PJM Generator Interconnection

X3-068 Graceton 230 kV

678 MW Capacity / 678 MW Energy

Feasibility Study Report

May 2012
DMS #685843v1

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 BG&E. An affected Transmission Owner is PECO.

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

Queue project X3-068 was studied as a(n) 678 MW (678 MW of which was Capacity) injection into BGE system with two options. The primary option was a 230 kV attachment at Graceton. A secondary option was to interconnect into a future 500 kV position at Graceton. Project X3-068 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Primary Option

The following contingencies resulted in overloads for the primary option:

Option 1 Impactful Contingencies	
Contingency Name	**File Description**
BG_CKT2310A	CONTINGENCY 'BG_CKT2310A' /* CONASTONE TO NORTHWEST CKT #2310 DISCONNECT BRANCH FROM BUS 220961 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT#2310 END
NOTTI90	CONTINGENCY 'NOTTI90' /* $CHESCO $NOTTI90 $K TRIP BRANCH FROM BUS 213844 TO BUS 213553 CKT 1 /* NOTTNGHM 230.00 DALEVLLE 230.00 $CHESCO $NOTTI90 $K END /* $CHESCO $NOTTI90 $K
PJM17	CONTINGENCY 'PJM17' DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1 /* CNASTONE PEACHBTM 500 END
PJM76	CONTINGENCY 'PJM76' REMOVE MACHINE 1 FROM BUS 200034 /* PB2 END
PP1EB	CONTINGENCY 'PP1EB' / NO PATH OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1 / 200003 BRIGHTON 500 200004 CNASTONE 500 1 END
PP1EC	CONTINGENCY 'PP1EC' / NO PATH OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1 / 200003 BRIGHTON 500 200004 CNASTONE 500 1 END

Network Impacts:

Generator Deliverability

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

X3-068 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	PJM17	BG&E PL	Graceton - Safe Harbor Units 3 - 4 Tap 230 kV line	220964	208071	1	DC	96.49	119.17	ER	485	110.72
002	Non	Non	BG&E PECO	Graceton - Cooper 230 kV line	220964	214089	1	DC	76.25	90.29	NR	379	53.22
003	N-1	PJM17	PL	South Akron Transformer 3 - South Akron Bus 230 kV line	208079	208078	1	DC	85.95	90.69	ER	588	45.47
004	Non	Non	PL	Safe Harbor Units 3-4 Tap - Manor Substation 230 kV line	208071	208019	1	DC	79.02	100.43	NR	463	99.61
005	N-1	NOTTI90	PECO DP&L	Conowingo 1 - Colora 230 kV line	213519	231006	1	DC	94.13	100.62	ER	571	37.05

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)

No problems identified.

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.)

X3-068 Opt. 1 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
006	N-1	PJM17	PECO	Nottingham Reactor - Nottingham 230 kV line	213846	213844	1	DC	107.02	117.68	ER	627	66.84
007	N-1	PP1EB	BG&E	North West 2311 & 2310 - Granite 2311 & 2312 230 kV line	220962	220972	1	DC	140.39	142.85	ER	621	45.47
008	N-1	PP1EC	BG&E	Conastone - EMORY GRV230 230 kV line	220963	220400	2	DC	113.31	116.43	ER	941	65.07
009	N-1	PJM17	BG&E PL	Conastone - Otter Creek Switchyard 230 kV line	220963	208048	1	DC	154.44	155.49	ER	531	34.8
010	N-1	PP1EB	BG&E	North West 2326 & 2322 - Granite 2326 & 2332 230 kV line	220961	220973	1	DC	117.75	120.05	ER	728	41.45
011	N-1	PJM17	BG&E PECO	Graceton - Cooper 230 kV line	220964	214089	1	DC	150.38	164.16	ER	485	66.84
012	N-1	BG_CKT2322A	BG&E	EMORY GRV230 - North West 2326 & 2322 230 kV line	220400	220961	1	DC	105.24	105.54	ER	1800	34
013	Non	Non	PJM	Conastone - EMORY GR500 500 kV line	200004	200101	1	DC	118.2	118.77	NR	2338	82.95
014	N-1	PJM17	PECO	Cooper - Peach Bottom 230 kV line	214089	213869	1	DC	147.9	161.68	ER	485	66.84
015	N-1	PJM17	PECO	Peach Bottom - Nottingham Reactor 230 kV line	213869	213846	1	DC	107.08	117.75	ER	627	66.84
016	N-1	PJM17	PL	Safe Harbor Units 3 - 4 Tap - Manor Substation 230 kV line	208071	208019	1	DC	109.57	128.5	ER	579	110.04
017	N-1	PP1EC	BG&E	Conastone - EMORY GRV230 230 kV line	220963	220400	1	DC	124.65	131.95	ER	819	64.3
018	N-1	PJM76	PJM	Conastone - Peach Bottom 500 kV line	200004	200013	1	DC	138.32	138.78	ER	2815	102.48
019	N-1	BG_CKT2310A	BG&E	EMORY GRV230 - North West 2311 & 2310 230 kV line	220400	220962	1	DC	105.47	105.78	ER	1800	34.79
020	N-1	PJM17	PL	Millwood Transformer #1 - South Akron Transformer 3 230 kV line	208030	208079	1	DC	100.81	108.57	ER	588	45.63

