#S33 Riverside 300 MW

Generator 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 Queue S33 project was studied as a 300 MW (capacity) injection at two possible POIs (Points of Interconnection) – Option #1 (Direct Connection to Riverside 115 kV substation) and Option #2 (Direct Connection to Riverside 230 kV substation). The project was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Option#1 – 115 kV

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

No problems identified.

Potential Overload
The Millwood – S.Akron 230 kV line is loaded 97% to 99.2% of its emergency rating (588 MVA) for the outage of Conastone – Peach Bottom 500 kV line (Cont Id. PJM17). This project contributes **16 MW** to the contingency loading.

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 identified.

Short Circuit
Will be performed for the Queue S33 Impact Study.

Stability Analysis
Will be performed for the Queue S33 Impact Study.

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)

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1. Contribution of **14 MW** further overloads the Conastone – Otter Creek 230 kV line from 104% to 106% of its emergency rating (632 MVA) for the **tower** outage of Conastone – Peach Bottom 500 kV ckt #1 and Conastone – Peach Bottom 500 kV ckt #2.

2. Contribution of **49 MW** further overloads the Conastone – Peach Bottom 500 kV ckt #2 from 137% to 139% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV ckt #1 (Cont. PJM17).

3. Contribution of **49 MW** further overloads the Conastone – Peach Bottom 500 kV ckt #1 from 137% to 139% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV ckt #2 (Cont. PJM17_2).

4. Contribution of **23 MW** further overloads the Graceton – Manor 230 kV line from 126% to 130% of its emergency rating (531 MVA) for the **tower** outage of Conastone – Peach Bottom 500 kV ckt #1 and Conastone – Peach Bottom 500 kV ckt #2.

New System Reinforcements

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

None required.

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. **Conastone – Otter Creek 230 kV Upgrade:**

   PPL upgrade

   The PPL portion of the Conastone to Otter Creek line (from Otter Creek to the point where ownership changes to BG&E) can be upgraded by reconductoring approximately 17.2 miles of 795 kcmil 30/19 ACSR conductor (Ratings 425/531 MVA Summer Normal/Emergency based on conductor temp @125^{O}C) with new 795 kcmil 30/19 ACSS (new ratings 516/632 MVA Summer Normal/Emergency, conductor operating temperature of 160^{O} C)

   No terminal equipment upgrade is required at Otter Creek, it is currently built with 2000 amp rating equipment. The estimated cost of this upgrade is **$8,500,000.** Estimated construction time is **36 months.**

   This upgrade will result in minimal change to the impedance of the line.
   Existing Z = 0.0042 + j 0.0266 pu
   New Z = 0.0048 + j 0.02676 pu

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BG&E Upgrade

The BG&E portion of the Conastone to Otter Creek line can be upgraded by Reconducting from Gorsuch Mills to the Pennsylvania State Line (change of ownership to PPL). The existing circuit 2302 conductor is 1,590 kcmil 45/7 ACSR from Conastone to Gorsuch Mills and 795 kcm 30/19 ACSR from Gorsuch Mills to the PA State Line.

Assumptions:

- Reconductor with 1,590 kcm ACSR from Gorsuch Mills to PA line to match capability of remainder of line.
- Length of this line section is 1.7 miles.
- Towers can be reinforced instead of replaced.

The estimated cost of this upgrade is **$700,000**. Estimated construction time is **36 months**.

2. **Conastone – Peach Bottom 500 kV Upgrade:** Construct a second Conastone – Peach Bottom 500 kV circuit.

If RIGHT OF WAY can be acquired the following is the Reinforcement and Cost Estimates:

PECO portion of the Conastone – Peach Bottom line:

Substation work at Peach Bottom	$ 2,500,000
Construct 6.25 miles of 500kV line	$10,000,000
	$12,500,000

This estimate does not include the cost of new right of way. Construction of the new line will take approximately **30 months** after the right of way is acquired.

Note: It should be noted that PJM Queue P04 project also requires widening of about two miles of this right of way for their direct connection line and would use the last remaining terminal position that exists at Peach Bottom substation. If Queue P04 proceeds with their project it may complicate right of way acquisition and double the substation costs at Peach Bottom.

