

#S56 Beaver Creek-Hazard 138kV **Generation Interconnection**

This analysis was completed to assess the reliability impact for the increase in generation interconnecting to the PJM system as a capacity resource.

Network Impacts

S56 option 1:

The Queue S56, interconnection option #1, project was studied as a 535 MW injection into the system as described for the direct connection of option #1. Project S56 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. The Topmost–Beckham 138 kV line is overloaded from 56% to 107% of its emergency rating (184 MVA) for the outage of the Talcum–Hiner 138 kV line and the Hiner–Hazard 138 kV line. This project contributes approximately 94 MW to cause the thermal violation.
2. The Topmost–Beaver Creek 138 kV line is overloaded from 56% to 105% of its emergency rating (194 MVA) for the outage of Talcum–Hiner 138 kV line and the Hiner–Hazard 138 kV line. This project contributes approximately 94 MW to cause the thermal violation.
3. The Clinch River–Lebanon 138 kV line is overloaded from 82% to 103% of its normal rating (266 MVA). This project contributes approximately 56 MW to cause the thermal violation.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No Problems were identified.

Short Circuit

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. “Network Impacts”, identified for earlier generation or transmission interconnection projects in the PJM Queue)

1. Contribution of 16 MW further overloads the Wolf Hills–North Bristol 138 kV line from 102% to 113% of its normal rating (153 MVA).
2. Contribution of 55 MW further overloads the Kemptown–N. Northwest 500 kV line from 192% to 194% of its normal rating (2078 MVA).
3. Contribution of 57 MW further overloads the Conastone–Peach Bottom CKT 2 500 kV line from 144% to 146% of its emergency rating (2598 MVA) for the single contingency: Peach Bottom–Conastone CKT 1 500 kV line (Cont ID: PJM17).

The first project to cause this overload is Q90. Other projects which contribute to this overload are R03, R14, R15, R16, R17, R29, R30, R33, R35, R44, R47, R60, R61, R64, R76, R77, R78, R88, R96, S12, S17, S18, S23, S29, S31, S32, S33, S52, S55

4. Contribution of 57 MW further overloads to the Conastone–Peach Bottom CKT 1 500 kV line from 144% to 146% of its emergency rating (2598 MVA) for the single contingency: Peach Bottom–Conastone CKT 2 500 kV line (Cont ID: PJM17_2).

The first project to cause this overload is Q90. Other projects which contribute to this overload are R03, R14, R15, R16, R17, R29, R30, R33, R35, R44, R47, R60, R61, R64, R76, R77, R78, R88, R96, S12, S17, S18, S23, S29, S31, S32, S33, S52, S55

5. Contribution of 54 MW further overloads the Kemptown–N. Northwest line from 185% to 187% of its emergency rating (2901 MVA) for the tower contingency: Peach Bottom 500/230 kV transformer and Muddy Run Machines 1-8 (Cont ID: PE500).

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. “Network Impacts”, initially caused by the addition of this project generation)

1. The overload of the Topmost-Beckham circuit can be alleviated by replacing the risers at the Topmost terminal and the bus, risers and switches at the Beckham terminal. The estimated cost is **\$300,000**.
2. The overload of the the Topmost-Beaver Creek circuit can be alleviated by replacing the risers at the Topmost terminal. The estimated cost is **\$100,000**.
3. The Clinch River-Lebanon 138kV circuit overload can be alleviated by replacing replacing the bus and risers at Lebanon substation. The estimated cost **\$200,000**.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

1. The overload on the North Bristol-Wolf Hills 138kV circuit can be alleviated by constructing a double circuit tower line between the two points.

North Bristol to Wolf Hills 138 kV Line:

On existing right-of-way construct a double circuit 138 kV steel lattice tower line – a distance of about 5.4 miles.

Estimated Cost ¹ \$ 7,290,000

2 & 5. The overload on the Kemptown-N. Northwest 500kV line can be alleviated by installing two single circuit 500kV transmission lines between Kemptown and N. Northwest. The estimated cost is **\$279 million** for the lines, **\$7.7 million** to create a new 3-breaker bay at N. Northwest 500kV substation and **\$7.7 million** to create a new 3-breaker bay at Kemptown. The estimated time to complete is 10 years.

Assumptions:

New 350 ft. wide R/W parallels existing Northwest to Mt Airy Tap R/W

Total R/W length = 28.3 miles

3 - bundle 1,590 kcm conductor

Kemptown located 1/4 mile west of Mt Airy Tap

North Northwest located 4 miles north of Northwest

3 & 4. The overload of the Conastone-Peach Bottom 500kV line can be alleviated by

Reinforcement if they are able to acquire Right of Way:

1. **Conastone – Peachbottom 500 kV Upgrade**

PECO Upgrade:

Substation work at Peach Bottom **\$2.5M**

Construct 6.25 miles of 500kV line **\$10M**

Construction of the new line will take approximately 30 months after the right of way is acquired.

