

## #N43 – Hanging Rock-Jefferson 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 #N43 project was studied as an injection of 1200 MW into a tap of the Hanging Rock – Jefferson 765 kV circuit. Project #N43 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Because of its electrical connection and its positioning within the PJM queue with respect to the #N41 and the #N42 projects, the results for the #N43 project will be given based on the 6 different combinations of the #N41 and the #N42 projects' interconnection options as follows:

### **Combination #1: N41 – Two 600 Mw units to Mountaineer 765kV N42 – Two 600 MW units to Mountaineer-Belmont 765kV**

#### **Generator Deliverability**

No problems were identified

#### **Multiple Facility Contingency – Tower Line Outages**

No problems were identified

#### **Short Circuit**

No problems were identified

#### **Contribution to Previously Identified Overloads**

No problems were identified

#### **Contribution to Previously Identified System Reinforcements**

None

### **Combination #2: N41 – One 600 MW unit to Sporn 345kV One 600 MW unit to Sporn 138kV N42 – Two 600 MW units to Mountaineer-Belmont 765kV**

#### **Generator Deliverability**

No problems were identified

#### **Multiple Facility Contingency – Tower Line Outages**

No problems were identified

#### **Short Circuit**

No problems were identified

### **Contribution to Previously Identified Overloads**

The #N43 will contribute to the costs associated with the following network reinforcements:

The Waterford – Muskingum 345 kV circuit. The #N43 project contributes 54 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**.

### **Combination #3: N41 – One 600 MW unit to Sporn 345kV**

**One 600 MW unit to Sporn 138kV**

**N42 – Two 600 MW units to Sporn-Ravenswood Al. 138kV**

#### **Generator Deliverability**

No problems were identified

#### **Multiple Facility Contingency – Tower Line Outages**

1. The Waterford – Muskingum 345 kV circuit is overloaded to 109% of its emergency rating (1942 MVA) for the Greene – Beaty and Beaty – Adkins 345 kV tower line outage. The #N43 project contributes approximately 347 MW to the contingency overloaded facility

#### **Short Circuit**

No problems were identified

### **Contribution to Previously Identified Overloads**

The #N43 project will have some cost contribution to the following network upgrades:

1. The Waterford – Muskingum 345 kV circuit. The #N43 project contributes approximately 54 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**.

### **Combination #4: N41 – Two 600 MW unit to Mountaineer 765kV**

**N42 – Two 600 MW units to Sporn-Ravenswood Al. 138kV**

#### **Generator Deliverability**

1. The Waterford – Muskingum 345 kV circuit is overloaded to 104% of its normal rating (1452 MVA). The #N43 project contributes approximately 348 MW to the normally overloaded facility

### **Multiple Facility Contingency – Tower Line Outages**

No problems were identified

### **Short Circuit**

No problems were identified

### **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**.

**Combination #5:** N41 – Two 600 MW unit to Mountaineer 765kV  
N42 – One 600 MW units to Sporn-Ravenswood Al. 138kV  
- One 600 MW unit to Sporn-Waterford 345kV

### **Generator Deliverability**

### **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**

The #N43 project contributes approximately 54 MW to the overload on 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**.

**Combination #6:** N41 – One 600 MW unit to Sporn 345kV  
One 600 MW unit to Sporn 138kV  
N42 – One 600 MW units to Sporn-Ravenswood Al. 138kV  
- One 600 MW unit to Sporn-Waterford 345kV

### **Generator Deliverability**

1. The Waterford – N42 tap 345 kV circuit is overloaded to 104% of its normal rating (1452 MVA). The #N43 project contributes approximately 88 MW to the normally overloaded facility.

2. The Wolf Creek to Muskingum 144/138 kV circuit is overloaded to 102% of its emergency rating (176 MVA) for the outage of the Kammer to Muskingum 345 kV circuit. The #N43 project contributes approximately 15 MW to the contingency overloaded facility.

### **Multiple Facility Contingency – Tower Line Outages**

1. The Chandler to Philo 138 kV circuit is overloaded to 106% of its emergency rating (173 MVA) for the Kammer – Muskingum – Beverly – Tidd 345 kV tower line outage. The #N43 project contributes approximately 12 MW to the contingency overloaded facility.
2. The Muskingum #A 345/138 kV transformer is overloaded to 105% of its emergency rating (543 MVA) for the Kammer – Muskingum – Beverly – Tidd 345 kV tower line outage. The #N43 project contributes approximately 29 MW to the contingency overloaded facility.
3. The Hillvill—Newcom 138 kV circuit is overloaded to 103% of its emergency rating (244 MVA) for the Kammer – Muskingum – Beverly – Tidd 345 kV tower line outage. The #N43 project contributes approximately 14 MW to the contingency overloaded facility.
4. The Muskingum #B 345/138 kV circuit is marginally overloaded with respect to its emergency rating (190 MVA) for the Kammer – Muskingum – Beverly – Tidd 345 kV tower line outage. The #N43 project contributes approximately 10 MW to the contingency overloaded facility.

### **Short Circuit**

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

### **Network Upgrades**

- The Wolf Creek-Muskingum 144/138kV transformer overload can be alleviated by retiring the transformer and implementing other measures to adjust voltage for the Wolf Creek station. This transformer at present is not owned by AEP, but will be owned by AEP when the N43 project is scheduled to go in service.
- The Muskingum transformer overloads can be alleviated by installing reactors on each of the transformers. The estimated cost is **\$3,000,000**.
- The overloads on the Chandler-Philo and Hillville-Newcom 138kV circuits can be alleviated by replacing miscellaneous station equipment to match the line conductor capabilities. The estimated cost is **\$745,000**.

### **Contribution to Previously Identified Overloads**

1. The #N43 project contributes approximately 73 MW 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 re-conductoring 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**. This upgrade includes re-conductoring both sets of conductors on the approximately 1 mile tower line. The above work will upgrade the ratings of both the Waterford-Muskingum 345 kV circuit and Waterford-Sporn 345 kV circuit.

### **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.