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BGE portion of the Conastone – Peach Bottom line:
Build a new 500 kV line adjacent to existing circuit 5012 from Conastone to Pennsylvania State Line at an estimated cost of **$48,000,000** and a construction time of approximately **84 months.**

Assumptions:

- Acquire 150 ft. wide R/W adjacent to existing R/W, mostly rural land at $100,000 per acre
- 2 to 3 year CPCN process prior to land acquisition
- Length of line 9.6 miles

Install one 500kV breaker at Conastone **$1,500,000**. Breaker installation can be completed concurrently with the line construction.

If RIGHT OF WAY cannot be acquired the following is the Reinforcement and Cost Estimates:

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 **$30,000,000** plus another **$1,000,000** for terminal modifications. It is assumed 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 $30,000,000** for a second cable.

Removal of the existing 230 kV tower line is about **$1,500,000**.

Construction of a double circuit 500kV line from Conastone to Peach Bottom would be about $3,500,000 per mile. The line is 16.5 miles long. Total cost **$58,000,000**.

Substation additions and modifications at Peach Bottom would cost about $10M.

Note: Future work is being done by PECO and BG&E to come up with reinforcements to further mitigate the overload.

3. **Upgrade #2 above also satisfies the upgrade requirements for Network Impact #3.**

4. **Graceton to Manor 230 kV line upgrade –** To mitigate an overload of 130% of the 531MVA emergency rating will require the following to obtain a new rating of at least 691 MVA.

BGE Upgrade
Reconductor from Graceton to PA line - **$700,000 ~ 3 yrs.**
Existing:
Circuit 2303 is 795 kcm 30/19 ACSR @ 125 C.
Assumptions:

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- Reconductor with 1,590 kcm ACSR from Graceton to PA line.
- Length of this line section is 1.4 miles.
- Towers can be reinforced instead of replaced.

PPL Upgrade - The estimated magnitude cost for this upgrade including substation terminal equipment cost is **$31,000,000**.

Description of Work:

In order to provide additional capacity on the Graceton – Manor 230kV line, PPL EU is proposing to rebuild the existing single circuit 230kV line and replace the existing 795 ACSR conductor. This rebuild will require new custom embedded steel poles to accommodate the larger conductor size. The new line will be 1590 Kcmil ACSR conductor (1 per phase) designed and operated at 230 kV. The 230 kV lines will be rated for summer normal/emergency of 653/793 MVA respectively. These ratings are based on the conductor ratings and may be lower when the line is actually built.

The rebuild will be 14.4 miles long and will travel the existing right of way.

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Option#2 – 230 kV

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

No problems identified.

Potential Overload
The Millwood – S. Akron 230 kV line is contingency loaded from 97% to 99.2% of its emergency rating (588 MVA) for the outage of Conastone – Peach Bottom 500 kV line (Cont Id. PJM17). This project contributes **15 MW** to the line loading.

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 identified.

Short Circuit
Will be performed for the Queue S33 Impact Study.

Stability Analysis
Will be performed for the Queue S33 Impact Study.

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 **14 MW** further overloads the Conastone – Otter Creek 230 kV line from 102% to 105% of its emergency rating (632 MVA) for the **tower** outage of Conastone – Peach Bottom 500 kV ckt #1 and Conastone – Peach Bottom 500 kV ckt #2.

2. Contribution of **48 MW** further overloads the Conastone – Peach Bottom 500 kV ckt #2 from 140% to 142% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV ckt #1 (Cont. PJM17).

3. Contribution of **48 MW** further overloads the Conastone – Peach Bottom 500 kV ckt #1 from 140% to 142% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV ckt #2 (Cont. PJM17_2).

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4. Contribution of **23 MW** further overloads the Graceton – Manor 230 kV line from 120% to 124% of its emergency rating (531 MVA) for the **tower** outage of Conastone – Peach Bottom 500 kV ckt #1 and Conastone – Peach Bottom 500 kV ckt #2.

New System Reinforcements

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

None required.

Contribution to Previously Identified System Reinforcements

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   No terminal equipment upgrade is required at Otter Creek, it is currently built with 2000 amp rating equipment. The estimated cost of this upgrade is **$8,500,000.** Estimated construction time is **36 months.**

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   Existing Z = 0.0042 + j 0.0266 pu
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   Assumptions:

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- Reconductor with 1,590 kcm ACSR from Gorsuch Mills to PA line to match capability of remainder of line.
- Length of this line section is 1.7 miles.
- Towers can be reinforced instead of replaced.

The estimated cost of this upgrade is **$700,000**. Estimated construction time is **36 months**.

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