

Q65 North Anna 500 kV (1594 MW)
Generation Interconnection

Network Impacts

Network Impacts

The #Q65 project was studied as a 1594 MW capacity resource at the North Anna 500 kV generating facility in the Dominion territory. Project #Q65 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts as assessed using PJM generator interconnection procedures are as follows:

Generator Deliverability

1. The Lady Smith-North Anna 500 kV line loads from 67% to 108% of its emergency rating (2676 MVA) for the outage of the Morrisville to North Anna 500 kV line. The Q65 project contributes 1104 MW to cause this thermal violation.

2. The 230 kV parallel circuits 2344-1 and 2344-2 from Hawkins Point Terminal to Sollers Point Terminal load from 96% to 101% of their emergency rating (569 MVA) for the outage of the #2 230/115 kV Riverside transformer. The Q65 project contributes 24 MW to cause this thermal violation. The suggested network reinforcement is to install a 230 kV HS breaker at the Riverside 230-2 transformer to isolate 230 kV line 2345 (Riverside-Sollers Point) for the loss of the transformer (See System Reinforcements section). This upgrade eliminates the overload caused by the loss of the Riverside 230-2 transformer. However, for the outage of the Riverside – Sollers Point (circuit 2345) 230 kV line, the Hawkins Point – Sollers Point (circuit 2344-1 and circuit 2344-2) 230 kV parallel cables are overloaded at around 100.7% of their emergency ratings (569 MVA each). See System Reinforcements section for initial conceptual options.

Multiple Facility Contingency

The 500 kV line 5012 from Peach Bottom to Conastone loads from 93% to 101% of its emergency rating (2598 MVA) for the tower outage of 230 kV lines 220-90 & 220-91. The Q65 project contributes 222 MW to cause this thermal violation.

Contribution to Previously Identified Overloads

No problems were identified.

New System Reinforcements

1. New 15-mile long 500 kV Line from North Anna Substation to Ladysmith Switching Substation. This line is estimated to cost **\$20 million** dollars and is

estimated to take five years to complete. The installation of two 500 kV breakers is included in this estimate one each at both terminal substations. No new right-of-way will be required for this line. Note: For the purpose of this Feasibility Study, this new system reinforcement is identified as a solution to address the thermal violation in the generator deliverability section above and is also identified as a required system reinforcement in the Dominion import and export studies (see p. 6).

2. The Peach Bottom end of the Conastone to Peach Bottom 500kV line can be upgraded by replacing terminal equipment at the Peach Bottom end. The thermal limit of the bundled conductor of this line is 3254 MVA normal and 4046 MVA emergency. The terminal equipment would be replaced as required to attain the new required rating. The estimated cost is approximately **\$600,000**. This work will require 9 to 12 months to complete.
3. The minimal solution to mitigate the constraints of lines 2344 and 2345 is to replace the HS switch at the Riverside 230-2 transformer—the loss of the transformer would not take out the 230 kV line then. The cost for this project is estimated at **\$400,000**.

This upgrade eliminates the overload caused by the loss of the Riverside 230-2 transformer. However for the outage of the Riverside – Sollers Point (circuit 2345) 230 kV line, the Hawkins Point – Sollers Point (circuit 2344-1 and circuit 2344-2) 230 kV parallel cables are overloaded at around 100.7% of their emergency ratings (569 MVA each).

The conceptual options identified for the Hawkins Point –Sollers Point (circuits 2344-1 and 2344-2) overloads are as follows:

Option 1: Install one (1) additional Harbor Crossing cable from Hawkins Point to Sollers Point; re-rate new OH sections to 180°C.

Option 1 estimated cost is **\$40.25 million**.

Initial evaluation by the Transmission Owner (BGE) of schedule for this work is 8-10 years to design and complete construction. However, further review of this option, including refined scope, cost and schedule, plus evaluation of other viable alternatives, will be performed during the System Impact Study.

Option 2: Construct a new single circuit 230kV line from Brandon Shores to Hawkins Point Terminal and Sollers Point Terminal to Riverside which also requires an additional 60 ft. easement along west side of existing tower line. (See Fig 2 & 3 below)

Option 2 estimated costs and construction time:

New 230 kV line - \$5.0 million
 Rebuild Riverside 230kV (breaker and a half) 11 breakers – \$16 million
 Brandon Shores - \$1.5 million.
 Total Option 1 estimated total cost is **\$22.5 million.**

Initial evaluation by the Transmission Owner (BGE) of schedule for this work is 8-10 years to design and complete construction. However, further review of this option, including refined scope, cost and schedule, plus evaluation of other viable alternatives, will be performed during the System Impact Study.

Figure 2 – Riverside Rebuild

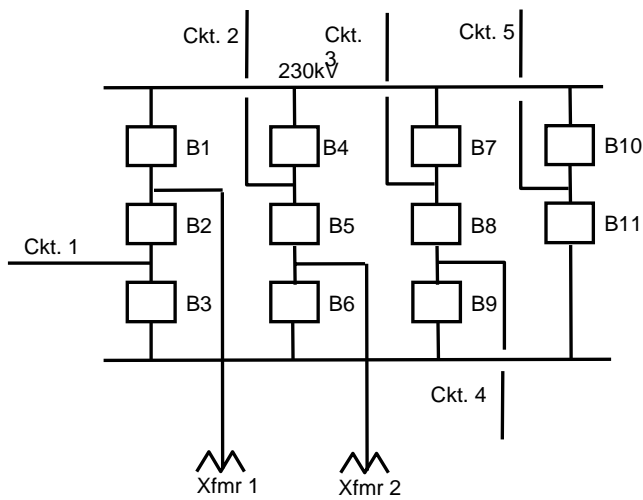
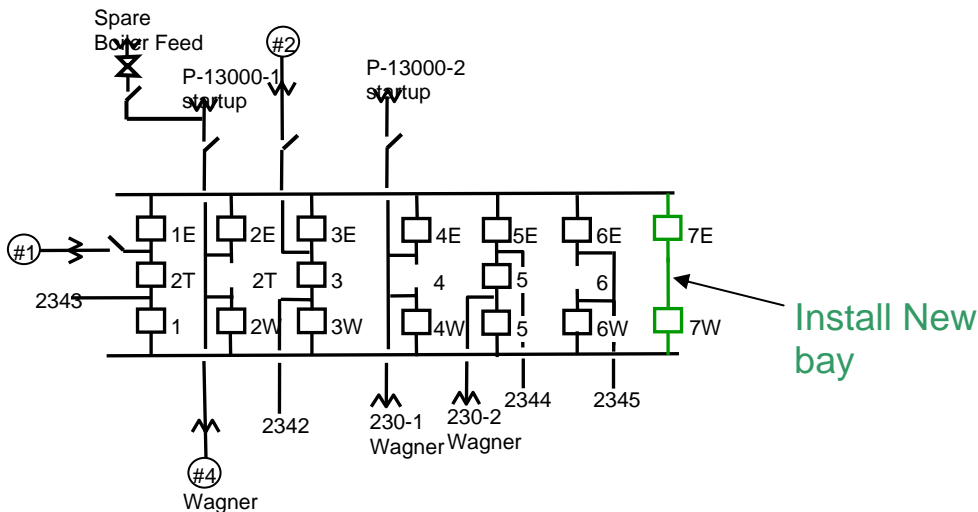


Figure 3 – Brandon Shores



Contribution to Previously Identified System Reinforcements

To be determined at the System Impact Study

Dominion Load Flow Study Results – Network Impacts

Dominion Transmission Planning evaluated the proposed Q65 Generation using a Summer 2014 base case using Dominion Transmission Planning criteria. This was based on the Interconnection Customer's requests that all proposed transmission facilities be in operation by April 2014 to allow for a commercial operation date of September 2014. The MMWG Summer 2005 series of cases was used as modified internally on 8/22/2006. All higher order PJM Queue generators were dispatched in this case consistent with previous Dominion generator interconnection evaluations. This resulted in the following generators being modeled P8 –600 MW; P9 – 91 MW; P38 – 600 MW; Q9 – 2.5 MW; Q64-20 MW in this base case. The system was studied under single contingency condition, double contingency conditions and import/export conditions. The results of these studies are shown below.

Results of N-1 and N-2 evaluations:

Overloaded Elements	Summer 2014	Summer 2014 With Q65
Ladysmith to North Anna Line #575		1 95%
N-2		
Morrisville to North Anna Line #573		1 129%
Gordonsville to Louisa CT Line#2088		1 128%
Ladysmith to North Anna Line #575		1 135%

Note:

The above N-2 results were obtained from an N-1 event followed by a second N-1 event. The identified overloads could not be eliminated without reducing North Anna generation, unless the reinforcements are implemented. It is likely that the reinforcement required for the N-1 violation (Ladysmith – North Anna) may eliminate the need for these upgrades for the N-2 contingencies, which will be further studied and identified in the System Impact Study phase.

Results of Import studies:

Imports			
	Summer 2014	Summer 2014 with Q65	Limiting Element
AEP	1775	1178 1338	Elmont 500-230 kV Tx Elmont - Northwest Line #221
APS	1700	1130 1265 1200	Elmont 500-230 kV Tx Elmont - Northwest Line #221
CPL	2000+	1511 1705	Elmont 500-230 kV Tx Elmont - Northwest Line #221
PJM	1700	1126 1871	Elmont 500-230 kV Tx Elmont - Northwest Line #221

Results of Export studies:

Exports			
	Summer 2014	Summer 2014 with Q65	Limiting Element
AEP	2000+	2000+	
APS	2000+	1639	Ladysmith to North Anna
CPL	2000+	2000+	
PJM	1823	1213	Ladysmith to North Anna

The results of these studies indicate Dominion criteria evaluations for both N-1 and N-2 contingencies. For N-1 evaluations Dominion uses a 94% loading level for overloads and for N-2 evaluation Dominion uses a 130% level. Since these study results are based on a DC analysis potential overloads within 2% of these levels are highlighted since they will most likely exceed criteria levels when an AC Analysis is completed. The results of import and export studies are indicating that the proposed generation facility will significantly impact Dominion's import and export capability. Dominion internal Planning criteria indicate a need to have approximately 2000 MW of import and export

capability. GDC-17 study requirements are also very dependent on the transmission system being able to handle such import levels since one of the main study requirements has been the loss of both existing units (1800 MW+) at North Anna Power Station. Therefore, it is projected that network improvements will be needed to interconnect Q65 to the Dominion System. These improvements are as follows.

- New 15-mile long 500 kV Line from North Anna Substation to Ladysmith Switching Substation. This line is estimated to cost **\$20 million** dollars and is estimated to take five years to complete. The installation of two 500 kV breakers is included in this estimate one each at both terminal substations. No new right-of-way will be required for this line.
- New 20-mile long 230 kV line between Midlothian Substation and Southwest Substation. Existing right-of-way can be used. This project is estimated to cost **\$11 million** dollars and would take five years to complete and includes the installation of one 230 kV breaker at Southwest Substation.
- Establish a new 230 kV Switching Substation at Ladysmith CT Substation or Ladysmith Substation and loop Line #256 (Elmont – Four Rivers) into the site. The line extension would be 5 miles long and would use existing right-of-way. This project is estimated to cost **\$11 million** dollars and is estimated to take five years to complete.

These proposed network upgrade resolve all the above noted contingency conditions including PJM’s Generation Deliverability overloads.

Short Circuit Study Results

As a result of queue Q#65, the following breakers fell above the 100% breaker duty trigger point and will need to be replaced:

Substation	kV	Operating Number
North Anna	500	57302
North Anna	500	57502
North Anna	500	57602
North Anna	500	G102-1
North Anna	500	G102-2
North Anna	500	G202
North Anna	500	G2T575
North Anna	500	H502
North Anna	500	H602
North Anna	500	WT576
North Anna	500	XT573

The estimated cost to replace these 11 breakers are about \$8,690,000 and will take about 18 - 24 months to complete.

These results are based on estimated data and may change with system conditions.