#Q26_Churchtown 550 MW

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 (Option #1)

The Queue Q26 project was studied as a **550 MW Capacity injection into the Churchtown 230 kV substation**. Q26 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability

1. The Pedricktown-Bridgeport 230 kV line is overloaded at around 111% of its emergency rating (552 MVA) for the outage of the Windsor-Salem Tap 500 kV line. The Q26 project contributes approximately 267 MW to the contingency facility loading.

2. The Bridgeport - Mickleton 230 kV line is overloaded at around 102% of its emergency rating (805 MVA) for the outage of the Windsor - Salem Tap 500 kV line. The Q26 project contributes approximately 266 MW to the contingency facility loading.

3. The Churchtown 230/69 kV transformer is overloaded at around 101% of its emergency rating (300 MVA) for the outage of the Pedricktown-Chambers 230 kV line. The Q26 project contributes approximately 128 MW to the contingency facility loading.

4. The Corson #2 138/69 kV transformer is overloaded at around 101% of its emergency rating (141 MVA) for the outage of the Corson #1 138/69 kV transformer. The Q26 project contributes approximately 3 MW to the contingency facility loading.

Multiple Facility Contingency (Double-Circuit Towerline Contingencies)

No problems identified.

Contribution to Previously Identified Overloads

None.

New System Reinforcements

1. The contingency overload of the Pedricktown-Bridgeport 230 kV line can be mitigated by upgrading a strand bus at Pedricktown at an estimated cost of **$0.03 Million**. This can be completed in approximately **12 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

2. The contingency overload of the Bridgeport-Mickleton 230 kV line can be mitigated by performing modifications to several structures and raising the operating temperature of the line at an estimated cost of **$0.1 Million** and by upgrading line traps at either end at a cost of **$0.2 Million**. These upgrades can be completed in approximately **12 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

3. The contingency overload of the Churchtown 230/69 kV transformer can be mitigated by replacing the existing transformer with a 300 MVA unit at an estimated cost of **$5.7 Million**. This transformer replacement can be completed in approximately **36 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

4. The contingency overload of the Corson 138/69 kV transformer can be mitigated by replacing the existing transformer with a new 225 MVA unit at an estimated cost of **$7.7 Million**. This transformer replacement can be completed in approximately **36 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

Short Circuit

Option #1 called for 550MW of generation to be connected to the 230kV bus at Churchtown, upgrade of T1 at Churchtown to a 300MVA unit, and upgrade of T2 at Corson to a 225MVA unit. All internal projects scheduled to be in service by 12/31/2008 were included in this model. The generator and GSU information for the Q26 installation was taken from the PJM model.

Option #1 - Overstressed breakers (**BL England contribution removed from the model**)
Deepwater 69kV: 6602 (104.4%), 6606 (104.8%), 6607 (101.3%), 6609 (101.3%), 6612 (104.8%), 6622 (103.5%), 6624 (107.9%), 6628 (100.0%), 6630 (101.3%), 6632 (101.3%), 6683 (103.1%)

Estimated Cost: **$3,025,000** (11 breakers at $275K each)
Estimated time to install replacement breakers: **18 Months**

Option #1 - Overstressed breakers (**BL England contribution included in the model**)
Corson 69kV: J (106.9%), M (100.1%)
Deepwater 69kV: 6602 (104.7%), 6606 (105.1%), 6607 (101.6%), 6609 (101.6%), 6612 (105.1%), 6622 (103.8%), 6624 (108.2%), 6628 (100.3%), 6630 (101.6%), 6632 (101.6%), 6683 (103.4%)
Lewis 69kV: F (102.0%), J (100.3%), K (102.8%), Q (100.9%), S (104.5%), W (100.9%)

Estimated Cost: **$5,225,000** (19 breakers at $275K each)
Estimated time to install replacement breakers: **18 Months**

Contribution to Previously Identified System Reinforcements

None

Network Impacts (Option #2)

The Queue Q26 project was studied as a **550 MW Capacity injection into the Deepwater 138 kV substation (with a Q26 initiated 230-138 kV transformer connection between Churchtown 230 kV and Deepwater 138 kV substations)**. Q26 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability

1. The Upper Pittsgrove - Deepwater 138 kV line is overloaded at around **110%** of its emergency rating (205 MVA) for the outage of the Mickleton - Bridgeport 230 kV line. The Q26 project contributes approximately 79 MW to the contingency facility loading.

2. The Upper Pittsgrove - Landis 138 kV line is overloaded at around **107%** of its emergency rating (196 MVA) for the outage of the Mickleton-Bridgeport 230 kV line. The Q26 project contributes approximately 79 MW to the contingency facility loading.

3. The Deepwater - Landis Tap 138 kV line is overloaded at around **110%** of its emergency rating (198 MVA) for the outage of the Mickleton-Bridgeport 230 kV line. The Q26 project contributes approximately 83 MW to the contingency facility loading.

4. The Deepwater #12 138/69 kV transformer is contingency overloaded at around 156% of its emergency rating (180 MVA). The Q26 project contributes approximately 65 MW to the contingency facility loading.

   ***Note**: The new 230-138 kV connection from Churchtown to Deepwater as part of the direct connect for the Q26 proposal also contributes to the increased loading on the Deepwater #12 138/69 kV transformer.*

Multiple Facility Contingency (Double-Circuit Towerline)

No problems identified.

