PJM Generator Interconnection Request
Queue #X2-050
Essex 230kV
Feasibility Study

716313

September 2012

Network Impacts

Queue project X2-050 was studied as a(n) 750.0 MW (750.0 MW of which was Capacity) injection into PSEG's system. Project X2-050 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Option 1: ESSEX 230.0 kV substation

Generator Deliverability

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

1. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.83% to 98.11% (DC power flow) of its emergency rating (627 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

2. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 2) loads from 88.19% to 102.91% (DC power flow) of its normal rating (512 MVA) for non contingency condition. This project contributes approximately 75.34 MW to the thermal violation.

3. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 88.19% to 102.91% (DC power flow) of its normal rating (512 MVA) for non contingency condition. This project contributes approximately 75.34 MW to the thermal violation.

4. (PSEG) The Essex-Kearny 4-6 230 kV line (from bus 217079 to bus 217061 ckt 1) loads from 89.62% to 142.3% (DC power flow) of its emergency rating (1000 MVA) for the **single contingency 'PS72'**. This project contributes approximately 531.85 MW to the thermal violation.

5. (PSEG) The Essex-Kearny 4-6 230 kV line (from bus 217079 to bus 217061 ckt 1) loads from 74.13% to 123.98% (DC power flow) of its normal rating (850 MVA) for non contingency condition. This project contributes approximately 427.99 MW to the thermal violation.

6. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.70% to 97.99% (DC power flow) of its emergency rating (627 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

Multiple Facility Contingency

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

No problems identified.

Short Circuit

The following 40 circuit breakers are overdutied due to the addition of the X2-052 project. Of the 40 circuit breakers 33 exceed 80 kA. A solution to bring the interrupting duty below 80kA will be developed in the Impact Study.

PSE&G

No.	BUS#	BUS	BREAKER	Rating Type	Duty % w_reinforce	Duty % w/o reinforce	Duty % Diff	Note	DUTY_A	BKR_CAP	ISC
1	5176	S WATER 230.kV	S.Water1	S	106.20%	98.50%	7.70%	New Over-duty	84976.9	80000	84879
2	5176	S WATER 230.kV	S.Water2	S	106.20%	98.50%	7.70%	New Over-duty	84976.9	80000	84879
3	5176	S WATER 230.kV	S.Water4	S	106.20%	98.50%	7.70%	New Over-duty	84976.9	80000	84879
4	5176	S WATER 230.kV	S.Water5	S	106.20%	98.50%	7.70%	New Over-duty	84976.9	80000	84879
5	5176	S WATER 230.kV	S.Water6	S	106.20%	98.50%	7.70%	New Over-duty	84977.1	80000	84879
6	5176	S WATER 230.kV	S.Water7	S	106.20%	98.50%	7.70%	New Over-duty	84977.1	80000	84879
7	5069	D08 230.kV	GSU	S	104.40%	97.80%	6.60%	New Over-duty	65750.9	63000	61258
8	5037	BERGEN 230.kV	Brg10	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
9	5037	BERGEN 230.kV	Brgn1	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
10	5037	BERGEN 230.kV	Brgn12	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
11	5037	BERGEN 230.kV	Brgn15	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
12	5037	BERGEN 230.kV	Brgn17	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
13	5037	BERGEN 230.kV	Brgn18	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
14	5037	BERGEN 230.kV	Brgn20	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
15	5037	BERGEN 230.kV	Brgn21	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
16	5037	BERGEN 230.kV	Brgn23	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
17	5037	BERGEN 230.kV	Brgn24	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
18	5037	BERGEN 230.kV	Brgn26	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
19	5037	BERGEN 230.kV	Brgn3	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
20	5037	BERGEN 230.kV	Brgn4	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
21	5037	BERGEN 230.kV	Brgn5	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
22	5037	BERGEN 230.kV	Brgn6	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
23	5037	BERGEN 230.kV	Brgn7	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
24	5037	BERGEN 230.kV	Brgn8	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
25	5037	BERGEN 230.kV	Brgn9	S	102.20%	95.90%	6.30%	New Over-duty	81748.7	80000	77566
26	5037	BERGEN 230.kV	Brgn22	S	102.00%	95.80%	6.20%	New Over-duty	81615.9	80000	77460
27	5037	BERGEN 230.kV	Brgn25	S	102.00%	95.80%	6.20%	New Over-duty	81615.9	80000	77460

No.	BUS#	BUS	BREAKER	Rating Type	Duty % w_reinforce	Duty % w/o reinforce	Duty % Diff	Note	DUTY_A	BKR_CAP	ISC
28	4990	HDSN7-12 230.kV	5HC	S	101.90%	98.50%	3.40%	New Over-duty	81518.3	80000	76140
29	5020	SADDLBRK 230.kV	SadleBrk1	S	101.90%	97.80%	4.10%	New Over-duty	64169.9	63000	64170
30	5020	SADDLBRK 230.kV	SadleBrk3	S	101.90%	97.80%	4.10%	New Over-duty	64169.9	63000	64170
31	5020	SADDLBRK 230.kV	SadleBrk4	S	101.90%	97.80%	4.10%	New Over-duty	64169.9	63000	64170
32	5020	SADDLBRK 230.kV	SadleBrk5	S	101.90%	97.80%	4.10%	New Over-duty	64169.9	63000	64170
33	4990	HDSN7-12 230.kV	5HA	S	101.80%	98.70%	3.10%	New Over-duty	81432.1	80000	79742
34	4990	HDSN7-12 230.kV	5HB	S	101.80%	98.70%	3.10%	New Over-duty	81432.1	80000	79742
35	4990	HDSN7-12 230.kV	6HA	S	101.80%	98.70%	3.10%	New Over-duty	81432.1	80000	79742
36	4990	HDSN7-12 230.kV	6HB	S	101.80%	98.70%	3.10%	New Over-duty	81432.1	80000	79742
37	4990	HDSN7-12 230.kV	4HB	S	101.40%	98.00%	3.40%	New Over-duty	81134.6	80000	75532
38	4961	BERGEN 138.kV	40P	S	101.30%	100.00%	1.30%	New Over-duty	63834.3	63000	57426
39	5037	BERGEN 230.kV	Brgn19	S	100.90%	94.60%	6.30%	New Over-duty	80722	80000	76716
40	5176	S WATER 230.kV	S.Water3	S	100.90%	90.20%	10.70%	New Over-duty	80695.6	80000	80696

The following 29 circuit breakers have over 3% fault duty contribution due to the X2-050 project and will be allocated a portion of the cost for replacement.

No.	BUS_NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_A	BKR_CAP A	ISC
1	5054	ESSEX 230.kV	22H	T	236.00%	209.70%	26.30%	Over 100%, > 3% contribution	109035.9	46198.1	80058.8
2	5054	ESSEX 230.kV	20H	S	154.40%	138.20%	16.20%	Over 100%, > 3% contribution	97287.3	63000	85193.8
3	5054	ESSEX 230.kV	21H	S	154.40%	138.20%	16.20%	Over 100%, > 3% contribution	97287.3	63000	85193.8
4	5054	ESSEX 230.kV	11H	S	150.80%	134.60%	16.20%	Over 100%, > 3% contribution	95025.9	63000	83214.2
5	5054	ESSEX 230.kV	10H	S	149.10%	133.00%	16.10%	Over 100%, > 3% contribution	93962.6	63000	81834.3
6	5054	ESSEX 230.kV	11HL	S	149.10%	133.00%	16.10%	Over 100%, > 3% contribution	93962.6	63000	81834.3
7	4992	KRNY 1-3 230.kV	Krny3	S	143.80%	138.40%	5.40%	Over 100%, > 3% contribution	115046.3	80000	102331
8	4992	KRNY 1-3 230.kV	Krny4	S	143.80%	138.40%	5.40%	Over 100%, > 3% contribution	115046.3	80000	102331
9	4993	KRNY 4-6 230.kV	Krny1	S	143.30%	137.70%	5.60%	Over 100%, > 3% contribution	114641.7	80000	102401
10	4993	KRNY 4-6 230.kV	Krny10	S	143.30%	137.70%	5.60%	Over 100%, > 3% contribution	114641.7	80000	102401
11	4993	KRNY 4-6 230.kV	Krny6	S	143.30%	137.70%	5.60%	Over 100%, > 3% contribution	114641.7	80000	102401
12	4993	KRNY 4-6 230.kV	Krny7	S	143.30%	137.70%	5.60%	Over 100%, > 3% contribution	114641.7	80000	102401
13	4993	KRNY 4-6 230.kV	Krny9	S	143.30%	137.70%	5.60%	Over 100%, > 3% contribution	114641.7	80000	102401
14	4992	KRNY 1-3 230.kV	Krny5	S	140.30%	134.80%	5.50%	Over 100%, > 3% contribution	112206.9	80000	99517.5
15	4993	KRNY 4-6	Krny8	S	139.80%	134.20%	5.60%	Over 100%, >	112206.9	80000	99517.5

