#N42 – Mountaineer-Belmont 765kV

Generation Interconnection

This analysis was completed to assess the reliability impact for a new generator interconnecting to the PJM system as a capacity resource.

Network Impacts

The #N42 project was studied as an injection of 1200 MW at three different points in the system. Option 1 considers the capacity injection into the Mountaineer-Belmont 765 kV transmission line. Option 2 considers the capacity injection into the Sporn-Ravenswood Aluminum 138 kV transmission limnes. Option 3 considers an injection of 600 MW into the Sporn-Ravenswood 138 kV transmission lines and 600 MW into the Sporn-Waterford 345 kV transmission line. Project #N42 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Interconnection Option #1: Connection to the Mountaineer-Belmont 765 kV substation.

N41 Connected to the 765kV Mountaineer Substation

Generator Deliverability
No problems were identified

Multiple Facility Contingency – Tower Line Outages
No problems were identified

Short Circuit
No identified problems

New System Reinforcements
None identified

Contribution to Previously Identified System Reinforcements

None

N41 connected 600MW to Sporn 345kV and 600MW to Sporn 138kV

Generator Deliverability
No problems were identified

Multiple Facility Contingency – Tower Line Outages
No problems were identified

Short Circuit
No identified problems

New System Reinforcements
None identified

Contribution to Previously Identified System Reinforcements
None

Interconnection Option #2: **Connection to the Sporn-Ravenswood 138kV transmission lines.**

N41 Connected to the 765kV Mountaineer Substation

Generator Deliverability

1. The Sporn 345/138 kV #4 transformer is overloaded to 160% of its emergency rating (611 MVA) for the outage of the Sporn #3 345/138 kV transformer. The #N42 project contributes approximately 1 GW to the contingency overloaded facility

2. The Sporn 345/138 kV #3 transformer is overloaded to 106% of its normal rating (492 MVA). The #N42 project contributes approximately 535 MW to the normally overloaded facility

3. The Sporn 345/138 kV #B transformer is overloaded to 107% of its emergency rating (190 MVA) for the outage of the Waterford – Muskingum 345 kV circuit. The #N42 project contributes approximately 82 MW to the contingency overloaded facility

Multiple Facility Contingency – Tower Line Outages
No problems were identified

Short Circuit
No identified problems

Contribution to Previously Identified Overloads
None

Contribution to Previously Identified System Reinforcements
None

N41 connected 600MW to Sporn 345kV and 600MW to Sporn 138kV

Generator Deliverability

1. The Sporn 345/138 kV #4 transformer is overloaded to 241% of its emergency rating (611 MVA) for the outage of the Collingwood – Robison Park 345 kV circuit. The #N42 project contributes approximately 1GW to the contingency overloaded facility

2. The Sporn 345/138 kV #3 transformer is overloaded to 161% of its normal rating (492 MVA). The #N42 project contributes approximately 535 MW to the normally overloaded facility

Multiple Facility Contingency – Tower Line Outages

1. The Sporn 345/138 kV #4 transformer is overloaded to 129% of its emergency rating (611 MVA) for the Greene-Beatty and Greene-Adkins 345 kV tower line outage. The #N42 project contributes approximately 535 MW to the contingency overloaded facility

2. The Sporn 345/138 #3 transformer is overloaded to 142% of its emergency rating (556 MVA) for the Greene-Beatty and Greene-Adkins 345 kV tower line outage. The #N42 project contributes approximately 535 MW to the contingency overloaded facility

Short Circuit

No identified problems

Contribution to Previously Identified Overloads

The #N42 project will have some contribution to the costs associated with the upgrade of:

1. The Sporn #B 345/138 kV transformer. The #N42 project contributes approximately 82 MW to the contingency overloaded facility

2. The Waterford – Muskingum 345 kV circuit. The #N42 project contributes approximately 348 MW to the normally overloaded facility

Contribution to Previously Identified System Reinforcements

- Overloads on the Waterford-Muskingum 345 kV circuit will require reconductoring approximately 1 mile of the circuit out of Waterford and changing line risers at Muskingum. These changes can be accomplished prior to the in-service date of the IGCC. The estimated cost is **$1.2 million**.

- Overloads on the Sporn B 345/138 kV transformer will require the transformer to be replaced with a 450 MVA transformer. A 4% reactor in series with the transformer will be required to maintain the same through flow impedance as the old transformer. The estimated cost is **$3,500,000**.

Interconnection Option #3: Connection to the Sporn-Ravenswood Aluminum 138 kV and Sporn-Waterford 345 kV facilities:

N41 Connected to the 765kV Mountaineer Substation

Generator Deliverability

1. The Waterford to Muskingum 345 kV circuit is overloaded to 113% of its normal rating (1452 MVA). The #N42 project contributes approximately 471 MW (174 MW from 138 kV and 297 MW from 345 kV generating units respectively) to the normally overloaded facility.
2. The Sporn B 345/138 kV transformer is overloaded to 109% of its emergency rating (190 MVA) for the loss of the Muskingum to Waterford 345 kV circuit. The #N42 project contributes approximately 85 MW to the contingency overloaded facility.

Multiple Facility Contingency – Tower Line Outages

No problems were identified

Short Circuit

Evaluation to be completed in the Impact Study if this option chosen.

Contribution to Previously Identified Overloads

See Generator Deliverability above.

Contribution to Previously Identified System Reinforcements

- Overloads on the Waterford-Muskingum 345 kV circuit will require reconductoring approximately 1 mile of the circuit out of Waterford and changing line risers at Muskingum. These changes can be accomplished prior to the in-service date of the IGCC. The estimated cost is **$1.2 million**.

- Overloads on the Sporn B 345/138 kV transformer will require the transformer to be replaced with a 450 MVA transformer. A 4% reactor in series with the transformer will be required to maintain the same through flow impedance as the old transformer. The estimated cost is **$3,500,000**.

N41 connected 600MW to Sporn 345kV and 600MW to Sporn 138kV

Generator Deliverability

1. The Sporn #3 345/138 kV transformer is overloaded to 178% of its emergency rating (556 MVA) for the loss of the Sporn #4 345/138 kV transformer. The #N42 project contributes approximately 501 MW (all 501 MW from the generation at the 138 kV) to the contingency overloaded facility.
2. The Sporn #4 345/138 kV transformer is overloaded to 162% of its emergency rating (611 MVA) for the loss of the #B and #3 Sporn 345 kV transformers. The #N42 project contributes approximately 500 MW (all from the generation at the 138 kV) to the contingency overloaded facility.

3. The Poston to Eliotz 138 kV circuit is overloaded to 101% of its emergency rating (301 MVA) for the loss of the Muskingum to Waterford 345 kV circuit. The #N42 project contributes approximately 28 MW (14 MW from each unit) to the contingency overloaded facility.

Multiple Facility Contingency – Tower Line Outages

1. The Turne1 to Ruth 138 kV circuit is overloaded to 109% of its emergency rating (244 MVA) for the Amos – Kanawah – Sporn 345 kV tower line outage. The #N42 project contributes approximately 22 MW (11 MW from each unit) to the contingency overloaded facility.

Short Circuit

Evaluation to be completed in the Impact Study if this option chosen.

Network Upgrades

1. The solution to the overloaded Sporn transformers is to replace the 2-450 MVA Sporn #3 and #4 transformers with 3-675 MVA Units and add the appropriate 345 kV and 138 kV circuit breakers.The estimated cost is **$ 11,500,000.**

2. The solution to the Poston-Elliots Z 138kV line overload is to insall a reactor in series with the line. The estimated cost is **$1,500,000.**

3. The solution to the Turner-Ruth 138kV circuit overload is to reconductor/rebuild approximately 7 miles of the circuit. The estimated cost is **$3,000,000**.

Contribution to Previously Identified Overloads

1. The #N42 project contributes approximately 87 MW (42 MW and 45 MW from the 138 kV and the 345 kV generating units respectively) to the overload at the Sporn B 345/138 kV transformer.
2. The #N42 project contributes 488 MW (185 MW and 303 MW from the 138 kV and the 345 kV generation units respectively) to the overload at the Waterford to Muskingum 345 kV circuit.

Contribution to Previously Identified System Reinforcements

Overloads on the Waterford-Muskingum 345 kV circuit will require reconductoring approximately 1 mile of the circuit out of Waterford and changing line risers at Muskingum. These changes can be accomplished prior to the in-service date of the IGCC. The estimated cost is **$1.2 million**.

- Overloads on the Sporn B 345/138 kV transformer will require the transformer to be replaced with a 450 MVA transformer. A 4% reactor in series with the transformer will be required to maintain the same through flow impedance as the old transformer. The estimated cost is **$3,500,000**.

Double Contingencies

The American Electric Power Form 715 filing Annual Transmission Planning and Evaluation Report describes AEP's Planning requirements for double contingencies when evaluating generator connection to the Transmission system as "if as a result of additional generation, the loading on an EHV facility would exceed its emergency rating during double contingencies, the generating plant owner would be responsible for the necessary system modifications to reduce the EHV facility loading to within

emergency capability. Alternatively, the generating plant owner would be expected to reduce plant output should double contingency events occur in actual operation to prevent overloads."

Since there is an option to reduce generator output for any double contingency overloads that occur due to the new generating plant and this option would not require reinforcement, PJM has decided to evaluate double contingency conditions for generating projects in the Impact Study. Since any upgrades are identified for such conditions are not mandatory, not providing that information should not affect the overall cost required to interconnect the generating project identified in the Feasibility Study report. In the Impact study report PJM will identify any overloads that occur and provide a cost and time estimate for the system upgrades that will mitigate the overload and identify the operating procedure that could be applied instead of completing the upgrade.

Kammer Transformer Re-Rating

After the feasibility analysis for this project and the others in the N queue were completed, Allegheny Power reduced the rating on the Kammer 765/500kV transformer. Since reevaluating all of the N queue projects would result in a significant delay to the Generator Interconnection process the N queue projects were not evaluated with the new transformer rating. The new rating will be included in the Impact Study evaluation for any N Queue projects that decide to move that stage of the process.

Black Oak-Bedington 500kV and Mt. Storm-Doubs 500kV

Project N41 causes increased loading on Black Oak - Bedington 500 kV and Mt. Storm - Doubs 500 kV. Both of these circuits were identified as reliability problems in the 2009 RTEP Baseline report, however, the baseline required system upgrades are still under development. At the time of the Impact Study for project N41, it is expected that the baseline system upgrade will have been identified and at that time any additional system upgrade needed to support the generation project will be included in the Impact Study."