#V4-002 Graceton 575 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

The Queue V4-002 project was studied as a 575 MW (Capacity) injection into the Cooper - Graceton 230 kV line. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

NETWORK IMPACTS

Generator Deliverability

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

1. The Conastone – Northwest 230 kV line #2322 (from bus 220963 to bus 220961 ckt 1) loads from **96.15% to 101.43%** of its emergency rating (819MVA) for the single contingency outage of the Conastone – Northwest 230 kV #2310 line (PJM Contingency 'BG_CKT2310') as a result of the addition of V4-002 generation. This project contributes approximately **43.2 MW** to cause this thermal violation.

Multiple Facility Contingencies

(Double Circuit Tower Line contingenciess for the full energy output, Stuck Breaker and Bus Fault contingencies will also be tested for the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes greater than the PJM cost allocation threshold loading to the following contingency overloads, i.e. "Network Impacts", identified for either earlier interconnection projects in the PJM Queue)

2. The V4-002 TAP - Graceton 230kV line (from bus 900010 to bus 220964 ckt 1) loads from **120.93% to 224.58%** of its emergency rating (485MVA) for the single contingency ('PJM17') as a result of the addition of V4-002 generation. This project contributes approximately **63.7 MW** to this thermal violation caused by an earlier project in the PJM Queue.

3. The Bagley – Raphael Road 230 kV line #2313 (from bus 220999 to bus 220980 ckt 1) loads from **128.66% to 143.82%** of its emergency rating (659 MVA) for the tower line

outage (PJM Contingency 'CNSTN_NWEST'). This project contributes approximately **63.7** MW to the thermal violation caused by an earlier project in the PJM Queue.

Contingency (CNSTN_NWEST) = Outage of the Conastone to Northwest double circuit 230 kV lines #2310 and 2322.

4. The Graceton – Bagley 230kV line #2313 (from bus 220964 to bus 220999 ckt 1) loads from **115.4% to 128.15%** of its emergency rating (802 MVA) for the tower line outage (CNSTN_NWEST). This project contributes approximately **63.7 MW** to the thermal violation caused by an earlier project in the PJM Queue.

.

Contingency (CNSTN_NWEST) = Outage of the Conastone to Northwest double circuit 230 kV lines #2310 and 2322.

Stability Analysis

TBD. Will be performed for the Queue V4-002 Facilities Study.

Short Circuit Analysis

V4-002 interconnection caused two Graceton 230 kV circuit breakers to exceed their interrupting rating and contributed to the overduty of 5 Conastone 230 kV breakers determined to have exceeded their interrupting rating as a result of earlier queues. All of these breakers need to be replaced to mitigate the overduty.

New overdutied 230 kV breakers*****: Graceton 22008/230-1 and 22008/2323

Contribution to existing overdutied Conastone 230 kV breakers******: Conastone #4, #5, #6, #7 and #8

**** Please note that these Graceton breakers may be replaced by BG&E's for baseline upgrade number b0497.***

***** Please note that some or all of these breakers may be BG&E's baseline upgrade responsibility. Please refer to PJM's RTEP Baseline upgrades b0497.1 and b0497.2***

NETWORK UPGRADE REQUIREMENTS

(Note: Network Upgrades 1 to 4 correspond to Network Impacts 1 to 4)

New System Reinforcements

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

1. In order to relieve the Conastone – Northwest 230kV line 2322 overload, line 2322 must be reconductored to 1,590kcmil 45/7 ACSR at 160°C to match 2310. Based on previously provided estimates and the mileages involved, this would cost ~$425k/mile. For the 24-mile line, the total estimate is **$10,200,000**. Structural evaluations would need to be performed to support installing the larger conductor. This estimate assumes replacement of 10 structures to cover both structural failures and clearance issues. It is likely a CPCN will NOT be needed, so the work could be completed in **24 months** and will be performed during the Spring & Fall only.

   The worst case scenario is that the structures significantly fail the structural analysis. In that scenario, we would have to rebuild the entire tower line. A conservative estimate for this work would be $45 million. This includes ~$30M for structures & foundations (~$250k each), $1.5M for CPCN & design effort, $2M for permitting & environmental controls, $5M for construction contracts (structure erection & wire stringing), $1.5M for conductor (reuse the existing 1590 wire on 2310), and an additional $5 million for temporary bypass work. This work would take ~18-24 months for the CPCN & design effort and an additional 5 years of seasonal construction work. Scheduling outages for this work may be very difficult to do, and other options would be considered due to cost and feasibility.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project will have a % allocation cost responsibility which will be calculated at this position in the Queue. Later Queue positions may also have a cost allocation and reduce this Queue's responsibility)

2. PECO portion of the V4-002 Tap – Graceton 230 line upgrade (V4-002 Tap to PA/MD border):

   The V4-002TAP – Graceton 230 kV line (aaprox 4 mi.) will have to be torn down and rebuilt to increase the emergency rating of the line. The cost to perform these modifications is $8M. The work will take approximately 48 months to complete.
   BG&E portion of the V4-002 Tap – Graceton 230 line upgrade (PA/MD border to Graceton):

The V4-002 Tap – Graceton 230 kV line upgrade requirement is to get 1095 MVA (SE) out of circuit 22008 (Graceton to Nottingham). To accomplish this rating, a double circuit line will be built with 1033.5kcmil ACSR creating one circuit by connecting the two lines into one. Rating for 2 – 1033.5kcmil 45/7 ACSR (Ortolan) at 125°C = 968/1227MVA SN/SE. BGE ownership is for 1.85 miles and the rebuild of 11 structures. It would be built as a double circuit line with the conductors jumpered across at the terminal ends. The line construction is estimated at $3,000,000. Two breakers ($400,000/breaker) would need to be replaced at Graceton for a cost of $800,000. An additional cost of $200,000 would also be incurred for 4 breaker disconnects and line connections to cover thermal. The project is estimated to take **30 months** to complete: 12 months for the CPCN process & design and an additional 18 months for construction. The total cost of the project is estimated at **$4,000,000**.

3. The Bagley – Raphael Road 230 kV line reinforcement needed to mitigate this overload involves rebuilding the 6 mile single circuit to a double circuit rated at 659MVA normal / 800MVA emergency on each circuit. The upgrade will cost approximately **$7,000,000** and construction time is estimated at **60-72 months**.

4. The Graceton - Bagley 230 kV line reinforcement needed to mitigate this overload involves rebuilding the 16.1 mile Graceton to Bagley 230 kV circuit to a double circuit rated at 659MVA normal / 800MVA emergency on each circuit. Add two new 230 kV breakers at Graceton to terminate the new circuit. In addition, two breakers would need to be replaced at Graceton with 63kA/3000A breakers, and the breaker bays would need to be upgraded to 3000A gear. This would cost an additional $1.0M. The total estimated cost of this upgrade is **$26,700,000**. The lead time required for construction is **48-72 months**.

Short Circuit Upgrades

V4-002 may be responsible for the replacement of Graceton 230 kV breakers 22008/230-1 and 22008/2323. Replacement cost is $400,000 each for a total of **$800,000***.

V4-002 may have cost allocation responsibility for the replacement of Conastone 230 kV breakers #4, #5, #6, #7 and #8. Total replacement cost is $400,000 each for a total of **$2,000,000****.

**** Please note that these Graceton breakers may be replaced by BG&E's for baseline upgrade number b0497.***

***** Please note that some or all of these breakers may be BG&E's baseline upgrade responsibility. Please refer to PJM's RTEP Baseline upgrades b0497.1 and b0497.2***