Short Circuit

Option #2 called for 550MW of generation to be connected to the 138kV bus at Deepwater, plus the addition of an autotransformer and 138kV line section between Deepwater and Churchtown, upgrade of T12 at Deepwater to a 300MVA unit, and reconductor of D/W-UP-Landis. All internal projects scheduled to be in service by 12/31/2008 were included in this model. The generator and gsu information for the Q26 installation was taken from the PJM model.

Option #2 - Overstressed breakers **(BL England contribution removed from the model)**

Corson 69kV: J (102.3%)
Deepwater 69kV: 6602 (127.6%), 6603 (124.1%), 6606 (132.0%), 6607 (127.6%), 6609 (127.6%), 6612 (132.0%), 6614 (114.7%), 6622 (129.9%), 6624 (133.5%), 6626 (108.8%), 6628 (126.1%), 6630 (127.6%), 6632 (127.6%), 6683 (130.0%)
Deepwater 138kV: 1317 (300.4%), 1318 (300.4%), 1321 (180.9%), 1323 (150.1%), 1324 (292.1%), 1325 (292.1%), 1326 (174.3%), 1328 (169.6%)

Estimated Cost: **$6,325,000** (23 breakers at $275K each)
Estimated time to install replacement breakers: **18 Months**

Option #2 - Overstressed breakers (BL England contribution included in the model)

Corson 69kV: J (109.8%), M (104.1%)
Deepwater 69kV: 6602 (127.9%), 6603 (124.4%), 6606 (132.3%), 6607 (127.9%), 6609 (127.9%), 6612 (132.3%), 6614 (114.9%), 6622 (130.2%), 6624 (133.7%), 6626 (109.0%), 6628 (126.4%), 6630 (127.9%), 6632 (127.9%), 6683 (130.3%)
Deepwater 138kV: 1317 (301.7%), 1318 (301.7%), 1321 (181.7%), 1323 (150.7%), 1324 (175.0%), 1325 (293.0%), 1326 (175.0%), 1328 (170.1%)
Lewis 69kV: F (102.8%), J (101.9%), K (103.6%), Q (101.7%), S (105.3%), W (101.7%)

Estimated Cost: **$8,250,000** (30 breakers at $275K each)
Estimated time to install replacement breakers: **18 Months**

New System Reinforcements

1. The contingency overload of the Upper Pittsgrove-Deepwater 138 kV line can be mitigated by reconductoring the line at an estimated cost of **$6.5 Million**. This can be completed in approximately **24 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

2. The contingency overload of the Upper Pittsgrove-Landis 138 kV line can be mitigated by reconductoring the line at an estimated cost of **$3.6 Million** and by upgrading a line trap at Landis at a cost of **$0.08 Million**. These upgrades can be completed in approximately **24 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

3. The contingency overload of the Deepwater-Landis Tap 138 kV line can be mitigated by reconductoring the line at an estimated cost of **$10.0 Million**. This can be completed in approximately **24 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

4. The contingency overload of the Deepwater 138/69 kV transformer can be mitigated by upgrading the transformer to a 300 MVA unit and upgrading two strain buses and a disconnect switch at an estimated cost of **$6.0 Million**. This transformer replacement can be completed in approximately **36 months** from the time "Notice to Proceed" is given after the ISA and CSA are executed.

Contribution to Previously Identified System Reinforcements

None.

Congestion Issues

1. The Upper Pittsgrove - Deepwater 138 kV line is **normally overloaded** at around **101%** of its normal rating (154 MVA). The Q26 project contributes approximately 54 MW to the contingency facility loading. The normal overload of the Upper Pittsgrove-Deepwater 138 kV line can be mitigated by reconductoring the line at an estimated cost of $6.5 Million. This can be completed in approximately 24 months from the time "Notice to Proceed" is given after the ISA and CSA are executed.

2. The Deepwater #12 138/69 kV transformer is **normally overloaded** at around **146%** of its normal rating (154 MVA). The Q26 project contributes approximately 72 MW to the normal facility loading. Note that the new 138 kV connection from Churchtown to Deepwater as part of the direct connect for the Q26 proposal also contributes to the increased loading on the Deepwater #12 138/69 kV transformer. The normal overload of the Deepwater 138/69 kV transformer can be mitigated by upgrading the transformer to a 300 MVA unit at an estimated cost of $6.0 Million. This transformer replacement can be completed in approximately 36 months from the time "Notice to Proceed" is given after the ISA and CSA are executed.

The above normal overloads (using a Generator Deliverability dispatch model with all Transmission facilities in service) have been identified as potential congestion issues for the Q26 interconnection – Option #2. These overloads can be mitigated by redispatch of the system (potentially backing off some of Q26 or other generation) if, and when, actual system conditions create these congestion situations. These potential congestion issues are not PJM generator interconnection Planning Criteria violations and do not require upgrade by Q26. However, "New System Reinforcement" numbers 1 (Reconductor Upper Pittsgrove – Deepwater 138 kV line) and 4 (Replace Deepwater 138/69 kV transformer), which are a Q26 upgrade requirements, will mitigate the above congestion issues**.**

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