Short Circuit

(Report Overdutied breakers here)

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With X3-068_opt1	Duty Percent Without X3-068_opt1	Duty Percent Difference	Note
4	CNASTONE 500.kV	B" 5012/500"	T	118.60%	93.30%	25.30%	New Over-duty
4	CNASTONE 500.kV	A" 2-500"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	C" 5012/3-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	H" 5011/2-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	K" 500-2 TR"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	M" 5013/3-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	N" BREAKER"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	J" 5011/3-5"	T	113.90%	89.60%	24.30%	New Over-duty
4	CNASTONE 500.kV	L" 5013/500"	T	101.90%	77.70%	24.20%	New Over-duty

The cost for the 9 breaker replacements is $14,179,824. This estimated time is 36-48 months.

The project contributes to the following. Allocations will be provided at the System Impact Study.

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With x3-068_PECO_opt1_500	Duty Percent Without x3-068_PECO_opt1_500	Duty Percent Difference	Note
13	PEACHBTM 500.kV	225	S	108.10%	102.40%	5.70%	Over 100%, > 3% contribution

Secondary Option

The following contingencies resulted in overloads for the secondary option:

Option 2 Impactful Contingencies	
Contingency Name	**File Description**
BG_CKT2310A	CONTINGENCY 'BG_CKT2310A' /* CONASTONE TO NORTHWEST CKT #2310 DISCONNECT BRANCH FROM BUS 220961 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT#2310 END
BG_CKT2322A	CONTINGENCY 'BG_CKT2322A' /*CONASTONE TO NORTHWEST CKT #2322 DISCONNECT BRANCH FROM BUS 220962 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT #2322 END
CNSTN__230-4	CONTINGENCY 'CNSTN__230-4' /* CONASTONE 230-4 TRANSFORMER DISCONNECT BRANCH FROM BUS 220963 TO BUS 200004 CKT 2 /* CONASTONE 500-4 TRANSFORMER END
CNSTN_NWESTA	CONTINGENCY 'CNSTN_NWESTA' /* CONASTONE TO NORTHWEST CKTS #2310 & #2322 DISCONNECT BRANCH FROM BUS 220963 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT#2310 DISCONNECT BRANCH FROM BUS 220963 TO BUS 220400 CKT 2 /* CONASTONE TO NORTHWEST CKT #2322 END
CNSTN_NWESTB	CONTINGENCY 'CNSTN_NWESTB' /* CONASTONE TO NORTHWEST CKTS #2310 & #2322 DISCONNECT BRANCH FROM BUS 220400 TO BUS 220962 CKT 1 /* CONASTONE TO NORTHWEST CKT#2310 DISCONNECT BRANCH FROM BUS 220400 TO BUS 220961 CKT 1 /* CONASTONE TO NORTHWEST CKT #2322 END
PJM17_X3-068A	CONTINGENCY 'PJM17_X3-068A' DISCONNECT BRANCH FROM BUS 200004 TO BUS 911010 CKT 1 /* CNASTONE PEACHBTM 500 END
PJM17_X3-068B	CONTINGENCY 'PJM17_X3-068B' DISCONNECT BRANCH FROM BUS 911010 TO BUS 200013 CKT 1 /* CNASTONE PEACHBTM 500 END
PJM27	CONTINGENCY 'PJM27' OPEN LINE FROM BUS 200010 TO BUS 200051 CIRCUIT 1 /* KEENEY EHV - A29 COLL 500 END
PJM40	CONTINGENCY 'PJM40' DISCONNECT BRANCH FROM BUS 200013 TO BUS 200024 CKT 1 /* PEACHBTM LIMERICK 500 END
PJM77	CONTINGENCY 'PJM77' REMOVE MACHINE 1 FROM BUS 200035 /* PB3 END
PP1EB	CONTINGENCY 'PP1EB' / NO PATH OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1 / 200003 BRIGHTON 500 200004 CNASTONE 500 1 END
PP1EC	CONTINGENCY 'PP1EC' / NO PATH OPEN BRANCH FROM BUS 200101 TO BUS 200004 CKT 1 / 200003 BRIGHTON 500 200004 CNASTONE 500 1 END
BG_CKT2310A	CONTINGENCY 'BG_CKT2310A' /* CONASTONE TO NORTHWEST CKT #2310 DISCONNECT BRANCH FROM BUS 220961 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT#2310 END
BG_CKT2322A	CONTINGENCY 'BG_CKT2322A' /*CONASTONE TO NORTHWEST CKT #2322 DISCONNECT BRANCH FROM BUS 220962 TO BUS 220400 CKT 1 /* CONASTONE TO NORTHWEST CKT #2322 END

