

PJM Generator Interconnection
T180 Gainesville 230-kV (873 MWC)
Feasibility Study

April 2008
DMS #479926 (PJM.com Version)

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 between Interconnection Customer (IC) and PJM Interconnection, LLC (PJM) (Transmission Provider).

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.

General

The Queue Project #T180 was studied as a 960 MW energy (873 MW Capacity) injection at the Gainesville 230 kV substation in the Dominion area. Project #T180 was evaluated for compliance with reliability criteria for summer peak conditions in 2012.

Summary

	Cost	Duration
Attachment Facilities:	\$1.0M	1.5 yrs.
Direct Connection Network Upgrades:	\$1.2M	1.5 yrs.
Non-Direct Connection Network Upgrades:		
New:	\$12.7-20.7M	4-5 yrs.
Contribution to Existing:	\$335.6M ¹	10 yrs.

¹ Cost allocation to these upgrades will be determined in the System Impact Study.

Network Impacts

Generator Deliverability

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

- 1) (DOM) The 6GAINSVL-6LOUDOUN 230kV line loads from 68.0% to 118.1% (DC power flow) of its emergency rating (1000MVA) for the single line contingency outage (LN 569). This project contributes approximately 501.7MW to cause this thermal violation.

Multiple Facility Contingency

(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)

- 2) (APS/PENNELEC) The 01GREENE-ROXBURY 138kV line loads from 96.53% to 105.02% (DC power flow) of its emergency rating (142MVA) for the tower line outage (CONAS_PB). This project contributes approximately 12.1MW to cause this thermal violation.

Short Circuit

- 3) There are six (6) breaker interrupting capability with more than 100% as a result of T180. They are as follow:

<u>Bus</u>	<u>Breaker No.</u>
Ladysmith 500 kV	568T575
Loudoun 230 kV	SC352
Morrisville 500 kV	H1T569
Morrisville 500 kV	H1T573
Morrisville 500 kV	H2T580
Morrisville 500 kV	SC122

These results are subject to change due to changing system conditions.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

- 4) (PPL/BGE) The GRACETON-MANOR 230kV line loads from 132.34% to 138.65% (DC power flow) of its emergency rating (531MVA) for the tower line outage (CONAS_PB). This project contributes approximately 33.5MW to the thermal violation.
- 5) (BGE/PPL) The CONASTON-OTTERCRK 230kV line loads from 105.19% to 110.90% (DC power flow) of its emergency rating (627MVA) for the tower line outage (CONAS_PB). This project contributes approximately 35.8MW to the thermal violation.
- 6) (APS) The 01KEMPTN-N-NWEST 500kV line loads from 210.97% to 216.99% (DC power flow) of its emergency rating (2901MVA) for the tower

line outage (HIRDG_BURTVL). This project contributes approximately 174.6MW to the thermal violation.

Stability Analysis

(Results of the dynamic studies should be inserted here)

To be determined at the System Impact Study.

Dominion Analysis

Dominion assessed the impact on the Dominion Transmission System that the proposed 873 MW injection of new generation capacity, as identified on Attachment N, would have at the Gainesville 230 kV Substation. The system was assessed using the summer 2012 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts that higher order queue generators may have on the study results, specifically those generators located on the Dominion Transmission System which have a signed a PJM ISA or IISA and their associated network upgrades were also modeled. The following higher order queue projects were modeled in the PJM Summer 2012 case; P16, P27, Q69, Q71, R17, R63, S86-S96 and T10. When performing a generation analysis Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria consider a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies Dominion considers a transmission facility overloaded if it exceed 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at http://www.dom.com/about/electransmission/pdf/Facility_Connection_Requirements.pdf

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the T180 evaluation three different assessments were conducted.

- 1) The first being when local generation including the proposed T180 facility is operated at their maximum capability. The result of this study is indicating significant system deficiencies and is shown below in Table A.
- 2) The second being a stressed system condition, specifically when the largest generator in the area is unavailable. The proposed T180 generator is located on the 230 kV system in the Northern Virginia load area. Therefore, the impact of T180 was studied under stressed system conditions where the most critical generating unit located on the 230 kV system in this load area is unavailable. Therefore, Possum Point Unit #5

was outaged to create this critical system condition. The result of this study is shown below in Table B.

- 3) The third being import and export conditions into and out of the Dominion System. Any new facility that is interconnected with the Dominion System should not significantly decrement FCITC (First Contingency Incremental Transfer Capability) between utilities. The results of these studies can be found in Tables C and D.

Table A
Summer 2012 Pmax System Conditions (Local Generators at Pmax)

Overloaded Element	Contingency Conditions	Pmax + T180
Gainesville-Loudoun	1	107%

Note: For this study condition, generation at the proposed T180 facility was scaled to its maximum value (Pmax) and generation was proportionally reduced throughout the PJM System.

Table B
Summer 2012 Stressed System Conditions (No Possum Point Unit #5)

Overloaded Element	Contingency Conditions	Base Case + T180
Gainesville-Loudoun	1	114%

Note: Note: For this stress system condition Possum Point Unit #5 was removed from service and generation was increased within the Dominion System proportionally to make-up for the reduced generation.

The results of these studies indicate that approximately 8 miles of 230 kV line is overloaded. Specifically the following 230 kV line is overloaded.

Line # 2030 (Gainesville – Loudoun) 8 miles

Dominion’s Planning Criteria also indicates a need to have approximately 2000 MW of import and export capability. The results of import and export studies are indicating that the proposed generation facility, with the associated upgrades detailed above, will not negatively impact Dominion’s import capability but will have a negative impact on its export capability.