These estimates do not include the cost of new right of way.

It should be noted that IPP project P04 also requires widening of about two miles of this right of way and that installation, if it moves forward, may complicate right of way acquisition and double the substation costs at Peach Bottom.

BGE Upgrade:

1. Build new 500 kV line adjacent to circuit 5012 from Conastone to PA line –
\$48M ~ 7 yrs.

Assumptions:

- Acquire 150 ft. wide R/W adjacent to existing R/W, mostly rural land at \$100,000 per acre
 - 2 - 3 year CPCN process prior to land acquisition
 - Length of line 9.6 miles
2. Install a 500kV breaker **\$1.5M**

Reinforcement if they are unable to acquire Right of Way:

The line from Graceton to Peach Bottom is about 7.5 miles long and has a normal rating of 528MVA. Assuming that we could maintain this rating with a single 230 kV pipe type cable (and we may not be able to do this), the new underground installation would cost about \$30M plus another \$1M for terminal modifications. I assume that the underground line will not have to cross any rivers or large creeks. If a cable rating of 450 MVA is insufficient, it will cost an additional \$30M.

Removal of the existing 230 kV tower line is about \$1.5M.

Construction of a double circuit 500kV line from Conastone to Peach Bottom would be about \$3.5M per mile. The line is 16.5 miles long. Total cost \$58M.
Substation additions and modifications at Peach Bottom would cost about \$10M.

S56 option 2:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. The Topmost–Beckham 138 kV line is overloaded from 56% to 107% of its emergency rating (184 MVA) for the outage of Talcum–Hiner 138 kV line and the Hiner–Hazard 138 kV line. This project contributes approximately 94 MW to cause the thermal violation.
2. The Topmost–Beaver Creek 138 kV line is overloaded from 56% to 105% of its emergency rating (194 MVA) for the outage of Talcum–Hiner 138 kV line and the

Hiner–Hazard 138 kV line. This project contributes approximately 94 MW to cause the thermal violation.

3. The Clinch River–Lebanon 138 kV line is overloaded from 82% to 103% of its normal rating (266 MVA). This project contributes approximately 56 MW to cause the thermal violation.
4. The Hazard 138/161 kV transformer is overloaded from -37% to 113% of its emergency rating (202 MVA) for outage of Talcum –Beaver Creek 138kV 138kV line. This project contributes approximately 303 MW to cause the thermal violation.
5. The Hazard – Wooten 161 kV line is overloaded from -34% to 102% of its emergency rating (224 MVA) for the outage of the Talcum – Beaver Creek 138kV. This project contributes approximately 303 MW to cause the thermal violation.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No Problems were identified.

Short Circuit

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. “Network Impacts”, identified for earlier generation or transmission interconnection projects in the PJM Queue)

1. Contribution of 18 MW further overloads to the Wolf Hills–North Bristol 138 kV line from 102% to 114% of its normal rating (153 MVA) for a base case violation.
2. Contribution of 55 MW further overloads to the Kemptown–Conastone 500 kV line from 192% to 194% of its normal rating (2078 MVA).
3. Contribution of 57 MW further overloads to the Conastone–Peach Bottom 500 kV line from 144% to 146% of its emergency rating (2598 MVA) for the single contingency Conastone – Peachbottom ckt#1 (Cont ID: PJM17).

The first project to cause this overload is Q90. Other projects which contribute to this overload are R03, R14, R15, R16, R17, R29, R30, R33, R35, R44, R47, R60, R61, R64, R76, R77, R78, R88, R96, S12, S17, S18, S23, S29, S31, S32, S33, S52, S55

4. Contribution of 57 MW further overloads to the Conastone–Peach Bottom CKT 1 500 kV line from 144% to 146% of its emergency rating (2598 MVA) for the single contingency: Peach Bottom–Conastone CKT 2 500 kV line (Cont ID: PJM17_2).

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5. Contribution of 54 MW further overloads to the Kemptown–Conastone 500 kV line from 185% to 187% of its emergency rating (2901 MVA) for the tower contingency: Peach Bottom 500/230 kV transformer, Remove machines: Muddy Run 1 - 8(Cont ID: PE500).

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. “Network Impacts”, initially caused by the addition of this project generation)

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3. The Clinch River-Lebanon 138kV circuit overload can be alleviated by replacing replacing the bus and risers at Lebanon substation. The estimated cost **\$200,000**.
- 4 & 5 The overload of the Hazard 138/161kV transformer and the Hazard-Wooten 161 kV circuit can be alleviated by replacing the existing transformer with a new 450MVA autotransformer with a spare phase, upgrade and installing new 161 & 138 kV bus work, and associated equipment at the Hazard substation. The estimated cost is **\$22,000,000**

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