

South Troy Substation:

- Replacement/upgrade of a disconnect switch (estimated to cost approximately \$80,000)
- Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)

P47 Substation:

It is assumed that the new equipment to be installed will not be a limiting component

Reconductor/upgrade of approximately 16 miles of the 17.46 miles of transmission line between Mansfield and South Troy (estimated to cost approximately \$4,500,000)

11. The Sabinsville-N36 115 kV line loads to 166% (264 MVA) of its emergency rating (159 MVA) for the outage of the Glade-Warren 230 kV line. Q24 contributes approximately 45 MW to this condition. Overload originally identified with O52 project.

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

Sabinsville Substation:

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

N36 Substation:

- **It is assumed that the new equipment to be installed will not be a limiting component.**

Reconductor/upgrade of approximately 10.55 miles of the 12.3 miles of transmission line between Gold and Sabinsville (estimated to cost approximately \$3,000,000)

12. The Sabinsville-Niles Valley 115 kV line loads to 157% (250 MVA) of its emergency rating (159 MVA) for the outage of the Glade-Warren 230 kV line. Q24 contributes approximately 45 MW to this condition. Overload originally identified with O59 project.

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

Sabinsville Substation:

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

Niles Valley Substation:

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

Reconductor/upgrade of approximately 13.89 miles of transmission line between Sabinsville and Niles Valley (estimated to cost approximately \$4,000,000)

13. The Sabinsville 115-34.5 kV transformer #1 loads to 192% (17.7 MVA) of its emergency rating (9.2 MVA) for the outage of the Niles Valley-Sabinsville 115 kV line. Q24 contributes approximately 2.7 MW to this condition. Overload originally identified with O52 project.

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

Sabinsville Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor (estimated to cost approximately \$1,500,000)**

14. The Sabinsville 115-34.5 kV transformer #2 loads to 145% (18.4 MVA) of its emergency rating (12.7 MVA) for the outage of the Niles Valley-Sabinsville 115 kV line. Q24 contributes approximately 2.7 MW to this condition. Overload originally identified with O52 project.

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

Sabinsville Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor (estimated to cost approximately \$1,500,000)**

15. The South Troy 115-34.5 kV transformer #1 loads to 197% (41.4 MVA) of its emergency rating (21 MVA) for the outage of the East Towanda-South Troy 115 kV line. Q24 contributes approximately 6 MW to this condition. Overload originally identified with P47 project.

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

South Troy Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor (estimated to cost approximately \$1,500,000)**

16. The South Troy 115-34.5 kV transformer #2 loads to 200% (41.8 MVA) of its emergency rating (21 MVA) for the outage of the East Towanda-South Troy 115 kV line. Q24 contributes approximately 7 MW to this condition. Overload originally identified with P47 project.

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

South Troy Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor (estimated to cost approximately \$1,500,000)**

17. The South Troy-East Towanda 115 kV line loads to 208% (248 MVA) of its emergency rating (119 MVA) for the outage of the East Towanda-P47 115 kV line. Q24 contributes approximately 36 MW to this condition. Overload originally identified with P47 project.

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

South Troy Substation:

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

East Towanda Substation:

- **Replacement/upgrade of 2 CT circuits (estimated to cost approximately \$150,000)**
- **Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)**
- **Replacement/upgrade of a line/wave trap (estimated to cost approximately \$115,000)**

Reconductor/upgrade of approximately 19.54 miles of transmission line between South Troy and East Towanda (estimated to cost approximately \$5,000,000)

Category C – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec). These contingency overloads were not possible prior to the Queue Q24 project. The identified contingency overloads are caused directly by Q24 and are likely to cause Q24 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 Q24) at 100% energy output and Peak summer loading (80/20 load forecast).

Q24 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 Q24 generation to below its 100% energy output.

18. The Gold-O52 115 kV line loads to 122% (276 MVA) of its emergency rating (225 MVA) for the outage of the Niles Valley-Sabinsville –N36 115 kV line. Q24 contributes approximately 95 MW to this condition.

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

Reconductor/upgrade of approximately 4.11 miles of the 16.11 miles of transmission line between Potter and Gold (estimated to cost approximately \$1,200,000)

O52 Substation:

- **It is assumed that the new equipment to be installed will not be a limiting component.**

19. The Grover 230-34.5 kV transformer loads to 108% (82 MVA) of its emergency rating (76 MVA) for the outage of the East Towanda-South Troy 115 kV line. Q24 contributes approximately 15 MW to this condition.

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

Grover Substation:

- **Replacement/upgrade of transformer, circuit breaker, and associated substation conductor(estimated to cost approximately \$1,700,000)**

20. The Two Mile - Potter 115 kV line loads to 161% (362 MVA) of its emergency rating (225 MVA) for the outage of the Niles Valley-Sabinsville –N36 115 kV line. Q24 contributes approximately 104 MW to this condition.

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

Two Mile Run Substation:

- Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)
- Replacement/upgrade of a disconnect switch (estimated to cost approximately \$80,000)

Reconductor/upgrade of approximately 13.3 miles of transmission line between Two Mile Run and Potter (estimated to cost approximately \$3,750,000)

21. The Two Mile – Farmers Valley 115 kV line loads to 190% (340 MVA) of its emergency rating (179 MVA) for the outage of the Niles Valley-Sabinsville –N36 115 kV line. Q24 contributes approximately 105 MW to this condition.

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

Two Mile Run Substation:

- Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)
- Replacement/upgrade of a disconnect switch (estimated to cost approximately \$80,000)

Farmers Valley Substation:

- Replacement/upgrade of some substation conductor (estimated to cost approximately \$125,000)
- Replacement/upgrade of a line/wave trap (estimated to cost approximately \$115,000)
- Replacement/upgrade of a CT circuit (estimated to cost approximately \$125,000)
- Replacement/upgrade of a circuit breaker (estimated to cost approximately \$225,000)

Reconductor/upgrade of approximately 7.97 miles of transmission line between Two Mile Run and Farmers Valley (estimated to cost approximately \$2,000,000)