PJM Generator Interconnection
T134 Chalk Point- Bowie 230-kV (325 MWC)
Feasibility Study

May 2008
DMS #481464

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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 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 System Impact Study is performed. In addition, projects modeled in the base case used for this Feasibility Study may or have already withdrawn from the PJM queue. The effect of withdrawn projects will be determined during the System Impact Study.

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 T134 was studied as a 325MWC injection at the Chalk Point–Bowie 230-kV substations in the PEPCO area in addition to the T133 project. Project T134 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. At the request of IC, the project was studied with and without transferring Capacity Injection Rights (CIRs).

Summary

Upgrade Type	Cost and Timing Without CIRs Xfr	Cost and Timing With CIRs Xfr
Attachment & Direct Connection Network Upgrades	$4M-5M & 3 yrs.	$4M-5M & 3 yrs.
Non-Direct Connection Network Upgrades	$517M-$537M & 10 yrs.*	$19M & 2 yrs.*

* Cost allocation to contributions to previously identified reinforcements will be determined at the System Impact Study.

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Network Impacts

Generator Deliverability

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

None.

Multiple Facility Contingency

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

None.

Short Circuit

None that exceed the PJM Manual 14B criterion.

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)

1) The OAKGV054-BOWIE044 230kV line loads from 94.7% to 103.0% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 50.6MW to cause this thermal violation. This is the first non-contingency overload to this line, but the reinforcement is already identified for contingency overload mitigation.
2) The OAKGV053-BOWIE043 230kV line loads from 94.3% to 102.7% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 50.5MW to cause this thermal violation. This is the first non-contingency overload to this line, but the reinforcement is already identified for contingency overload mitigation.
3) The S17TAP81-BURCH230 230kV line loads from 226.80% to 230.71% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PP47_WITH_R17TAP85230_A_S17A). This project contributes approximately 28.5MW to the thermal violation.
4) The S17-S17TAP82 230kV line loads from 155.06% to 156.79% (DC power flow) of its emergency rating (999MVA) for the single line contingency outage (PP50_WITH_R17TAP86230_A_S17B). This project contributes approximately 17.3MW to the thermal violation.
5) The S17TAP82-BURCH230 230kV line loads from 226.16% to 230.98% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PP50_WITH_R17TAP86230_A_S17B). This project contributes approximately 35.2MW to the thermal violation.
6) The R17TAP85-TALBT082 230kV line loads from 122.40% to 124.88% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PP50_WITH_R17TAP86230_A_S17A). This project contributes approximately 18.1MW to the thermal violation.

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7) The R17TAP86-TALB 068 230kV line loads from 120.76% to 123.15% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PP47_WITH_R17TAP85230_A_S17A). This project contributes approximately 17.5MW to the thermal violation.
8) The OAKGV230-BOWIE045 230kV line loads from 137.76% to 140.71% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 17.9MW to the thermal violation.
9) The OAKGV230-BOWIE042 230kV line loads from 137.96% to 140.92% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 18.0MW to the thermal violation.
10) The BOWIE045-BURT2314 230kV line loads from 137.62% to 140.57% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 17.9MW to the thermal violation.
11) The S17TAP81-BURCH230 230kV line loads from 146.04% to 149.15% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 18.9MW to the thermal violation.
12) The S17TAP82-BURCH230 230kV line loads from 146.04% to 149.15% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 18.9MW to the thermal violation.
13) The BOWIE042-BURT2334 230kV line loads from 137.83% to 140.79% (DC power flow) of its normal rating (608MVA) for non-contingency condition. This project contributes approximately 18.0MW to the thermal violation.
14) The SOLPT 44-RIV2339 230kV line loads from 108.78% to 111.04% (DC power flow) of its emergency rating (1131MVA) for the single line contingency outage (BG26). This project contributes approximately 25.6MW to the thermal violation.
15) The 01KEMPTN-N-NWEST 500kV line loads from 196.76% to 198.28% (DC power flow) of its normal rating (2078MVA) for non-contingency condition. This project contributes approximately 31.6MW to the thermal violation.
16) The BRANDN.S-HWKPT 44 230kV line loads from 106.75% to 108.97% (DC power flow) of its emergency rating (1153MVA) for the single line contingency outage (BG26). This project contributes approximately 25.6MW to the thermal violation.
17) The TALBT082-S17TAP82 230kV line loads from 103.74% to 107.72% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PJM1D). This project contributes approximately 29.1MW to the thermal violation.
18) The TALB 068-S17TAP81 230kV line loads from 103.74% to 107.72% (DC power flow) of its emergency rating (730MVA) for the single line contingency outage (PJM1D). This project contributes approximately 29.1MW to the thermal violation.

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19) The BURT2334-SANDY34T 230kV line loads from 111.29% to 113.03% (DC power flow) of its emergency rating (923MVA) for the single line contingency outage (PJM13B_NNWEST_B). This project contributes approximately 16.1MW to the thermal violation.
20) The BURT2314-SANDY14T 230kV line loads from 109.37% to 111.16% (DC power flow) of its emergency rating (923MVA) for the single line contingency outage (PJM13B_NNWEST_B). This project contributes approximately 16.5MW to the thermal violation.
21) The SANDY14T-H.RDGE16 230kV line loads from 102.34% to 104.12% (DC power flow) of its emergency rating (923MVA) for the single line contingency outage (PJM13B_NNWEST_B). This project contributes approximately 16.5MW to the thermal violation.
22) The SANDY34T-H.RDGE16 230kV line loads from 101.75% to 103.49% (DC power flow) of its emergency rating (923MVA) for the single line contingency outage (PJM13B_NNWEST_B). This project contributes approximately 16.1MW to the thermal violation.
23) The OAKGV054-BOWIE044 230kV line loads from 112.48% to 121.37% (DC power flow) of its emergency rating (730MVA) for the tower line outage (7PEPCO_WITH_T133). This project contributes approximately 64.9MW to the thermal violation.
24) The OAKGV053-BOWIE043 230kV line loads from 112.29% to 121.17% (DC power flow) of its emergency rating (730MVA) for the tower line outage (5PEPCO_WITH_T133). This project contributes approximately 64.8MW to the thermal violation.
25) The OAKGV230-BOWIE045 230kV line loads from 154.59% to 158.49% (DC power flow) of its emergency rating (730MVA) for the tower line outage (5PEPCO_WITH_T133). This project contributes approximately 28.5MW to the thermal violation.
26) The OAKGV230-BOWIE042 230kV line loads from 154.60% to 158.51% (DC power flow) of its emergency rating (730MVA) for the tower line outage (7PEPCO_WITH_T133). This project contributes approximately 28.5MW to the thermal violation.
27) The BOWIE045-BURT2314 230kV line loads from 154.48% to 158.38% (DC power flow) of its emergency rating (730MVA) for the tower line outage (5PEPCO_WITH_T133). This project contributes approximately 28.5MW to the thermal violation.
28) The BOWIE042-BURT2334 230kV line loads from 154.49% to 158.40% (DC power flow) of its emergency rating (730MVA) for the tower line outage (7PEPCO_WITH_T133). This project contributes approximately 28.5MW to the thermal violation.
29) The GRACETON-MANOR 230kV line loads from 136.20% to 139.06% (DC power flow) of its emergency rating (531MVA) for the tower line outage (CONAS_PB). This project contributes approximately 15.2MW to the thermal violation.
30) The CONASTON-OTTERCRK 230kV line loads from 109.61% to 111.90% (DC power flow) of its emergency rating (627MVA) for the tower line outage

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(CONAS_PB). This project contributes approximately 14.4MW to the thermal violation.

Stability Analysis

(Results of the dynamic studies should be inserted here)

To be determined at the System Impact Study.

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)

None.

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)

1) The cost to add a second conductor to this Oak Grove - Bowie 230kV circuit is approximately $5 million. Estimated construction time is approximately two years.
2) The cost to add a second conductor to this Oak Grove - Bowie 230kV circuit is approximately $5 million. Estimated construction time is approximately two years.
3) Talbert – Burches Hill 230 kV circuit (23081) is approximately 4.5 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor with an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $ 4,500.000. Estimated construction time is two years.
4) Talbert – Burches Hill 230 kV circuit (23082) is approximately 4.5 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor with an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $ 4,500,000. Estimated construction time is two years.
5) Same as 4.
6) Talbert – Morgantown 230 kV circuit (23085) is approximately 26 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor to an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $ 26,000,000. Estimated construction time is two years.

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7) Talbert – Morgantown 230 kV circuit (23086) is approximately 26 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor with an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $ 26,000,000. Estimated construction time is two years.
8) Oak Grove – Bowie 230 kV circuit (23045) is approximately 12 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor to an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $12,000,000. Estimated construction time is two years.
9) Oak Grove – Bowie 230 kV circuit (23042) is approximately 12 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor to an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $12,000,000. Estimated construction time is two years.
10) Bowie – Burtonsville 230 kV circuit (23045) is approximately 8 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor to an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $8,000,000. Estimated construction time is two years.
11) Same as 3.
12) Same as 5.
13) Bowie – Burtonsville 230 kV circuit (23042) is approximately 8 miles. Currently this circuit is an ACSR conductor, which is rated at 730 MVA SE. Upgrading this circuit will require replacing the existing conductor to an ACCR conductor, which will be rated at 3000 amps or 1200 MVA SE. The approximate cost is $8,000,000. Estimated construction time is two years.
14) Install one additional Harbor Crossing cable from Hawkins Point to Sollers Point and re-rate new OH sections to 180C. The estimated cost is $60M-$80M and is estimate to take 8-10 years to design and complete.
15) Kemptown 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.
16) Same as 14.
17) Same as 4.
18) Same as 3.
19) The solution to the overload is to rebuild the existing double circuit line using double bundle 1033 ACSR @ 125 degC (1227 MVA) at an estimated cost of $540,000. The estimated construction time is 5 years. This fix assumes that full structure replacement is required and includes

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existing structure removal. The line length of 0.2 miles, and it is anticipated that a 2+ year Certificate of Public Convenience & Necessity (CPCN) process required.

20) Same as 19.
21) Rebuild the existing line using double bundle 1033 ACSR @ 125 degC (1227 MVA) at a cost of $10,000,000 and 5 years to construct. Assumptions include; a full structure replacement required, existing structure removal, line length of 3.61 miles and 2+ year CPCN process required.
22) Same as 21.
23) Same as 1.
24) Same as 2.
25) Same as 8.
26) Same as 9.
27) Same as 10.
28) Same as 13.
29) Reconductor with 1,590 kcm ACSR from Graceton to PA line 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 recondcutor with 1590 kcmil ACSR conductors (1 per phase). This rebuild will require new custom embedded steel poles to accommodate the 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.
30) 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 $0.8M 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.

Direct Connection Network Upgrades

Pepco will add a separate 230 kV breaker bay, two breakers to the T133 substation (see the one line diagram). The total estimated cost is $3.2M and it will take approximately 36 months to construct.

Attachment Facilities

Queue T134 Interconnection Customer is responsible for design, construction and costs for all facilities associated with the T134 generating station on the Interconnection Customer side of the POI (Point of Interconnection) on the one line diagram. The cost of and schedule of terminating the generator connection

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from the POI at a single bay in the new substation is included as part of the Direct Connection Network Upgrade estimate.

Capacity Rights Transfer

A preliminary study was performed to see the effects of transferring the capacity rights to the T133 and T134 projects. This study was done using a simple mathematical analysis of the line-loading contributions from each of the transferring units. The contributions (measured in MW) were then summed, and compared to the line-loading contributions of the T133 and T134 projects. This comparison was done on an overload by overload basis. If the contributions from the transferring units (summed together) were greater than or equal to the contributions from the T133 and T134 projects (summed together) for a particular overload, the capacity rights transfer would relieve T133 and T134 from any cost allocation.

Our analysis showed that a capacity rights transfer would relieve T133 and T134 contributions to all but four overloads. The overloads for which T133 and T134 would still be partially responsible are shown below.

R17 Tap 85 to Talbert Tap 82
R17 Tap 86 to Talbert Tap 68
Oak Grove 54 to Bowie 44
Oak Grove 53 to Bowie 43

It should be noted that this study was based on the generator deliverability study methodology described in PJM manual 14B. The methodology involves calculating the "worst case scenario" dispatch of the surrounding generation. For this reason, certain generators located close to a particular line may not actually contribute to its overloading. Looking at the chart above, this explains why the transferring generators do not have a greater impact on the four overloads. Although they may be electrically close to the overloaded lines, the worst case scenario dispatch calculation does not involve a significant contribution from these units.

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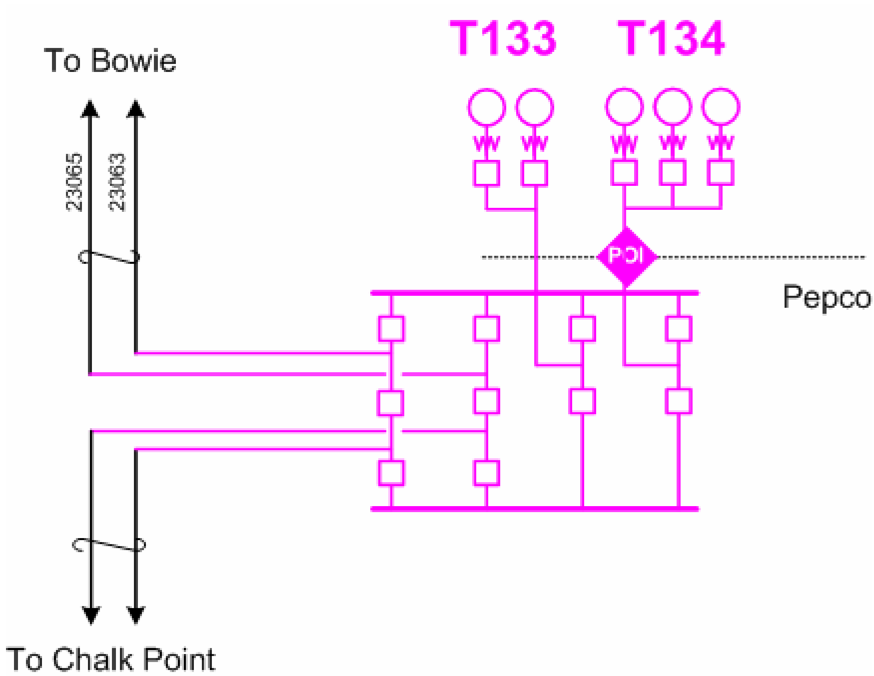
T134 Single Line Diagram



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