PJM Generator Interconnection

X4-035 Burches Hill – Chalk Point 230 kV

735.5 MW Capacity / 735.5 MW Energy

Feasibility Study Report

Revised

June 2012
DMS #696748v3

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 (TP). The Interconnected Transmission Owner (ITO) is Potomac Electric Power Company. Affected transmission owners include Dominion and BGE.

Preface

The intent of this 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 IC. As a requirement for interconnection, IC 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 and the underlying system. All facilities required for interconnection of a generation interconnection project must be designed to meet ITO technical specifications.

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. IC is responsible for its right of way, real estate, and construction permit issues.

General

The queue project X4-035 was studied as a 735.5 MW (Capacity 735.5 MW) injection in to the ITO area. Project X4-035 was evaluated for compliance with reliability criteria for summer peak conditions in 2015. Potential network impacts were as follows:

Primary Option

The following contingencies resulted in overloads for the primary option:

Option 1 Impactful Contingencies	
Contingency Name	**File Description**
PP47	CONTINGENCY 'PP47' OPEN BRANCH FROM BUS 223982 TO BUS 223990 CKT 1 / 223982 OAKGV230 230 223990 TALB 068 230 1 OPEN BRANCH FROM BUS 290891 TO BUS 223990 CKT 1 / 290891 S17 230 223990 TALB 068 230 1 / S17. END
7PEPCO_A	CONTINGENCY '7PEPCO_A' /* BOWIE045 TO OAKGV23 DISCONNECT BRANCH FROM BUS 223978 TO BUS 223961 CKT 1 /* OAKGV05 TO CHALK230 DISCONNECT BRANCH FROM BUS 223982 TO BUS 223978 CKT 1 DISCONNECT BRANCH FROM BUS 224061 TO BUS 223980 CKT 1 DISCONNECT BRANCH FROM BUS 292454 TO BUS 224061 CKT 1 /BUS 223983 -> 292454 END
5PEPCO	CONTINGENCY '5PEPCO' /* CHALK230 TO BOWIE044 DISCONNECT BRANCH FROM BUS 223983 TO BUS 224600 CKT 1 /* OAKGV230 TO AQUASCO1 DISCONNECT BRANCH FROM BUS 224600 TO BUS 224060 CKT 1 /* AQUASCO1 TO BOWIE044. FEB. 17, 2009. DISCONNECT BRANCH FROM BUS 224060 TO BUS 223979 CKT 1 DISCONNECT BRANCH FROM BUS 223982 TO BUS 223977 CKT 1 DISCONNECT BRANCH FROM BUS 223977 TO BUS 223962 CKT 1 END
8OX _8POSSUM _043	CONTINGENCY '8OX _8POSSUM _043' DISCONNECT BRANCH FROM BUS 314919 TO BUS 314922 CKT 1 /* 500/500KV, AREA 345/345. END

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 Contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

None.

Contribution to Previously Identified Overloads

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

X4-035 Opt. 1 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
001	N-1	PP47	PHI	TALBT082-OAKGV230 230 kV line	223991	223982	1	DC	102.78	108.19	NR	680	36.84
002	DCTL	7PEPCO_A	PHI	BOWIE042-BURT2334 230 kV line	223977	223962	1	DC	110.04	110.99	NR	730	42.91
003	DCTL	7PEPCO_A	PHI	OAKGV230-BOWIE042 230 kV line	223982	223977	1	DC	110.29	111.24	NR	730	42.91
004	DCTL	5PEPCO	PHI	BOWIE045-BURT2314 230 kV line	223978	223961	1	DC	111.5	112.45	NR	730	43.05
005	DCTL	5PEPCO	PHI	OAKGV230-BOWIE045 230 kV line	223982	223978	1	DC	111.62	112.57	NR	730	43.05
006	N-1	8OX_8POSSUM_043	PHI	8POSSUM 500/230 kV transformer	314922	314074	1	DC	104.27	115.22	NR	969	106.21

001 Reconductoring the Talbert – Oakgrove 230 kV circuit is estimated to cost $8 Million and take 2.5 years for engineering and construction.

002 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.

003 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.

004 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.

005 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.

006 Dominion would need to install a second 500-230 kV Tx at this location to resolve this overload. The estimated cost of this is $20 million. Estimated construction time is three years.

Short Circuit

(Report Overdutied breakers here)

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With X4-035_opt1	Duty Percent Without X4-035_opt1	Duty Percent Difference	Note
314918	NORTH ANNA 500.kV	G102-1	S	100.10%	99.90%	0.20%	New Over-duty
314918	NORTH ANNA 500.kV	G202	S	100.10%	99.90%	0.20%	New Over-duty
314918	NORTH ANNA 500.kV	H602	S	100.10%	99.90%	0.20%	New Over-duty
314918	NORTH ANNA 500.kV	WT576	S	100.10%	99.90%	0.20%	New Over-duty
314918	NORTH ANNA 500.kV	XT573	S	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-1	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-1/2342 T	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-2	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-2/2338 T	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-3	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-3/2343 T	T	100.10%	99.90%	0.20%	New Over-duty
20	CLVT CLF 500.kV	2GEN/5072 (6	T	101.70%	99.80%	1.90%	New Over-duty
20	CLVT CLF 500.kV	5051/1GEN (2	T	101.30%	99.40%	1.90%	New Over-duty

Dominion:

The five overdutied 500 kV breakers G102-1, G202, H602, WT576 and XT573 at North Anna are 500-SFM-50E breakers with name plate rating of 40 kA. ITO can get the name plate rating change to 50 kA from the manufacturer for about $2,000 each.

BGE:

The six 230kV breakers Waugh Chapel overdutied breakers are estimated to cost $400K each to replace, or $2.4M total, and the time to complete all six is 36-40 months depending on outage availability.

The two 500kV breakers overdutied at Calvert Cliffs are estimated to cost $520K each to upgrade, or $1.04M total, and the time to complete is 36 months.

Secondary Option

The following contingencies resulted in overloads for the secondary option:

Option 2 Impactful Contingencies	
Contingency Name	**File Description**
HIRDG_BURTVL	CONTINGENCY 'HIRDG_BURTVL' /* HIGH RIDGE TO BURTONSVILLE CKTS #2314 & #2334 DISCONNECT BUS 220983 /* CKT #2314 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-2 DISCONNECT BUS 220984 /* CKT #2334 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-1 END
7PEPCO_A	CONTINGENCY '7PEPCO_A' /* BOWIE045 TO OAKGV23 DISCONNECT BRANCH FROM BUS 223978 TO BUS 223961 CKT 1 /* OAKGV05 TO CHALK230 DISCONNECT BRANCH FROM BUS 223982 TO BUS 223978 CKT 1 DISCONNECT BRANCH FROM BUS 224061 TO BUS 223980 CKT 1 DISCONNECT BRANCH FROM BUS 292454 TO BUS 224061 CKT 1 /BUS 223983 -> 292454 END
5PEPCO	CONTINGENCY '5PEPCO' /* CHALK230 TO BOWIE044 DISCONNECT BRANCH FROM BUS 223983 TO BUS 224600 CKT 1 /* OAKGV230 TO AQUASCO1 DISCONNECT BRANCH FROM BUS 224600 TO BUS 224060 CKT 1 /* AQUASCO1 TO BOWIE044. FEB. 17, 2009. DISCONNECT BRANCH FROM BUS 224060 TO BUS 223979 CKT 1 DISCONNECT BRANCH FROM BUS 223982 TO BUS 223977 CKT 1 DISCONNECT BRANCH FROM BUS 223977 TO BUS 223962 CKT 1 END
8OX _8POSSUM _043	CONTINGENCY '8OX _8POSSUM _043' DISCONNECT BRANCH FROM BUS 314919 TO BUS 314922 CKT 1 /* 500/500KV, AREA 345/345. END
12PEPCO_S17	CONTINGENCY '12PEPCO_S17' DISCONNECT BRANCH FROM BUS 223988 TO BUS 223991 CKT 1 / MORGNTW230 – TALB082 DISCONNECT BRANCH FROM BUS 223991 TO BUS 223982 CKT 1 / TALB068 – OAKGV230 DISCONNECT BRANCH FROM BUS 223993 TO BUS 224078 CKT 1 / HAWK077 – HAWK 69 DISCONNECT BRANCH FROM BUS 223991 TO BUS 290892 CKT 1 / TALB082 – S17TAP82230 DISCONNECT BRANCH FROM BUS 223988 TO BUS 223993 CKT 1 /MORGT230 – HAWK 077 DISCONNECT BRANCH FROM BUS 223993 TO BUS 224124 CKT 1 / HAWK 077 – TALB 087 DISCONNECT BRANCH FROM BUS 224124 TO BUS 223982 CKT 1 / TALB 087 – OAKGV 230 END

Network Impacts:

Generator Deliverability

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

X4-035 Opt. 2 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
001	Non	Non	PHI	TALBT082-OAKGV230 230 kV line	223991	223982	1	DC	87.5	101.78	NR	559	79.82
002	Non	Non	PHI	TALB 068-OAKGV230 230 kV line	223990	223982	1	DC	95.88	108.04	NR	608	73.9

The magnitude of overload will put the conduction over its rating which will require a these feeders to be re-conductor with the high temperature ACCR conductor with potential of having to replace breakers and disconnect switches at Talbert and Oak Grove. These two lines or on separate tower lines and engineering standard would require the other circuit on each tower line to also be upgraded. This could require the four 230kV feeders from Morganton - Talbert - Oak Grove to have to be upgraded.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

None.

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.)

X4-035 Opt. 2 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
003	DCTL	HIRDG_BURTVL	PHI	BOWIE044-BOWIEBC0 230 kV line	223979	220959	1	DC	105.14	106.31	NR	720	52.21
004	DCTL	7PEPCO_A	PHI	OAKGV054-BOWIE044 230 kV line	224060	223979	1	DC	108.46	109.3	NR	730	37.94
005	DCTL	7PEPCO_A	PHI	AQUASCO1-OAKGV054 230 kV line	224600	224060	1	DC	109.02	109.86	NR	730	37.94
006	DCTL	7PEPCO_A	PHI	BOWIE042-BURT2334 230 kV line	223977	223962	1	DC	110.07	111.82	NR	730	78.81
007	DCTL	7PEPCO_A	PHI	OAKGV230-BOWIE042 230 kV line	223982	223977	1	DC	110.32	112.06	NR	730	78.81
008	DCTL	5PEPCO	PHI	BOWIE045-BURT2314 230 kV line	223978	223961	1	DC	111.53	113.29	NR	730	79.27
009	DCTL	5PEPCO	PHI	OAKGV230-BOWIE045 230 kV line	223982	223978	1	DC	111.65	113.4	NR	730	79.27
010	N-1	8OX_8POSSUM_043	PHI	8POSSUM 500/230 kV transformer	314922	314074	1	DC	104.07	113.81	NR	969	94.42
011	DCTL	12PEPCO_S17	PHI	TALB 068-OAKGV230 230 kV line	223990	223982	1	DC	118.02	133.37	NR	691	106.06

Contributions are not provided for secondary interconnections at the Feasibility Study.

Short Circuit

(Report over-dutied breakers.)

Analysis found new breakers for the secondary option to be over-duty in the ITO transmission area.

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With X4-035_opt1	Duty Percent Without X4-035_opt1	Duty Percent Difference	Note
5955	W.CHAPEL 230.kV	230-1	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-1/2342 T	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-2	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-2/2338 T	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-3	T	100.10%	99.90%	0.20%	New Over-duty
5955	W.CHAPEL 230.kV	230-3/2343 T	T	100.10%	99.90%	0.20%	New Over-duty
20	CLVT CLF 500.kV	2GEN/5072 (6	T	100.30%	99.80%	0.50%	New Over-duty
223994	BHILL 230 230.kV	ABB GCB	S	141.00%	124.50%	16.50%	Over 100%, > 3% contribution
223994	BHILL 230 230.kV	ITE OCB	S	141.00%	124.50%	16.50%	Over 100%, > 3% contribution
223994	BHILL 230 230.kV	WEST OCB	S	141.00%	124.50%	16.50%	Over 100%, > 3% contribution

BGE:

The six 230kV breakers Waugh Chapel overdutied breakers are estimated to cost $400K each to replace, or $2.4M total, and the time to complete all six is 36-40 months depending on outage availability.

The two 500kV breakers overdutied at Calvert Cliffs are estimated to cost $520K each to upgrade, or $1.04M total, and the time to complete is 36 months.

PEPCO:

The three breakers at Burches Hill exceed 80 kA with the addition of X4-035. Estimates to address the fault duty will be performed at the SIS if the customer elects this option.

Primary Option Upgrades:

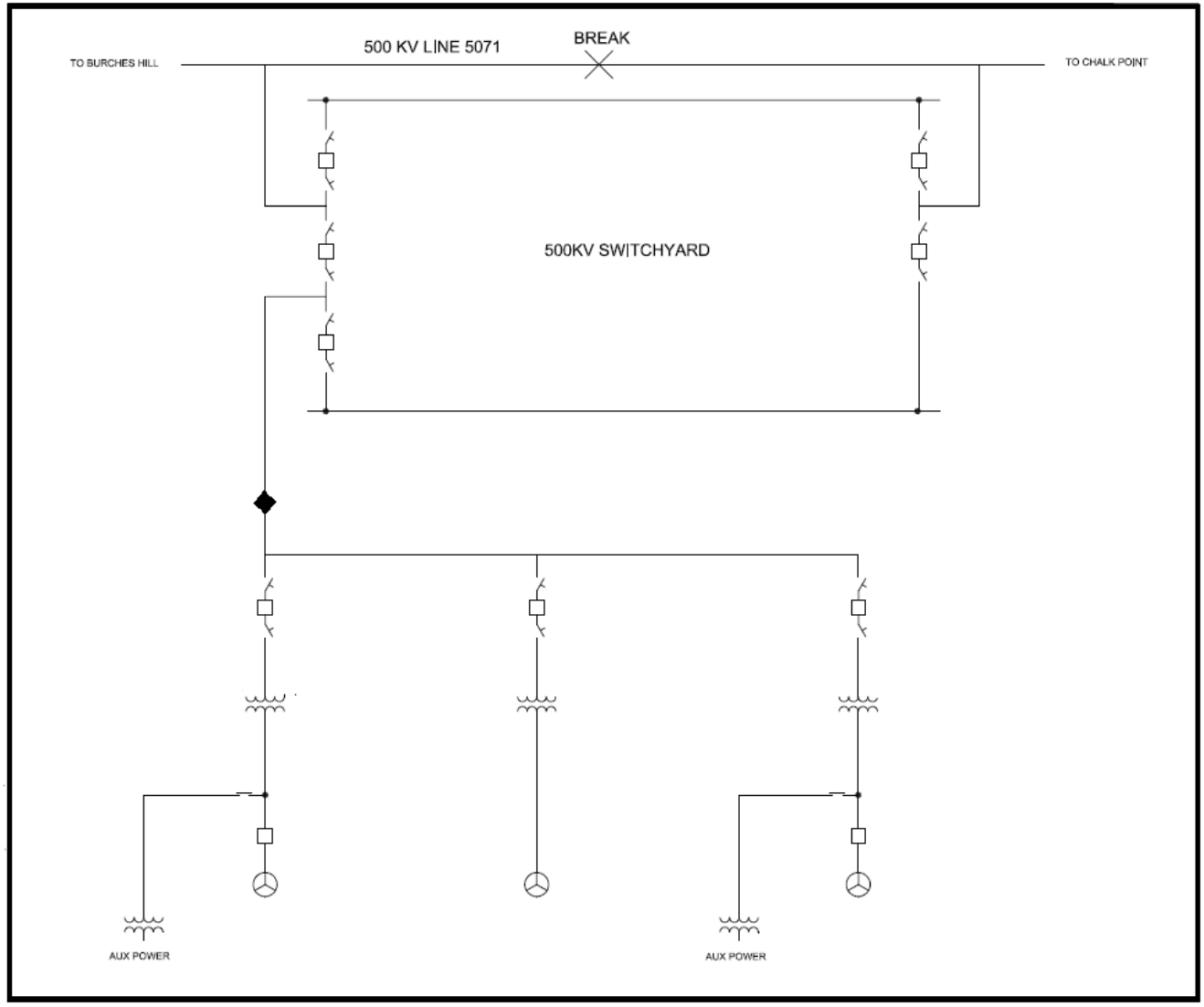
Attachment Facilities:

Interconnection Customer will construct attachment lines into the proposed Point of Interconnection as depicted in the primary option one-line diagram.

Direct Connection Network Upgrades:

ITO: Construct (5) 500kV Circuit Breakers Substation, $10,100,000, and turning poles from 500kV line into new substation, $3,000,000. Work is estimated to take 36 months.

Primary Option One-line:



Secondary Option:

Required Interconnection Facilities:

Attachment Facilities:

Interconnection Customer will construct attachment lines into the proposed Point of Interconnection as depicted in the secondary option one-line diagram.

Direct Connection Network Facilities:

ITO: To construct one 230kV breaker at Point of Interconnection, $1,250,000, and one 230kV breaker at Burches Hill also for $1,250,000. $3,000,000 per mile to feeder 23080 tap point plus any recondition costs for the spare feeder 23080. These facilities will require more detailed inspection and engineering, which will occur at the System Impact Study and Facilities Study. Engineering and construction is estimated to take 36 months.

Secondary Option One-line: