

#Q90 Mickleton 800 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 Q90** project was studied as an injection of 800 MW (capacity) into the **Mickleton 230 kV station**. Project #Q90 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability

1. The Cuthbert - Gloucester 138 kV line is overloaded at around **107%** of its normal rating (239 MVA). The Q90 project contributes approximately 64 MW to the contingency facility loading.
2. The Cuthbert - Gloucester 138 kV line is overloaded at around **101%** of its emergency rating (341 MVA) for the outage of the Windsor - Salem Tap 500 kV line. The Q90 project contributes approximately 69 MW to the contingency facility loading.
3. The Gloucester 230/138 kV transformer is overloaded at around **101%** of its emergency rating (341 MVA) for the outage of the Windsor - Salem Tap 500 kV line. The Q90 project contributes approximately 69 MW to the contingency facility loading.
4. The Churchtown - Churchtown Tap 230 kV line is overloaded at around **103%** of its emergency rating (755 MVA) for the outage of the Salem - Salem Tap 500 kV line. The Q90 project contributes approximately 108 MW to the contingency facility loading.

Multiple Facility Contingency

(Double Circuit Towerline contingencies only. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

5. The Mickleton - Thorofare 230 kV line is overloaded at around **117%** of its emergency rating (566 MVA) for the tower outage of the two Mickleton - Monroe 230 kV lines. The Q90 project contributes approximately 280 MW to the contingency facility loading.
6. The Conastone - Mount Carmel (new BG&E proposed transformer tap) 230 kV line #2310 is overloaded at around **101%** of its emergency rating (947 MVA) for the tower outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 56 MW to the contingency facility loading.
7. The Five Forks - Rock Ridge (circuit 110511) 115 kV line is overloaded at around **103%** of its emergency rating (240 MVA) for the outage of the Brighton-Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 9 MW to the contingency facility loading.
8. The Five Forks - Face Rock #1 115 kV line is overloaded at around **100%** of its emergency rating (114 MVA) for the outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 4 MW to the contingency facility loading. The limiting element in the Five Forks – Face Rock 115kV line is a set of parallel in-line 115-69kV transformers at the Face Rock end of the line.

Short Circuit

Q90 contribution to system short circuit level causes the need to replace four 230kV breakers at New Freedom switching station which will have insufficient short circuit interrupting capability. The cost to replace these four circuit breakers is estimated to be \$350,000 each (**\$1.4M total cost**) and replacement time is estimated to be **18 months**.

Stability Analysis

Will be performed during the Impact Study.

New System Reinforcements

1. Cuthbert - Gloucester 138 kV line upgrade - **see 2 below which mitigates both number 1 and 2 contingency overloads.**
2. The Cuthbert - Gloucester 138 kV underground circuit will need to be re-conducted at an estimated cost of **\$9.5M**.
3. It may be possible to sufficiently increase the Gloucester 230/138 kV transformer rating through the addition of cooling upgrades at an estimated cost of **\$700,000**. This is will require additional study. If it is not possible to increase the rating sufficiently with cooling upgrades, replacement cost is estimated to be **\$2.1M**.
4. The Churchtown - Churchtown Tap 230 kV line requires an upgrade to a strand bus at Churchtown for an estimated cost of **\$30,000**. This can be completed in approximately **12 months**.
5. The Mickleton - Thorofare 230 kV line upgrade requires reconductor of a 1.7 mile line section at an estimated cost of **\$425,000**. This can be completed in approximately **24 months**.
6. The Conastone - Mt Carmel (new proposed BG&E Distribution Station) 230 kV line #2310 upgrade requires rebuild of the Mount Carmel to Conastone **2310 & 2322** lines to 2,167kcmil 72/7 ACSR at 125°C (rating: 794/968MVA SN/SE & 914/1090MVA WN/WE). This work would take **5-6 years** to complete at a cost of **\$21M**. This is a total rebuild of the Double Circuit Tower Line (circuits 2310 and 2322) which would also satisfy **Number 10 below "Previously Identified Overloads"**
7. The Five Forks to Rock Ridge (circuit 110511) 115kV overload requires re-conductoring to achieve 255+ MVA (>1280A) as the existing conductor is at its maximum allowable operating temperature. The estimate for this is **\$6,500,000** and is based on re-conductoring 9.04 circuit miles to 795kcmil 30/19 ACSR "Mallard" at a minimum of 120C operation. This conductor is approximately twice as heavy as the existing conductor and would require a complete rebuild of the existing 64 single circuit steel lattice towers to single circuit steel poles (with arms).

The work from project kick-off to in-service would probably take **5 years** (2 years for CPCN approval & 3 years of construction). Construction is very involved, There is a neighboring circuit on a tight right-of-way (100'), 64 structures to be erected, 64 structures to be removed and scrapped, and between conductor and static wire, approximately 45 miles of wire to pull, and if the circuit is congested, it may be hard to get outages (seasonal, daily outages only).

8. The Five Forks to Face Rock #1 (110511) 115kV overload may possibly be mitigated by an upgrade to the transformer cooling (on only one of the two 115-69kV in-line transformers) at an estimated cost of **\$250,000** with a **24 month** lead time. If the above option is not a viable solution, one* of the following will be required:
 - a) Replace one existing transformer with higher MVA rated transformer - \$2,000,000 with a 42 month lead time, or
 - b) Reconnect the existing, but operated “normally open” 115kV Five Forks line #2. The cost for the PPL work at Face Rock 69 kV station is estimated to be \$650,000 with a 30 month lead time. The cost of the BG&E work at Five Forks (and other locations if necessary due to impacts of operating the second line normally closed) has not been determined.*

These are only order of magnitude estimates and schedules to complete the outlined work. No studies were completed to arrive at these estimates. It may also be possible that one or more of these solutions can not be constructed.

Contribution to Previously-Constructed Transmission Upgrades

9. PJM Tariff Section 37.7c states the following:

“In the event that Transmission Provider determines that accommodating an Interconnection Customer’s Interconnection Request would require, in whole or part, any Local Upgrade or Network Upgrade that was previously determined to be necessary to accommodate, and that was constructed in connection with, an Interconnection Request that was part of a previous Interconnection Queue, such Interconnection Customer may be responsible, subject to terms of Sections 46.4 and 48.5 below and in accordance with criteria prescribed by Transmission Provider in the PJM Manuals, for an additional costs up to an amount equal to a proportional share of the costs of such previously-constructed facility or upgrade. Cost responsibility under this Section 37.7 may be assigned with respect to any facility or upgrade

- a.
- b.
- c. *the completed cost of which was \$10,000,000 or more, provided that the facility or upgrade was placed in service no more than 5 years prior to the affected Interconnection Customer’s Interconnection Queue closing date.”*

Network Upgrade N28 (“CONSTRUCT A SECOND MICKLETON – MONROE 230KV LINE”) was completed in June 2003 at an actual cost was \$10,500,461 and was previously paid for by Queues A19 and A21. Since Queue Q90 “Queue closing date” of August 31, 2006 is less than 5 years after Network Upgrade N28 was put into service, and since it has been determined that accommodating Q90’s Interconnection Request would require Network Upgrade N28, **Q90 will be responsible, in whole or part, for the \$10,500,461 cost to construct Network Upgrade N28.** A cost allocation for Q90 will be performed during the Q90 Impact Study.

Using a 2005 RTEP Load Flow Case (used to determine Queues A19 and A21 allocation for Network Upgrade N28) the interconnection of Q90 caused a contingency overload of the original Mickleton - Monroe 230kV line for the contingency loss of the Eagle Point to Gloucester 230 kV circuit thereby necessitating the second Mickleton – Monroe 230kV circuit. **Q90 contributes 218 MW to the overload,** well above the minimum threshold required for cost allocation.

Contribution to Previously Identified Overloads

(Overloads initially caused by prior Queue positions with additional contribution to overloading by Queue Q90. Queue Q90 will have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

10. The Conastone - Mt Carmel (new proposed BG&E Distribution Station) 230 kV line #2322 is overloaded at around **116%** of its emergency rating (803 MVA) for the outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 55 MW to the contingency facility loading. This facility was initially overloaded by the Q75 Transmission Interconnection project.

Upgrade Requirement:

This work would take **12-18 months** to complete at a cost of **\$3.7M.** **(Q90 would be responsible for a portion of this cost to be determined during the Q90 Impact Study)**

Also see number 6 above which takes care of number 6 as well as number 10.

Rebuild Mount Carmel to Conastone.

11. The Graceton - Bagley (new proposed BG&E Distribution Station) 230 kV line is overloaded at around **121%** of its emergency rating (659 MVA) for the tower outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 66 MW to the contingency facility loading. This facility was initially overloaded by the Q75 Transmission Interconnection project.

Upgrade Requirement = 659MVA x 1.21 = 798MVA (2002A):

The Graceton – Bagley line section upgrade would require it to be reconducted with 1,590kcmil 45/7 ACSR at 125°C (rating: 650/805MVA SN/SE & 749/906MVA

WN/WE). The reconductoring would require significant rebuild to support the larger wire at higher tensions (this was outlined in the B48 Facilities Study Report available on the PJM Website). The larger wire and taller structures would require a CPCN (Maryland Certificate of Public Convenience and Necessity Permit). The work would take an estimate **42-48 months** to complete. Estimated costs would be **\$13,000,000**. **(Q90 would be responsible for a portion of this cost to be determined during the Q90 Impact Study)**

12. The Northwest - Mt Carmel (new proposed BG&E Distribution Station) 230 kV line #2322 is overloaded at around **113%** of its emergency rating (803 MVA) for the tower outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 55 MW to the contingency facility loading. This facility was initially overloaded by the Q75 Transmission Interconnection project.

Upgrade Requirement:

Reconductor Northwest – Mount Carmel Tap, line #2322, to 1,590kcmil 45/7 ACSR at 160°C to match ratings with 2310 for the same section. This work would take **12-18 months** to complete and cost **\$4,000,000**. **(Q90 would be responsible for a portion of this cost to be determined during the Q90 Impact Study)**

13. The Raphael Road - Bagley (new proposed BG&E Distribution Station) 230 kV line #2313 is overloaded at around **109%** of its emergency rating (659 MVA) for the tower outage of the Brighton - Conastone 500 kV line and the Brighton - Doubs 500 kV line. The Q90 project contributes approximately 66 MW to the contingency facility loading. This facility was initially overloaded by the Q89 project.

Upgrade Requirement = 659MVA x 1.09 = 719MVA (1803A):

The upgrade to this section of line #2313 would require it to be reconducted with 1,590kcmil 45/7 ACSR at 125°C (rating: 650/805MVA SN/SE & 749/906MVA WN/WE). The reconductoring would require significant rebuild to support the larger wire at higher tensions (this was outlined in the B48 project – see Facilities Study Report on the PJM Website). The larger wire and taller structures would require a CPCN (Maryland Certificate of Public Convenience and Necessity Permit). The work would take an estimate **36-42 months** to construct. Estimated costs would be **\$5,500,000**. **(Q90 would be responsible for a portion of this cost to be determined during the Q90 Impact Study)**