Table C
Import Study Results

Area	Summer 2012	Summer 2012 with T168	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table D

Export Study Results			
Area	Summer 2012	Summer 2012 with T168	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	1635+	Brambleton-Pleasant View 230kV Line

Non-Direct Connection Network Upgrades

New System Reinforcements

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

The estimated cost to replace the six breakers (item #3) is \$2,680,000 and will take about 22 weeks to complete. The equipment order time will take about 8 to 10 months.

As noted earlier the study results are indicating that the following 230 kV lines are overloaded.

- a. Line # 2030 (Gainesville – Loudoun) 8 miles
- b. Line #201 (Brambleton – Pleasant View) 8 miles

The solution to resolve overload (a) would be to convert the existing 115kV Line #124 (Gainesville – Loudoun) to 230kV to provide a parallel 230kV path between Gainesville and Loudoun Substations. This solution would also require the replacement of NOVEC’s Catharpin Delivery Point transformer that is fed from Line #124. This solution is estimated to cost approximately \$ 6-10 million dollars and will require an SCC permit. This upgrade is estimated to take 3-5 years to complete.

The solution to resolve overload (b) would be to rebuild Line #201 (Brambleton – Pleasant View) to achieve a greater thermal rating. This solution would require the reconductoring/rebuilding of approximately 8 miles of 230kV line. This solution is estimated to cost approximately \$4-8 million dollars depending on whether the line can be reconductored or if it needs to be rebuilt. This upgrade is estimated to take 2-3 years to complete.

The proposed solutions would resolve all the projected overloads identified in the Dominion and PJM Analysis as they relate to Dominion Transmission Facilities.

More precise engineering cost and construction details will be developed as part of the System Impact Study.

To mitigate the Multiple Facility Contingency (item 2 above) overload, the Roxbury 138/115-kv transformer should be operated open, consistent with existing FirstEnergy procedures to control thermal contingencies that occur on the Penelec/AP tie lines.

Contribution to Previously Identified System Reinforcements

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

This addresses item #4 from the previously identified overloads listed above: The BGE reinforcement is to reconductor with 1,590 kcm ACSR from Graceton to PA line (transfer of ownership to PPL) at an estimated cost and duration of \$1.0M and 3 yrs. The length of this line section is 1.8 miles and its towers can be reinforced instead of replaced. The PPL reinforcement is to reconductor with 1590 kcmil ACSR conductors (1 per phase). This rebuild will require new custom embedded steel poles to accommodate a larger conductor size. The rebuild will be 14.4 miles long and will travel the existing right of way. The estimated cost for this upgrade including substation terminal equipment cost is \$31M.

This reinforcement addresses item #5 from the previously identified overloads listed above: The BG&E portion of the Conastone to Otter Creek line can be upgraded by reconductoring with 1,590 kcm ACSR from Gorsuch Mills to the Pennsylvania State Line (change of ownership to PPL). The length of this line section is 1.7 miles and its towers can be reinforced instead of replaced. The estimated cost and duration is \$0.7M and 3 years. The PPL portion of the line can be upgraded by reconductoring approximately 17.2 miles with new 795 kcmil 30/19 ACSS. No terminal equipment upgrade is required at Otter Creek; it is currently built with 2000 amp rating equipment. The estimated cost of this upgrade is \$8.5 million and the estimated construction time is 3 years.

This addresses item #6 from the previously identified overloads listed above: Kempton to North Northwest 500 kV reinforcement requires two single circuit lines at an estimated cost of \$279-million and estimated time of 10 yrs to complete. The substation work will be performed concurrently and is estimated to cost \$15.4M.

Direct Connection Network Upgrades

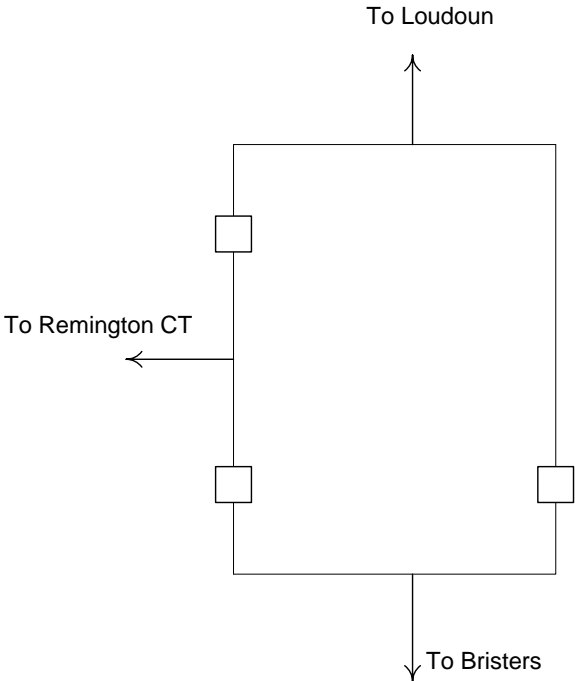
To accommodate the proposed new generation, the existing Gainesville 230 kV Substation (Figure A) will need to be rearranged as shown in Figure B. The network attachment facilities include the installation of two 230 kV breakers and

associated equipment and are estimated to cost \$1.2 million dollars. This work is estimated to take 12-18 months to complete.

Attachment Facilities

The estimated cost of these facilities, which includes 0.75 miles of conductor, metering, protection, and associated equipment, is \$1 million. This work will be coordinated with the Direct Connection Network Upgrades.

Figure A
Existing Arrangement
GAINESVILLE 230-kV SUBSTATION



**Figure B
Proposed Arrangement**