Network Impacts:

Generator Deliverability

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

X3-068 Opt. 2 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
001	N-1	PP1EB	BG&E	Granite 2326 & 2332-Howard 2332 230 kV line	220973	220954	1	DC	90.23	102.85	ER	728	54.37
002	N-1	PJM17_X3-068A	PECO	Nottingham-Nottingham Reactor 230 kV line	213844	213846	1	DC	99.56	101	ER	627	55.79
003	N-1	PJM40	PJM	U2-74 TAP-Rock Springs 500 kV line	293025	200051	1	DC	95.27	99.09	ER	2611	99.7
004	N-1	PJM17_X3-068A	PECO	Nottingham Reactor-Peach Bottom 230 kV line	213846	213869	1	DC	99.49	100.93	ER	627	55.79
005	Non	Non	PJM/AP	EMORY GR500-Kemptown 500 kV line	200101	235632	1	DC	83.84	97.5	NR	2338	212.34
006	N-1	PJM17_X3-068B	BG&E/PL	Graceton-Safe Harbor Units 3-4 Tap 230 kV line	220964	208071	1	DC	96.44	97.44	ER	485	30.27
007	N-1	PP1EC	PENELEC	Roxbury-Roxbury 115/138 kV transformer	200520	200532	1	DC	96.69	97.95	ER	138	10.82
008	N-1	PJM40	PJM	Peach Bottom-U2-74 TAP 500 kV line	200013	293025	1	DC	91.14	94.95	ER	2611	99.7

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)

No violations identified.

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.)

X3-068 Opt. 2 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
009	N-1	PJM17_X3-068B	PECO	Nottingham Reactor-Nottingham 230 kV line	213846	213844	1	DC	107.01	107.89	ER	627	34.4
010	N-1	PP1EB	BG&E	North West 2311 & 2310-Granite 2311 & 2312 230 kV line	220962	220972	1	DC	138.42	152.68	ER	621	56.11
011	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	2	DC	113.31	116.36	ER	941	64.32
012	N-1	PJM17_X3-068A	PECO BG&E	Cooper-Graceton 230 kV line	214089	220964	1	DC	130.82	132.68	ER	485	55.79
013	N-1	PJM17_X3-068B	BG&E PL	Conastone-Otter Creek Switchyard 230 kV line	220963	208048	1	DC	154.46	164.81	ER	531	55.47
014	N-1	PJM17_X3-068A	PL METED	Brunner Island Bus-Yorkana 230 kV line	207922	204515	1	DC	136.29	137.24	ER	617	36.58
015	N-1	PJM17_X3-068A	PL BG&E	Otter Creek Switchyard-Conastone 230 kV line	208048	220963	1	DC	108.23	109.74	ER	531	50.19
016	N-1	PP1EB	BG&E	North West 2326 & 2322-Granite 2326 & 2332 230 kV line	220961	220973	1	DC	115.04	127.54	ER	728	54.52
017	N-1	PJM17_X3-068B	BG&E PECO	Graceton-Cooper 230 kV line	220964	214089	1	DC	150.38	151.53	ER	485	34.4
018	N-1	PJM40	PJM	Rock Springs-Keeney 500 kV line	200051	200010	1	DC	100.02	103.25	ER	3014	97.32
019	N-1	BG_CKT2322A	BG&E	EMORY GRV230-North West 2326 & 2322 230 kV line	220400	220961	1	DC	105.26	107.86	ER	1800	47.2
020	DCTL	CNSTN_NW ESTA	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	DC	141.39	143.86	ER	2901	249.1
021	N-1	CNSTN__230-4	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	DC	104	117.63	ER	2901	240.43
022	Non	Non	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	DC	118.73	133.66	NR	2338	226.59
023	N-1	PJM17_X3-068B	PECO	Cooper-Peach Bottom 230 kV line	214089	213869	1	DC	147.91	149.05	ER	485	34.4
024	DCTL	CNSTN_NW ESTB	PJM AP	EMORY GR500-Kemptown 500 kV line	200101	235632	1	DC	122.53	124.82	ER	2901	240.59
025	N-1	PJM17_X3-068B	PECO	Peach Bottom-Nottingham Reactor 230 kV line	213869	213846	1	DC	107.07	107.96	ER	627	34.4

X3-068 Opt. 2 ###	Contingency		Affected Area	Facility Description	Bus		Circuit	Analyses Type	Loading		Rating		MW Contribution
	Type	Name			To	From			Before	After	Type	MVA	
026	N-1	PJM17_X3-068B	PL	Safe Harbor Units 3-4 Tap-Manor Substation 230 kV line	208071	208019	1	DC	109.54	110.36	ER	579	29.59
027	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	1	DC	124.66	131.87	ER	819	63.56
028	N-1	PJM17_X3-068A	PL/BG&E	Safe Harbor Units 3-4 Tap-Graceton 230 kV line	208071	220964	1	DC	105.51	106.8	ER	485	38.71
029	N-1	PJM17_X3-068A	METED	Three Mile Island-Jackson 1 230 kV line	204514	204502	1	DC	107.17	118.15	ER	591	36.08
030	N-1	PJM17_X3-068A	PECO	Peach Bottom-Cooper 230 kV line	213869	214089	1	DC	132.29	134.15	ER	485	55.79
031	N-1	PJM27	PJM	Peach Bottom-Limerick 500 kV line	200013	200024	1	DC	114.13	117.91	ER	2598	98.12
032	N-1	BG_CKT2310A	BG&E	EMORY GRV230-North West 2311 & 2310 230 kV line	220400	220962	1	DC	105.48	108.09	ER	1800	47.3
033	N-1	PJM17_X3-068A	PJM/METED	Three Mile Island-Three Mile Island 500/230 kV transformer	200016	204514	2	DC	126.85	136.67	ER	1072	105.25
034	N-1	PJM40	PJM	X3-068 TAP-Conastone 500 kV line	911010	200004	1	DC	147.87	167.26	ER	2815	413.06
035	Non	Non	PJM	X3-068 TAP-Conastone 500 kV line	911010	200004	1	DC	147.89	169.83	NR	2490	394.79
036	N-1	PJM77	PJM	X3-068 TAP-Peach Bottom 500 kV line	911010	200013	1	DC	137.81	145.09	ER	2815	283.21

Short Circuit

(Report over-dutied breakers.)

Analysis found new breakers for the secondary option to be over-duty.

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With X3-068_DOM_opt2	Duty Percent Without X3-068_DOM_opt2	Duty Percent Difference	Note
4	CNASTONE 500.kV	B" 5012/500"	T	118.60%	93.30%	25.30%	New Over-duty
4	CNASTONE 500.kV	A" 2-500"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	C" 5012/3-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	H" 5011/2-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	K" 500-2 TR"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	M" 5013/3-5"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	N" BREAKER"	T	115.10%	90.70%	24.40%	New Over-duty
4	CNASTONE 500.kV	J" 5011/3-5"	T	113.90%	89.60%	24.30%	New Over-duty
4	CNASTONE 500.kV	L" 5013/500"	T	101.90%	77.70%	24.20%	New Over-duty

The project contributes to the following. Allocations will be provided at the System Impact Study.

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With x3-068_PECO_opt1_500	Duty Percent Without x3-068_PECO_opt1_500	Duty Percent Difference	Note
13	PEACHBTM 500.kV	225	S	113.10%	102.40%	10.70%	Over 100%, > 3% contribution

Primary Option Upgrades:

The ITO analyzed the reliability impacts of a 825 MW capacity injection into this new 500 kV switching station. This analysis used the ITO's reliability criteria as identified in Appendix A of Dominion's Facility Connection Requirements. The results of these reliability studies have identified the following deficiencies as noted below.

Attachment Facilities:

BGE: To construct 2 miles using 2167 MCM conductor from Graceton to the PA state line, BGE estimates 60 months, which includes acquisition time for land. The cost for the new line would be $6,000,000. It is estimated that $5,000,000 additional cost will be needed to obtain 100 feet Right of Way for this 230 kV line.

PECO: PECO estimate to engineer and construct a new 230kV line from proposed X3-068 to PA/MD State line is $10.25 million and 36 months. This estimate does not include the time or cost to purchase land, or obtain right of ways to build the estimated 3.3 mile, 230kV line.

Direct Connection Network Upgrades:

BGE estimates $400,000 to install a tie breaker into an existing bay 24 months to build.

Non-Direct Connection Network Upgrades:

X3-068 Opt. 1 ###	ITO	Work Description	Estimated Cost	Approximate Duration
001	PPL	An existing PPL project to re-conductor Manor-Graceton 230 kV with 1590 ACSR is underway. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency).	$22,700,000	18
	BG&E	Remove sag limitation rate to 550 MVA from Graceton to PA line; CPCN likely. Existing: Circuit 2303 is 795 kcm 30/19 ACSR @ 125 C. Assumptions: Length of this line section is 1.4 miles.	$500,000	36
002	PECO	Reconductor Line 220-93 from Cooper Substation to Graceton Substation to get a minimum summer emergency rating of 725 MVA. The line is approximately 4 miles long. This cost is for the PECO portion only.	$2,800,000	24
	BG&E	Construct a 1.8 Mile of 230kV from Graceton to the PA border, connect line to Graceton Sub. **Line** $6,000,000, 60 months to construct using 2167 MCM conductor, ROW add $5,000,000. 100 feet ROW for 230 kV **Substation** $400,000 to install a tie breaker into an existing bay 24 months to build.	$6,400,000	60
003	PL	Change setting of CT from 1200 A to 2000 A, this would increase the summer Emergency rating of 208079 to bus 208078 ckt 1 to 624 MVA.	$15,000	
004	PL	Upgrade current 795 kcmil 30/19 (140 degrees C) line section to 1590kcmil 45/7 (125 degrees).	$56,000	
005	PECO	In 2015 there is an RTEP project (b1198) to replace terminal equipment at the Conowingo substation on line 220-88 to achieve the existing 795 ACSR conductor emergency rating of 571 MVA. If the 795 ACSR is replaced with 1590 ACSR for X3-068, the next limiting component on line 220-88 will be the existing metering at Conowingo substation which has an emergency rating of 600MVA. This assumes that the terminal equipment replaced in the 2015 RTEP project has an emergency rating greater than 600 MVA. The cost estimate $2.4 million and includes the reconductoring across the Susquehanna River with the exception of replacing or modifying any of the structures for the river crossing. PECO would have to perform a detailed engineering analysis of the structures for the river crossing to determine if the new conductor would require the structures to replaced or modified.	$2,400,000	36
	DPL	To obtain a minimum emergency rating of 586 MVA for the Conowingo - Colora 230kV line, DPL will need to reconductor their portion of the circuit.	$8,900,000	48
006	PECO	Replace Line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 741 MVA.	$1,700,000	24
007	BG&E	The overload can be alleviated by reconductoring the line with 2167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement.	$23,600,000	72

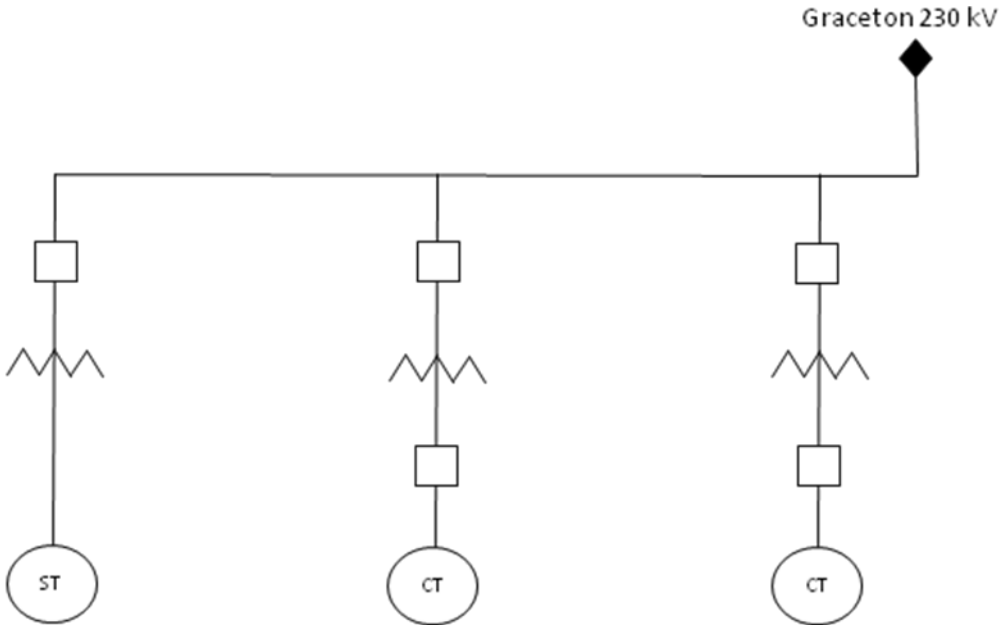
X3-068 Opt. 1 ###	ITO	Work Description	Estimated Cost	Approximate Duration
008	BG&E/PECO	Construct a new double circuit 230kV line from Conastone-NW using 1590 MCM conductor. The estimates are based on a cursory review of BGE land for transmission lines. A detailed study will be conducted when the facility study is done. **Substation** Conastone - install two new bays with 2 bus breakers $3.6M. Northwest sub - install (2) 230KV 63kA breakers on existing foundations would be $700,000. **Line** 230KV line length 23.7 miles with new ROW land; purchase and clear 80' x 3 miles ROW (10 acres) for a 230KV double circuit line. Cost estimate $3M, or $300K per acre. Estimate to build the 230KV double circuit Line would be $47.4M, or $2M per mile.	$54,700,000	84
009	BG&E	The BG&E portion of the Conastone to Otter Creek line can be upgraded by reconducting from Gorsuch Mills to the Pennsylvania State Line (change of ownership to PPL). The existing circuit 2302 conductor is 1590 kcmil 45/7 ACSR from Conastone to Gorsuch Mills and 795 kcm 30/19 ACSR from Gorsuch Mills to the PA State Line. Assumptions: • Reconductor with 1590 kcm ACSR from Gorsuch Mills to PA line to match capability of remainder of line; • Length of this line section is 1.7 miles; • Towers can be reinforced instead of replaced; and • Based on previous estimate by R.W.M. for PJM (B48) study on circuit 22008.	$700,000	36
	PL	A PPL project to re-conductor Manor-Conastone with 1590 ACSR is underway. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency).	$1,700,000	18
010	BG&E	Same as X3-068-1-007.	already captured	already captured
011	BG&E/PECO	Same as X3-068-1-002.	already captured	already captured
012	BG&E/PECO	Same as X3-068-1-008.	already captured	already captured
013	BG&E	The two breaker bay at Conastone for the Brighton line is over the continuous rating. Upgrade Conastone bay with two 4000A breakers, four 4000A breaker disconnects and a 4000 A line switch need to be either. New rating 3710.	$3,000,000	36
014	PECO	Reconductor Line 220-08 from PB Tap to Cooper Substation to get a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long.	$1,000,000	24
015	PECO	Reconductor Line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 741 MVA. The line is approximately 14 miles long.	$10,000,000	48
016	PL	Same as X3-068-1-004.	already captured	already captured
017	BG&E/PECO	Same as X3-068-1-008.	already captured	already captured
018	BG&E	• At Conastone construct a new two breaker 4000A bay (breakers D, F) with two 63 kA breakers. Includes line termination structures, allowance for a second line and the relocation of the 500kV cap bank. 36 months to complete - $14M. • Construct a new 500kV line from Conastone - Peachbotton rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV line from Conastone to Pennsylvania line. Purchase 150' R/W. Total for project $46.8 million 5-7 years.	$60,800,000	84

X3-068 Opt. 1 ###	ITO	Work Description	Estimated Cost	Approximate Duration
	PECO	• Replace existing Peach Bottom-Conastone 500kV Line (5012) terminal equipment at Peach Bottom Substation to match the conductor summer normal and emergency rating of 2920 / 3707 MVA (PECO portion only)- $5 million, 3 years • Build new second Peach Bottom-Conastone 500kV Line on separate towers from existing 5012 Line with a minimum summer emergency rating of 3510 MVA (PECO portion only)- $20 million, 5 years [Right-of-way costs are not included]	$25,000,000	60
019	BG&E/PECO	Same as X3-068-1-008.	already captured	already captured
020	PL	Upgrade current1033 kcmil 54/7 (125 degrees C) line section to 1590kcmil 45/7 (125 degrees C). The cost of this upgrade would be approximately $25 Million.	$25,000,000	
THERMAL NON-DIRECT CONNECTION NETWORK UPGRADE COSTS			**$250,971,000**	**84**

Primary Option Contingency Overload Summary:

Option 1 (X3-068-1-###)									
Contingency	Overloads Identified								
	1	2	3	4	5	6	7	8	9
BG_CKT2310A	019	012							
Non	002	004	013						
NOTTI90	005								
PJM17	001	003	006	009	011	014	015	016	020
PJM76	018								
PP1EB	007	010							
PP1EC	008	017							

Primary Option One-line:



Secondary Option:

Required Interconnection Facilities:

Attachment Facilities:

BGE: To construct two miles of 500 kV conductor from Graceton to the PA state line, BGE estimates 64 months, which includes acquisition time for land. The cost for the new line would be $8,000,000. It is estimated that $8,000,000 additional cost will be needed to obtain 200 feet Right of Way for this 500 kV line.

PECO:
The estimate for the primary option to engineer and construct a generator Attachment Facility line from X3-068 to the PA/MD state line. PECO estimates to engineer and construct a new 500kV line from proposed X3-068 to PA/MD State line to be $12.15 million and 42 months. This estimate does not include the time or cost to purchase land, or obtain right of ways to build the estimated 3.3 mile, 500kV line.

Direct Connection Network Facilities:

BGE estimates $8,000,000 to install a three breaker 500kV ring 36 months to construct. Detailed design will be performed is elected to better define scope.

Non-Direct Connect Network Upgrades:

Not provided for secondary point of interconnection at Feasibility Study.

Secondary Option Contingency Overload Summary:

Option 2 (X3-068-2-###)									
Contingency	**Overloads Identified**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
BG_CKT2310A	032								
BG_CKT2322A	019								
CNSTN__230-4	021								
CNSTN_NWESTA	020								
CNSTN_NWESTB	024								
Non	005	022	035						
PJM17_X3-068A	002	004	012	014	015	028	029	030	033
PJM17_X3-068B	006	009	013	017	023	025	026		
PJM27	031								
PJM40	003	018	034						
PJM77	036								
PP1EB	001	010	016						
PP1EC	007	011	027						

Secondary Option One-line: