PJM Generator Interconnection
S52 Morrisville 500-kV (600 MW)
Feasibility Study

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Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, §36.2, as well as the Feasibility Study Agreement.

Preface

The intent of the feasibility study is to determine a plan, with preliminary cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications for the appropriate transmission owner.

In some instances an interconnection customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

Summary

The following provides the transmission owners' cost and time estimates for upgrades based on the results of this Feasibility Report:

Attachment Facilities:	$ 1.0 M	3 Years
Direct Connection Network Upgrades:	$ 4.5 M	3 Years
Non-Direct Connection Network Upgrades:	$491.0 M[1,2]	10 Years[3]
Total Project:	$ 5.5 M + allocated costs	10 Years

[1] Cost does not include all ROW acquisition costs and assumes all necessary ROW is acquirable.

[2] This project is a contributor to the overloads that the Non-Direct Connection Network Upgrades are mitigating. The project may have an allocation to these costs. If the queue request proceeds through the study process, the estimated allocation will be identified in the System Impact Study.

[3] This is the current time estimate provided by the affected Transmission Owner for one or more of the network upgrades. If this duration has not been reduced at the time of your System Impact Study results, then PJM will provide the amount of generation that will be deliverable without the upgrade(s). Also, potential exists such that if sufficient projects on the constrained side of the upgrade sign ISAs the upgrade may no longer be required.

System Reinforcement Analyses

The following section shows the results of PJM and affected Transmission Owner Feasibility Study analyses.

Network Impacts

The Queue S52 Project was studied as a 600 MW capacity injection at the Front Royal substation. Project S52 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Generator Deliverability (Single Contingency)
PJM and DVP studies identified no problems.

Multiple Facility Contingencies
PJM and DVP studies identified no problems.

Short Circuit Analysis
PJM and Dominion studies indicate that there is no impact to breaker interrupting capabilities in Dominion's service area due to S52. These results are subject to change due to changing system conditions.

Stability Analysis
To be performed at the System Impact Study.

New Network Upgrade Requirements
To be finalized at the System Impact Study.

Contribution to Previously Identified Upgrade Requirements

1. Contribution of 78 MW further overloads the Kemptown – North North West 500 kV line from 176% to 179% of its normal rating (2078 MVA).

   Previous projects which contribute to this overload are: R17, R19, R22, R30, R33, R35, R44, R61, R76, R78, R80, R88, S12, S17, S18, S29 and S31.

2. Contribution of 84 MW further overloads the Kemptown – North North West 500 kV line from 171% to 174% of its emergency rating (2901 MVA) for the tower outage of Peach Bottom 230/500 kV transformer and eight machines at Muddy Run.

   Previous projects which contribute to this overload are: R03, R16, R17, R19, R22, R29, R30, R33, R35, R44, R47, R52, R54, R55, R59, R61, R64, R65, R76, R78, R79, R80, R88, R96, S06, S12, S17, S18, S26, S29, S31, S36, S37, S45 and S46.

3. Contribution of 75 MW further overloads the North North West – Conastone 500 kV line from 109% to 113% of its normal rating (2078 MVA).

   Previous projects which contribute to this overload are: R17, R19, R77, R80, S18 and S29.

4. Contribution of 7 MW further overloads to the Greene – Roxbury 138 kV line from 115% to 120% of its emergency rating (142 MVA) for the outage of Kemptown – NNWest 500 kV line (CONT ID: PJM13B_NNWEST_B).

   The previous project that contributes to this overload is S18.

5. Contribution of 26 MW further overloads to the High Ridge – Howard 230 kV line from 110% to 112% of its emergency rating (1131 MVA) for the outage of Kemptown – NNWest 500 kV line (CONT ID: PJM13B_NNWEST_B).

   Previous projects which contribute to this overload are: S18 and S29.

6. Contribution of 80 MW further overloads to the Conastone – Peach Bottom CKT 2 500 kV line from 140% to 143% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom CKT 1 (CONT ID: PJM17).

   Previous projects which contribute to this overload are: R16, R17, R19, R29, R30, R33, R35, R44, R47, R60, R61, R64, R76, R77, R78, R80, R88, R96, S12, S17, S18, S23, S29, S31, S32 and S33.

7. Contribution of 80 MW further overloads to the Conastone – Peach Bottom CKT 1 500 kV line from 140% to 143% of its emergency rating (2598 MVA) for the outage of Conastone – Peach Bottom 500 kV line CKT 2 (CONT ID: PJM17_2).

   Previous projects which contribute to this overload are: R16, R17, R19, R29, R30, R33, R35, R44, R47, R60, R61, R64, R76, R78, R80, R88, R96, S12, S17, S18, S23, S29, S31, S32 and S33.

Dominion Virginia Power Analysis

Dominion's Planning Criteria requires that the transmission system must be capable of importing and exporting power in excess of existing scheduled transfers between utilities. The system must be capable of handling this incremental transfer with any single facility (first contingency) out of service and not exceed the maximum continuous rating of any remaining facility. Any new facility that is connected to the transmission system should not significantly decrement First Contingency Incremental Transfer Capability (FCITC) for

transfers between utilities. Also Dominion's Planning Criteria requires that no facility be loaded to more than 94% of its emergency rating for an outage. For this same outage voltages can not be less than 93% of nominal with the exception of 500 kV voltages where it is desired to maintain a minimum of 101% of nominal voltage for an outage. A complete listing of Dominion's Planning Criteria along with interconnection requirements can be found in Dominion's Facility Connection Document which is publicly available on the Dominion web site.

Dominion used a 2012 RTEP case for the generation feasibility study. This case was supplied to Dominion on August 16, 2007 by PJM. Dominion modified this case to include all higher order Queue generation requests including proposed network facilities associated with these projects. This included the following Queue requests being modeled: P8 – 600 MW, P9 – 91 MW, P16 340 MW, P38 - 625 MW, Q65 -1594, R19-340 MW, R31 – 8 MW and R63 – 19 MW. Generation was scaled down proportional throughout the PJM System, including the Dominion System, to accommodate this increase in generation.

The results of the FCITC Studies under import and export conditions indicate the following.

The Pleasant View – Dickerson 230 kV line is a 2012 RTEP deficiency and PJM is working to develop a solution. In summary, the results of these studies indicate that the proposed facility is not adversely impacting FCITC's on the Dominion System.

Interconnection Requirements

The following describes the attachment, local and network facilities required to interconnect the unit to the system.

Consistent with Dominion Facility Connection Requirements the proposed facility will need to interconnect with the Meadow Brook to Morrisville 500 kV Line #580 as shown below.

Attachment Facilities

The IC is responsible for procurement, installation and maintenance to all Attachment Facilities from the generator leads up to the Point of Interconnection. DVP's Attachment Facility interconnection costs are estimated to be $1,000,000 dollars (2007 dollars). This cost includes the metering, relays and 500 kV line work to directly connect the proposed facility at the Point of Interconnection to the proposed 500 kV Switching Station. This work requires coordination with the Direct Connection Network Facitities with an estimated duration of three years for completion.

Direct Connection Network Facilities

The Direct Connection interconnection costs are estimated to be $4,500,000 dollars (2007 dollars) for the proposed 500 kV Switching Station. This cost estimate is based on the assumption that the developer will acquire the land needed for the switching station and that it will be located next to the existing Line #580 right-of-way. It is estimated to take 3 years to complete construction.

Non-Direct Connection Network Facilities

Estimates to mitigate overloads, which this project contributes to, are listed in the same order as identified previously in this report:

Kemptown to North Northwest 500 kV

The following addresses the first two overloads identified that this project contributes: two single circuit lines and associated substation terminations at an estimated cost of $ 294.4 million (2012 dollars) and estimated time of 10 yrs.

Assumptions:

- New 350 foot wide right of way (ROW) parallels existing Northwest to Mt Airy Tap ROW
- Total ROW length is 28.3 miles
- Three bundle 1,590 kcm conductor
- Kemptown located a quarter mile west of Mount Airy Tap
- North Northwest located four miles north of Northwest

Substation Terminations (included in estimate above):

- NNW - Install a 3 breaker bay $7.7M
- Kemptown - Install a 3 breaker bay $7.7M

Conastone to North Northwest 500 kV

This overload is mitigated with addition of a single circuit line at an estimated cost of $118.6 million (2012 dollars) and estimated time of 10 yrs.

Assumptions:

- New 200 foot wide right of way parallels existing Conastone to Northwest right of way
- Total right of way length = 19.6 miles
- Three bundle 1,590 kcm conductor
- North Northwest located four miles north of Northwest

Substation Terminations (included in estimate above):

- Conastone - Install a 1 breaker bay $3.2M
- NNW - Install a 2 breaker bay $6.4M

Greene to Roxbury 138 kV

This upgrade would be addressed with a Regional Transmission Expansion Plan replacement/upgrade of the Roxbury 138/115 kV transformer.

High Ridge to Howard 230 kV

Rebuild existing 1590 kcm circuit to accommodate 2167 kcm ACSR at an estimated cost of $16M and approximate duration of five years.

Assumptions:

- Length of line 8.0 miles
- 2+ year CPCN process at a cost of $500,000 included.
- Existing tower removal at a cost of $1M included.

Conastone – Peach Bottom 500 kV

To mitigate the overload of the Conastone – Peach Bottom 500 kV circuit a second circuit will need to be built[4]. The following estimates for cost and time are given by both PECO and BG&E for their respective portions. The estimates are provided first assuming acquisition of necessary ROW and then without.

With Necessary ROW:

PECO:
This estimate do not include the cost of new right of way.

Substation work at Peach Bottom	$ 2,500,000[5]
Construct 6.25 miles of 500kV line	$10,000,000[6]
Total	$12,500,000

BGE:
Build 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. Install one 500kV breaker at Conastone $1,500,000. The breaker installation can be completed concurrently with the line construction.

Assumptions:

- Acquire 150 foot wide ROW adjacent to existing ROW, mostly rural land at $100,000 per acre

[4] Additional work is being done by the TOs to come up with reinforcements to further mitigate this overload.

[5] 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.

[6] This estimate does not include the cost of new right of way.

- Two to three year CPCN process prior to land acquisition
- Length of line 9.6 miles

Without Necessary ROW:

The 230 kV line from Graceton to Peach Bottom is approximately 7.5 miles long and has a normal rating of 528 MVA. Assuming that this rating can be maintained with a single 230 kV pipe type cable[7], a new underground installation would cost about $30M and another $1M for terminal modifications. If the cable rating is insufficient, it will cost an additional $30M for a second cable. The existing 230 kV tower line could then be removed for about $1.5M and the existing ROW converted to 500 kV. Construction of a double circuit 500 kV line along this route from Conastone to Peach Bottom could be constructed at about $3.5M per mile. The line would be about 16.5 miles long and cost approximately $58M. Substation additions and modifications at Peach Bottom would cost an additional $10M.

[7] This would need further evaluation to determine and assumes no river or large creek crossings.

Figure 1
Single Line Drawing