# P48 - Bedford North-Allegheny 115 kV

# Generation Interconnection

## Network Impacts

**The #P48 project was studied as an injection of 120 MW (24 MW of capacity) into a tap of Allegheny to Bedford North 115 kV circuit.** Project #P48 was evaluated for compliance with reliability criteria for summer peak conditions in 2010. Potential network impacts were as follows:

## Generator Deliverability – at the 24 MW capacity value level

No problem identified (no facility overloads under system single contingency conditions).

## Multiple Facility Contingency – Reliability Requirements at the 120 MW full output level

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

1. The Garret 115 kV/138kV transformer is overloaded to 124% of its emergency rating (92MVA) for the **tower outage** of the Homer City-Quemahoning 230kV line and the Seward–Tower 115 kV line. The P48 project contributes approximately 29 MW to the contingency facility loading.
   To mitigate this overload condition and provide a rating higher than the estimated loading requires replacement of the Garrett 138-115 kV transformer with one of a larger size at an estimated cost of $1,750,000. It will take approximately 2 years to complete this work.
2. The Homer City–Shelocta 230kV line is overloaded to 100.8% of its emergency rating (854MVA) for the **tower outage** of the Juniata-Lewistown 230kV line and the Juniata–Dauphin 230kV line. The P48 project contributes approximately 43 MW to the contingency facility loading.
   To mitigate this overload condition and provide a rating higher than the estimated loading requires the replacement of a disconnect switch at Shelocta substation at an estimated cost of $90,000.

## Contribution to Previously Identified Overloads (prior P queue projects)

None.

## New System Reinforcements – Single Contingency Reliability Requirements

None.

## Contribution to Previously Identified System Reinforcements (projects prior to P queue)

None

## Short Circuit

Under review by FirstEnergy. It will be completed in the Impact Study.

**Potential Congestion Issues**

PJM also studied the delivery of the energy portion of this interconnection request. The following analysis has been performed to inform the Interconnection Customer (Queue P48) of potential congestion issues (operational restrictions) that may occur and affect the P48 project's ability to operate at full output for certain system conditions. **The upgrades listed below are not required reliability upgrades for the Queue P48 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 P48 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 P48) at 100% energy output and Peak summer loading (80/20 load forecast).

P48 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 P48 generation to below its 100% energy output.

1. The P48 project contributes approximately 38 MW to the overloading of the Keystone 500/230kV transformer #4 (121% of its 465 MVA summer emergency rating) for the outage of the Keystone 500/230kV transformer #3, which was previously identified as a potential congestion issue for the P22, P28, P45A and P47 projects. To mitigate this overload would require replacement of the existing 500-230 kV transformer rated at 436 MVA summer normal / 465 MVA summer emergency with a new transformer. It is estimated that this upgrade will cost $5,500,000 and take approximately 2 years to complete.
2. The P48 project contributes approximately 38 MW to the overloading of the Keystone 500/230kV transformer #3 (120% of its 471 MVA summer emergency rating) for the outage of the Keystone 500/230kV transformer #4, which was previously identified as a potential congestion issue for the P22, P28, P45A and P47 projects. To mitigate this overload would require replacement of the existing 500-230 kV transformer rated at 440 MVA summer normal / 471 MVA summer emergency with a new transformer. It is estimated that this upgrade will cost $5,500,000 and take approximately 2 years to complete.
3. The P48 project contributes approximately 45 MW to the overloading of the Homer City-Shelocta 230 kV line for the outage of the Erie W. to Wayne 115 kV circuit, which was previously identified as a potential congestion issue for the O56, O72, P22, P28, P45A and P47 projects. The Homer City-Shelocta 230 kV line is rated at 694 MVA summer normal / 854 MVA summer emergency. The loading on this 230 kV line during the contingency condition reaches 995 MVA

(or 117% of its 854 MVA rating). To mitigate this overload would require replacement/upgrade of a disconnect switch at Shelocta (estimated to cost approximately $85,000), 10.73 miles of transmission line (estimated to cost approximately $4,800,000), a line/wave trap at Homer City (estimated to cost approximately $125,000), a CT circuit at Homer City (estimated to cost approximately $100,000) and a circuit breaker at Homer City (estimated to cost approximately $425,000).

4. The P48 project contributes 16 MW to the overloading of the Lewistown - Juniata 230 kV line (109% of its emergency rating of 617 MVA) for the outage of Juniata to Keystone 500 kV line, which was previously identified as a potential congestion issue for the O38, O72, P45A and P47 projects. The Lewistown-Juniata 230 kV line is rated at 499 MVA summer normal / 617 MVA summer emergency. The loading on this 230 kV line during the contingency condition reaches 672 MVA (or 109% of its rating). To mitigate this overload would require replacement/upgrade of 24.69 miles of 230 kV transmission line between Lewistown and Juniata (estimated to cost approximately $11,750,000), 1.05 miles of transmission line between Lewistown and Juniata (estimated to cost approximately $500,000) and the upgrade/replacement of a disconnect switch at Juniata (estimated to cost approximately $100,000).

5. The P48 project contributes 53 MW to the overloading (112% of its emergency rating of 854 MVA) of the Shelocta–Keystone 230 kV line for the outage of the Erie W. to Wayne 345 kV circuit, which was previously identified as a potential congestion issue for the P28, P45A and P47 projects. The Shelocta-Keystone 230 kV line is rated at 694 MVA summer normal / 854 MVA summer emergency. The loading on this 230 kV line during the contingency condition reaches 956 MVA (or 112% of its rating). To mitigate this overload would require replacement/upgrade of the disconnect switches at Shelocta and Keystone substations and is estimated to cost approximately $150,000, replacement of CTs at Keystone (estimated to cost approximately $140,000) and reconductoring approximately 2.26 miles of transmission line between Shelocta and Keystone (estimated to cost approximately $1,400,000).

6. The P48 project contributes 15.5 MW to the overloading of the Altoona-Raystown 230 kV line to 101.7% of its emergency rating for the outage of the Homer City-Shelocta 230 kV line, which was previously identified as a potential congestion issue for the O72, P01 and P45A projects. The Altoona-Raystown 230 kV line is rated at 488 MVA summer normal / 554 MVA summer emergency. The loading on this 230 kV line during the contingency condition reaches 563 MVA (or 101.7% of its rating). To mitigate this overload would require replacement/upgrade of the line/wave trap at Altoona substation and is estimated to cost approximately $125,000.

**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 P48) at 100% energy output and Peak summer loading (80/20 load forecast).

P48 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 P48 generation to below its 100% energy output.

7. The P48 project contributes 11 MW to the previously identified overload of the Glory-Dixonville 115 kV line for the outage of the Homer City-Shelocta-Keystone 230 kV circuit, which was previously identified as a potential congestion issue for the O56, O72, P01, P22 and P28 projects. The Glory-Dixonville 115 kV line is rated at 90 MVA summer normal / 124 MVA summer emergency. The loading on this 115 kV line during the contingency condition reaches 139 MVA (or 112% of its rating). To mitigate this overload would require replacement/upgrade of the substation conductor at Glory Substation and is estimated to cost approximately $125,000.
8. The P48 project contributes 23 MW to the previously identified overloading of the Lewistown-Raystown 230 kV line for the outage of the Homer City-Shelocta-Keystone 230 kV circuit, which was previously identified as a potential congestion issue for the O72 project. The Lewistown-Raystown 230 kV line is rated at 478 MVA summer normal / 554 MVA summer emergency. The loading on this 230 kV line during the contingency condition reaches 582 MVA (or 105% of its rating). To mitigate this overload would require replacement/upgrade of the line/wave trap at Lewistown (estimated to cost approximately $125,000), a CT circuit at Lewistown (estimated to cost approximately $100,000), and a circuit breaker at Lewistown (estimated to cost approximately $425,000).
9. The P48 project contributes 2.5 MW to the overloading of the Eldorado-Park Plaza 46 kV line to 113.5% of its emergency rating for the outage of the Altoona-N39 230 kV line, which was previously identified as a potential congestion issue for the O18 project. The Eldorado-Park Plaza 46 kV line is rated at 63 MVA summer normal / 63 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 71.5 MVA (or 113.5% of its rating). To mitigate this overload would require replacement/upgrade of 1.87 miles of transmission line conductor (estimated to cost approximately $240,000).
10. The P48 project contributes 1.1 MW to the overloading of the Meadows-EH1 Tap 46 kV line to 101.7% of its emergency rating for the outage of the Altoona-N39 230 kV line which was previously identified as a potential congestion issue for the P22 project. The Meadows-EH1 Tap 46 kV line is rated at 36 MVA summer normal / 36 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 36.6 MVA (or 101.7% of its rating). To mitigate this overload would require replacement/upgrade of 1 mile of transmission line conductor (estimated to cost approximately $125,000).
11. The P48 project contributes 2.3 MW to the overloading of the Raystown-Huntingdon 46 kV line to 104.8% of its emergency rating for the outage of the Altoona-Raystown 230 kV line which was previously identified as a potential congestion issue for the O56 project. The Raystown-Huntingdon 46 kV line is rated at 44 MVA summer normal / 44 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 46.1MVA (or 104.8% of

its rating). To mitigate this overload would require replacement/upgrade of 3.132 miles of transmission line (estimated to cost approximately $400,000).

12. The P48 project contributes 1.1 MW to the overloading of the Westfall-S21 Tap 46 kV line to 102% of its emergency rating for the outage of the Altoona-N39 230 kV line which was previously identified as a potential congestion issue for the P01 project. The Westfall-S21 Tap 115 kV line is rated at 42 MVA summer normal / 42 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 42.8 MVA (or 102% of its rating). To mitigate this overload would require reconductoring of 2.07 miles of transmission line (estimated to cost approximately $250,000).
13. The P48 project contributes 2.2 MW (5.2%) to the overloading of the WRH Tap-OC1 Tap 46 kV line for the outage of the Altoona-Raystown 230 kV line, which was previously identified as a potential congestion issue for the N39 and O17 projects. The WRH Tap-OC1 Tap 46 kV line is rated at 42 MVA summer normal / 42 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 66 MVA (or 157% of its rating). To mitigate this overload would require reconductoring of 4.01 miles of transmission line (previously estimated to cost approximately $450,000).

**Category C – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec). These contingency overloads were not possible prior to the Queue P48 project. The identified contingency overloads are caused directly by P48 and are likely to cause P48 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 P48) at 100% energy output and Peak summer loading (80/20 load forecast).

P48 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 P48 generation to below its 100% energy output.

14. The Garret 115kV/138kV transformer loads to 120% of its normal rating (67 MVA). The energy portion of #P48 contributes approximately 20 MW to this condition. The Garrett 138-115 kV transformer is rated at 67 MVA summer normal / 92 MVA summer emergency. The loading on this transformer during **normal** conditions reaches 80 MVA (or 120% of its normal rating). To mitigate this overload would require replacement/upgrade of the existing transformer to a larger size and replacement of the circuit breaker and is estimated to cost approximately $1,750,000. **NOTE:** Overloading of the Garret 115kV/138kV transformer was previously identified as a potential congestion issue under **contingency** conditions for the O17, O18, O19, O48 and O56 projects.
15. The Somerset – Pride 115kV line loads to 108% of its normal rating (115 MVA). The energy portion of #P48 contributes approximately 76 MW to this condition. The Somerset-Pride 115 kV line is rated at 115 MVA summer normal / 151 MVA

summer emergency. The loading on this 115 kV line during **normal** conditions reaches 124 MVA (or 108% of its normal rating). To mitigate this overload would require replacement/upgrade of (4 miles of the total of 11.08 miles) of transmission line conductor between the Somerset and Pride substations and is estimated to be approximately $800,000.

16. The Rockwood – Penn-Mar 115 kV line loads to 105% of its emergency rating (143 MVA) for the outage of the Homer City-Shelocta-Keystone 230 kV circuit. The energy portion of P48 contributes approximately 19 MW to this condition. The Rockwood-Penn Mar 115 kV line is rated at 124 MVA summer normal / 143 MVA summer emergency. The loading on this 115 kV line during the contingency condition reaches 150 MVA (or 105% of its emergency rating). To mitigate this overload would require replacement/upgrade of the CT circuit at Penn Mar substation (estimated to cost approximately $100,000) and upgrade/replacement of the circuit breaker at Penn Mar substation (estimated to cost approximately $325,000).
17. The P48 project contributes 2.1 MW to the overloading of the Altoona-AH26 Tap 46 kV line to 104.9% of its emergency rating (31 MVA) for the outage of the Altoona-N39 230 kV line. The Altoona-AH26 Tap 46 kV line is rated at 31 MVA summer normal / 31 MVA summer emergency. The loading on this 46 kV line during the contingency condition reaches 32.5 MVA (or 104.9% of its emergency rating). To mitigate this overload would require replacement/upgrade of 1.07 miles of transmission line conductor (estimated to cost approximately $150,000).
18. The P48 project contributes 88 MW to the overloading of the Bedford North-P48 115 kV line to 136% of its emergency rating for the outage of the O17-Somerset 115 kV line. The Bedford North-P48 115 kV line is rated at 115 MVA summer normal / 150 MVA summer emergency. The loading on this 115 kV line during the contingency condition reaches 204 MVA (or 136% of its emergency rating). To mitigate this overload would require replacement/upgrade of the line/wave trap at Bedford North (estimated to cost approximately $115,000), a CT circuit at Bedford North (estimated to cost approximately $100,000), and approximately 20 miles of transmission line between Bedford North and P48 (estimated to cost approximately $4,500,000).
19. The P48 project contributes 85.1 MW to the overloading of the Bedford North-Snake Springs 115 kV line to 118.7% of its emergency rating (178 MVA) for the outage of the O17-Somerset 115 kV line. The Bedford North-Snake Springs 115 kV line is rated at 115 MVA summer normal / 150 MVA summer emergency. The loading on this 115 kV line during the contingency condition reaches 178 MVA (or 118.7% of its emergency rating). To mitigate this overload would require replacement/upgrade of 7.05 miles of transmission line between Bedford North and Snake Springs (estimated to cost approximately $1,600,000) and the upgrade/replacement of a CT circuit at Bedford North (estimated to cost approximately $100,000).
20. The P48 project contributes 85.2 MW to the overloading of the Saxton-Snake Springs 115 kV line to 122.7% of its emergency rating for the outage of the O17-Somerset 115 kV line. The Saxton-Snake Springs 115 kV line is rated at 90 MVA summer normal / 124 MVA summer emergency. The loading on this 115 kV line during the contingency condition reaches 152 MVA (or 122.7% of its emergency rating). To mitigate this overload would require replacement/upgrade

of some substation conductor at Saxton substation (estimated to cost approximately $125,000) and reconductoring of 18.1 miles of transmission line between Saxton and Snake Springs substations (estimated to cost approximately $4,600,000).