No.	BUS_NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_A	BKR_CAPA	ISC
		230.kV						3% contribution			
16	5048	NEWPRT R 230.kV	23H	S	136.00%	120.20%	15.80%	Over 100%, > 3% contribution	67988.3	50000	67988.3
17	4992	KRNY 1-3 230.kV	krny2	S	127.70%	123.00%	4.70%	Over 100%, > 3% contribution	102162.5	80000	90907.6
18	5037	BERGEN 230.kV	GSU1	S	126.50%	118.50%	8.00%	Over 100%, > 3% contribution	79707.7	63000	75629.5
19	5037	BERGEN 230.kV	GSU2	S	126.50%	118.60%	7.90%	Over 100%, > 3% contribution	79713.4	63000	75634.9
20	5037	BERGEN 230.kV	GSU3	S	125.50%	117.50%	8.00%	Over 100%, > 3% contribution	79050.5	63000	75005.9
21	5040	HUDSN1-6 230.kV	1HA	S	124.60%	117.30%	7.30%	Over 100%, > 3% contribution	99701.2	80000	89635.4
22	5040	HUDSN1-6 230.kV	3HA	S	124.60%	117.30%	7.30%	Over 100%, > 3% contribution	99701.2	80000	89635.4
23	5040	HUDSN1-6 230.kV	3HC	S	124.60%	117.30%	7.30%	Over 100%, > 3% contribution	99701.2	80000	89635.4
24	5040	HUDSN1-6 230.kV	1HC	S	122.00%	115.50%	6.50%	Over 100%, > 3% contribution	97634.1	80000	87709.6
25	5040	HUDSN1-6 230.kV	3HB	S	122.00%	115.50%	6.50%	Over 100%, > 3% contribution	97634.1	80000	87709.6
26	5040	HUDSN1-6 230.kV	2HC	S	119.10%	111.70%	7.40%	Over 100%, > 3% contribution	95296.1	80000	85675
27	5040	HUDSN1-6 230.kV	1HB	S	118.80%	111.90%	6.90%	Over 100%, > 3% contribution	95012.7	80000	89635.4
28	5040	HUDSN1-6 230.kV	2HA	S	118.80%	111.90%	6.90%	Over 100%, > 3% contribution	95012.7	80000	89635.4
29	5040	HUDSN1-6 230.kV	2HB	S	118.80%	111.90%	6.90%	Over 100%, > 3% contribution	95012.7	80000	89635.4

JCP&L

One circuit breaker in JCP&L territory is overdutied due to the installation of the X2-050 project.

BUS_NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note
2550	WHIPPANY 230.kV	AQ	S	100.30%	99.80%	0.50%	New Over-duty

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)

7. (PSEG) The Kearny 4-6-Kearny 1-3 230 kV line (from bus 217061 to bus 217060 ckt 1) loads from 128.55% to 179.64% (DC power flow) of its emergency rating (482 MVA) for the **single contingency 'PS72'.** This project contributes approximately 246.22 MW to the thermal violation.

8. (PSEG) The Kearny 4-6-Kearny 1-3 230 kV line (from bus 217061 to bus 217060 ckt 1) loads from 119.66% to 166.13% (DC power flow) of its normal rating (360 MVA) for non contingency condition. This project contributes approximately 167.30 MW to the thermal violation.

9. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 124.57% to 126.65% (DC power flow) of its emergency rating (621 MVA) for the **single contingency 'PP1EB'**. This project contributes approximately 48.76 MW to the thermal violation.

10. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 156.58% to 161.54% (DC power flow) of its emergency rating (581 MVA) for the **tower contingency '24PS'**. This project contributes approximately 178.27 MW to the thermal violation.

11. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 127.83% to 131.98% (DC power flow) of its emergency rating (581 MVA) for the **single contingency 'PS50A'**. This project contributes approximately 149.74 MW to the thermal violation.

12. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 153.19% to 158.18% (DC power flow) of its normal rating (398 MVA) for non contingency condition. This project contributes approximately 123.31 MW to the thermal violation.

13. (BG&E) The Conastone-Emory Grove 230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.75% to 107.59% (DC power flow) of its emergency rating (941 MVA) for the **single contingency 'PP1EC'**. This project contributes approximately 58.07 MW to the thermal violation.

14. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 127.22% to 128.88% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

15. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 138.87% to 141.54% (DC power flow) of its emergency rating (617 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 40.33 MW to the thermal violation.

16. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 104.07% to 105.77% (DC power flow) of its emergency rating (531 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.55 MW to the thermal violation.

17. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 103.27% to 104.98% (DC power flow) of its emergency rating (728 MVA) for the **single contingency 'PP1EB'**. This project contributes approximately 47.09 MW to the thermal violation.

18. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.33% to 141.21% (DC power flow) of its emergency rating (2815 MVA) for the **single contingency 'PJM67'**. This project contributes approximately 226.03 MW to the thermal violation.

19. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 140.66% to 142.84% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 238.09 MW to the thermal violation.

20. (BG&E) The Emory Grove 230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 101.83% to 102.19% (DC power flow) of its emergency rating (1800 MVA) for the **single contingency 'BG_CKT2322A'**. This project contributes approximately 41.92 MW to the thermal violation.

21. (PSEG) The Bergen-Athenia 230 kV line (from bus 217100 to bus 216900 ckt 1) loads from 110.23% to 116.0% (DC power flow) of its normal rating (305 MVA) for non contingency condition. This project contributes approximately 108.83 MW to the thermal violation.

22. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 2) loads from 106.44% to 124.2% (DC power flow) of its emergency rating (789 MVA) for the **single contingency 'PS26'**. This project contributes approximately 140.12 MW to the thermal violation.

23. (PJM) The Conastone-Emory Grove 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 123.79% to 124.94% (DC power flow) of its emergency rating (2901 MVA) for the **tower contingency 'CNSTN_NWESTA'**. This project contributes approximately 204.88 MW to the thermal violation.

24. (PJM) The Conastone-Emory Grove 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 100.25% to 102.21% (DC power flow) of its emergency rating (2901 MVA) for the **single contingency 'CNSTN__230-4'**. This project contributes approximately 184.04 MW to the thermal violation.

25. (PJM) The Conastone-Emory Grove 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 114.35% to 116.71% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 179.27 MW to the thermal violation.

26. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 160.05% to 164.67% (DC power flow) of its emergency rating (624 MVA) for the **tower contingency '24PS'**. This project contributes approximately 178.27 MW to the thermal violation.

27. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 128.63% to 132.5% (DC power flow) of its emergency rating (624 MVA) for the **single contingency 'PS50A'**. This project contributes approximately 149.74 MW to the thermal violation.

28. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 161.36% to 166.15% (DC power flow) of its normal rating (415 MVA) for non contingency condition. This project contributes approximately 123.31 MW to the thermal violation.

29. (PJM/AP) The Emory Grove-Kemptown 500 kV line (from bus 200101 to bus 235632 ckt 1) loads from 107.14% to 107.57% (DC power flow) of its emergency rating (2901 MVA) for the **tower contingency 'CNSTN_NWESTB'**. This project contributes approximately 201.95 MW to the thermal violation.

30. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 166.63% to 171.59% (DC power flow) of its emergency rating (581 MVA) for the **tower contingency '24PS'**. This project contributes approximately 178.27 MW to the thermal violation.

31. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 132.88% to 137.03% (DC power flow) of its emergency rating (581 MVA) for the **single contingency 'PS50A'**. This project contributes approximately 149.74 MW to the thermal violation.

32. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 160.56% to 165.55% (DC power flow) of its normal rating (398 MVA) for non contingency condition. This project contributes approximately 123.31 MW to the thermal violation.

33. (BG&E) The Conastone-Emory Grove 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 123.15% to 123.66% (DC power flow) of its emergency rating (819 MVA) for the **single contingency 'PP1EC'**. This project contributes approximately 57.38 MW to the thermal violation.

34. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 105.89% to 107.4% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 45.44 MW to the thermal violation.

35. (METED) The Three Mile Island-Jackson 1 230 kV line (from bus 204514 to bus 204502 ckt 1) loads from 107.57% to 108.61% (DC power flow) of its emergency rating (591 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 37.82 MW to the thermal violation.

36. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 128.69% to 130.35% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

37. (BG&E) The Emory Grove-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 101.87% to 102.23% (DC power flow) of its emergency rating (1800 MVA) for the **single contingency 'BG_CKT2310A'**. This project contributes approximately 42.08 MW to the thermal violation.

38. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 114.12% to 115.21% (DC power flow) of its emergency rating (1072 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 74.16 MW to the thermal violation.

39. (PSEG) The North Bergen X-Bergen 230 kV line (from bus 217091 to bus 217100 ckt 1) loads from 125.48% to 129.9% (DC power flow) of its normal rating (247 MVA) for non contingency condition. This project contributes approximately 70.97 MW to the thermal violation.

New System Reinforcements

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

	Contingency	Reinforcement	Schedule	Cost
1	'PJM17'	Replace Line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 622 MVA. The estimated cost to perform this work is $1.9M, and will require 24 months to complete.	24 months	$1,900,000
2	'Non'	Can be fixed by new 49th street switchyard. Cost for this project is $45.4MM with an approximate lead time of 27 months. Also there needs to be a new connection between Penhorn X tap and Hudson. This will include constructing a new bay at Hudson 230kV bus. Total cost for this project will be $8.3MM with a lead time of 25 months.	27 months	$53,700,000
3	'Non'	Same as #2		
4	'PS72'	This overload can be fixed by looping in P-2216 line into and out of Kearny. This is already an RTEP 2016 project. But due to this project, the reinforcement needs to be expedited. Total cost for this project will be $48M with a lead time of 36 months.	36 months	$48,000,000
5	'Non'	Same as #4		
6	'PJM17'	Reconductor Line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 622 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is $10M, and will require 48 months to complete.	48 months	$10,000,000
			Total	**$113,600,000**

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)

	Contingency	Reinforcement	Schedule	Cost
7	'PS72'	Not an actual overload. It's one solid Kearny 230kV bus.		
8	'Non'	Same as #7		
9	'PP1EB'	This overload can be alleviated by reconductoring the line with 2,167 ACSR which will increase the rating to 1105MVA. There will also be substation terminal cost upgrades associated with the reinforcement. The total cost estimate of the reinforcement is approximately $23.6M, and the time estimate for completion is about 6 years.	6 years	$23,600,000
10	24PS'	Same as #2		
11	'PS50A'	Same as #2		
12	'Non'	Same as #2		
13	'PP1EC'	**Conastone-EMORY GRV230 230 kV and EMORY GRV230-North West circuit 1 and 2**: Construct a new double circuit 230kV line from Conastone-NW using 1590 MCM conductor **Total cost $ 67.5 M 72-84 months CPCN needed**. (This estimate is 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 breakers on existing foundations would be $700,000. These breakers are 63kA. **Line:** 230KV line length 23.7 miles ROW land - purchase and clear 80' x 3 miles RW (10 acres) for a 230KV double Ckt line would be $3M or $300K per acre to build a 230KV double Ckt. Line would be $47.4M or $2M per mile. Total $63.2M	72-84 months	$135,000,000
14	'PJM17'	PECO portion: Reconductor Line 220-93 from Cooper Substation to Graceton Substation to get a minimum summer emergency rating of 630 MVA. The line is approximately 4 miles long. This cost is for the PECO portion only. The estimated cost to perform this work is $2.9M, and will require 24 months to complete.	24 months	$2,900,000

	Contingency	Reinforcement	Schedule	Cost
	'PJM17'	BGE portion: a double circuit line will be built with 1033.5kcmil ACSR creating one circuit by connecting the two lines into one. Rating for 2 – 1033.5kcmil 45/7 ACSR (Ortolan) at 125°C = 968/1227MVA SN/SE. BGE ownership is for 1.85 miles and the rebuild of 11 structures. It would be built as a double circuit line with the conductors jumpered across at the terminal ends. The line construction is estimated at $3,000,000. Two breakers ($400,000/breaker) would need to be replaced at Graceton for a cost of $800,000. An additional cost of $200,000 would also be incurred for 4 breaker disconnects and line connections to cover thermal. The project is estimated to take 30 months to complete: 12 months for the CPCN process & design and an additional 18 months for construction. The total cost of the project is estimated at $4.0M.	30 months	$4,000,000
15	'PJM17'	PPL portion: rebuild and upgrade approximately 0.6 miles of PPL EU owned Brunner Island – Yorkana 230kV line and the substation line terminal equipment. The existing 1033 kcmil ACSR conductor will be replaced with new 1590 kcmil ACSR conductor or equivalent with and operating temperature of 140deg C to achieve the summer normal and emergency ratings of 712 MVA and 865 MVA respectively. The Yorkana 230kV bay conductors at Brunner Island 230kV switchyard will also be upgraded to conform the higher line ratings.PPL EU will require 24 months to construct this upgrade after the ISA/CSA are signed. The total transmission and substation upgrade cost is $1.3 million.	24 months	$1,300,000
	'PJM17'	METED: To reconductor Met-Ed's 12.5 mile section of the Brunner -Yorkana (1055) 230 kV line with 1590 ACSS conductor. Based on the Feasibility Study review performed, the total cost of this Network Upgrade is $9,270,900 excluding tax. Should tax need to be added, the total cost will be $12,382,200. It is estimated that it will take three years from the full execution of a Construction Service Agreement to complete the work needed to implement this project. Note that a revised estimate will be required if this project proceeds to an Impact Study.	36 months	$9,270,000
16	'PJM17'	BGE portion: 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 1,590 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 1,590 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. Based on previous estimate by R.W.M. for PJM (B48)	36 months	$700,000

	Contingency	Reinforcement	Schedule	Cost
		study on circuit 22008 The estimated cost of this upgrade is $700,000. Estimated construction time is 36 months.		
	'PJM17'	PPL portion: 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).Estimated cost: $17M. Estimated in-service date: October 2013	Oct-13	$17,000,000
17	'PP1EB'	Same as #9		
18	'PJM67'	Install new 2nd PB-Conastone 500 kV line with a minimum normal and emergency rating of 2,920 / 3,707 MVA, respectively. Also replace the 5012 terminal equipment at PB substation to achieve the conductor normal and emergency rating of 2,920 / 3,707 MVA, respectively. Total Cost $28.2M ~ 7 yrs. This cost is for the PECO portion only, and does not include right-of-way costs for new line.	7 yrs	$28,200,000
19	'Non'	Same as #18		
20	'BG_CKT2322 A'	Same as #13		
21	'Non'	Putting in a bigger conductor for O66 project. The timing of this project should allow us to do this. If the in-service dates of the two projects line up, it may be possible to install a larger conductor and bill X2-050 for the incremental cost. But without a firm in-service date for either project we are not sure if this will be possible. If they can be coordinated, an incremental cost is estimated at $10M for the larger size. If the above is not possible, and installation is coordinated with construction of the O-66 cable, the estimate is $50M. The construction time is estimated to require 36 months.		$50,000,000
22	'PS26'	Same as #2		
23	CNSTN_NWE STA'	To mitigate the overload on Conastone-EMORY GR500 500 kV line, BGE has proposed to upgrade the two breaker bay at Conastone with two 4000A circuit breakers, four 4000A circuit breaker disconnect switches, a one 4000A line switch. The upgrade is estimated to cost $3,000,000 and take approximately 24-36 months. This overload has been caused by a prior project. Cost allocations for this upgrade will be determined during the System Impact Study phase.	24-36 months	$3,000,000
24	'CNSTN__230-4'	Same as #23		
25	'Non'	Same as #23		

	Contingency	Reinforcement	Schedule	Cost
26	'24PS'	Same as #2		
27	'PS50A'	Same as #2		
28	'Non'	Same as #2		
29	'CNSTN_NWESTB'	Same as #23		
30	'24PS'	Same as #2		
31	PS50A'	Same as #2		
32	'Non'	Same as #2		
33	'PP1EC'	Same as #13		
34	'PJM17'	Line rated 559/674. There are substation limitations at Graceton that will be removed with project b0497. Projected in Service date is 6/1/15 (from TI Database)	6/1/2015	
35	'PJM17'	Replace 18.05 miles of 230kV line. Estimated cost $10,910,000.		$10,910,000
36	'PJM17'	Reconductor Line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 638 MVA. The line is approximately 1.4 miles long. The estimated cost to perform this work is $1M, and will require 24 months to complete.	24 months	$1,000,000
37	'BG_CKT2310A'	Same as #13		
38	'PJM17'	To mitigate the 3 MILE I-TMI 500/230kV (METED) transformer overload would require the addition of a second 500/230kV transformer at TMI as well as transmission line upgrades between the 230kV and 500kV substations. The estimated cost to perform this work is $15,000,000 and will take 36 months to complete.	36 months	$15,000,000
39	'Non'	Reconductor X-2250-5 from N.Bergen 138kV to Bergen 138kV to increase the normal line rating from 247MVA to 400MVA .Cost of reconductoring is $4.0MM and the lead time for this re-inforcement will be 11 months.	11 months	$4,000,000
			Total	**$305,880,000**

Option 1: Summary of Costs

		New System Reinforcements	Contribution to Previously Identified System Reinforcements
	Attachment Costs	1 through 6	7 through 39
Sub Total	$9,200,000	$1,900,000	$23,600,000
		$53,700,000	$135,000,000
		$48,000,000	$2,900,000
		$10,000,000	$4,000,000
	Sub Total	$113,600,000	$1,300,000
			$9,270,000
			$700,000
			$17,000,000
JCP&L Breaker	$882,300		$28,200,000
			$50,000,000
			$3,000,000
			$10,910,000
			$1,000,000
			$15,000,000
			$4,000,000
		Sub Total	$305,880,000
		Total	$429,562,300

Summary of costs = Attachment Fees + Reinforcements 1 through 39 + JCP&L Breaker. Cost allocations where applicable will be calculated in the Impact Study.

It is important to note that the summary of costs does not include costs for the 40 newly overdutied breakers, or the allocated costs for the 29 breakers that have >3% fault contribution due to the addition of this project.

A solution to the affected breakers, and cost allocations will be developed in the Impact Study Phase of this project. A worst case economic assumption would be the X2-050 project would bear the full cost of replacing each breaker at an estimated cost of between $1,000,000 to $1,250,000.

Option 2: ESSEX 230.0 kV & 138kV substation

Generator Deliverability

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

1. (PSEG) The North Avenue.-Passaic Valley S.C. 138 kV line (from bus 216993 to bus 216992 ckt 1) loads from 83.41% to 122.5% (DC power flow) of its normal rating (229 MVA) for non contingency condition. This project contributes approximately 101.10 MW to the thermal violation.

2. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 96.79% to 98.08% (DC power flow) of its emergency rating (627 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

3. (PSEG) The Essex-Kearny 4-6 230 kV line (from bus 217079 to bus 217061 ckt 1) loads from 89.63% to 120.54% (DC power flow) of its emergency rating (1000 MVA) for the **single contingency 'PS72'**. This project contributes approximately 472.95 MW to the thermal violation.

4. (PSEG) The Essex-Kearny 4-6 230 kV line (from bus 217079 to bus 217061 ckt 1) loads from 74.13% to 103.45% (DC power flow) of its normal rating (850 MVA) for non contingency condition. This project contributes approximately 384.01 MW to the thermal violation.

5. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 96.66% to 97.95% (DC power flow) of its emergency rating (627 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

6. (PSEG) The Passaic Valley S.C.-Bayonne Dummy Bus 138 kV line (from bus 216992 to bus 217160 ckt 1) loads from 81.23% to 125.98% (DC power flow) of its normal rating (200 MVA) for non contingency condition. This project contributes approximately 101.10 MW to the thermal violation.

7. (PSEG) The Linden 1-North Avenue. 138 kV line (from bus 217050 to bus 216993 ckt 1) loads from 98.61% to 124.99% (DC power flow) of its emergency rating (319 MVA) for the **single contingency 'PS8A'.** This project contributes approximately 84.15 MW to the thermal violation.

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.

Short Circuit

The following 40 circuit breakers are overdutied due to the addition of the X2-050 project. Of the 40 circuit breakers 35 exceed 80 kA. A solution to bring the interrupting duty below 80kA will be developed in the Impact Study.

PSE&G

No.	BUS _NO	BUS	BREAKER	Rating Type	Duty % w/reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_A	BKR_ CAP A	ISC
1	5176	S WATER 230.kV	S.Water1	S	105.80%	98.50%	7.30%	New Over-duty	84647.2	80000	84471
2	5176	S WATER 230.kV	S.Water2	S	105.80%	98.50%	7.30%	New Over-duty	84647.2	80000	84471
3	5176	S WATER 230.kV	S.Water4	S	105.80%	98.50%	7.30%	New Over-duty	84647.2	80000	84471
4	5176	S WATER 230.kV	S.Water5	S	105.80%	98.50%	7.30%	New Over-duty	84647.2	80000	84471
5	5176	S WATER 230.kV	S.Water6	S	105.80%	98.50%	7.30%	New Over-duty	84647.3	80000	84471
6	5176	S WATER 230.kV	S.Water7	S	105.80%	98.50%	7.30%	New Over-duty	84647.3	80000	84471
7	5069	D08 230.kV	GSU	S	103.10%	97.80%	5.30%	New Over-duty	64932.6	63000	60474
8	5037	BERGEN 230.kV	Brg10	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
9	5037	BERGEN 230.kV	Brgn1	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
10	5037	BERGEN 230.kV	Brgn12	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
11	5037	BERGEN 230.kV	Brgn15	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
12	5037	BERGEN 230.kV	Brgn17	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
13	5037	BERGEN 230.kV	Brgn18	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
14	5037	BERGEN 230.kV	Brgn20	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
15	5037	BERGEN 230.kV	Brgn21	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
16	5037	BERGEN 230.kV	Brgn23	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
17	5037	BERGEN 230.kV	Brgn24	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
18	5037	BERGEN 230.kV	Brgn26	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
19	5037	BERGEN 230.kV	Brgn3	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
20	5037	BERGEN 230.kV	Brgn4	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
21	5037	BERGEN 230.kV	Brgn5	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
22	5037	BERGEN 230.kV	Brgn6	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
23	5037	BERGEN 230.kV	Brgn7	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
24	5037	BERGEN 230.kV	Brgn8	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
25	5037	BERGEN 230.kV	Brgn9	S	101.90%	95.90%	6.00%	New Over-duty	81553.5	80000	77335
26	5037	BERGEN 230.kV	Brgn22	S	101.80%	95.80%	6.00%	New Over-duty	81421.2	80000	77229
27	5037	BERGEN 230.kV	Brgn25	S	101.80%	95.80%	6.00%	New Over-duty	81421.2	80000	77229

No.	BUS _NO	BUS	BREAKER	Rating Type	Duty % w/reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_A	BKR_ CAP A	ISC
28	4990	HDSN7-12 230.kV	5HC	S	101.60%	98.50%	3.10%	New Over-duty	81280.6	80000	75866
29	5020	SADDLBRK 230.kV	SadleBrk1	S	101.60%	97.80%	3.80%	New Over-duty	64016.5	63000	64017
30	5020	SADDLBRK 230.kV	SadleBrk3	S	101.60%	97.80%	3.80%	New Over-duty	64016.5	63000	64017
31	5020	SADDLBRK 230.kV	SadleBrk4	S	101.60%	97.80%	3.80%	New Over-duty	64016.5	63000	64017
32	5020	SADDLBRK 230.kV	SadleBrk5	S	101.60%	97.80%	3.80%	New Over-duty	64016.5	63000	64017
33	4990	HDSN7-12 230.kV	5HA	S	101.50%	98.70%	2.80%	New Over-duty	81190.1	80000	79448
34	4990	HDSN7-12 230.kV	5HB	S	101.50%	98.70%	2.80%	New Over-duty	81190.1	80000	79448
35	4990	HDSN7-12 230.kV	6HA	S	101.50%	98.70%	2.80%	New Over-duty	81190.1	80000	79448
36	4990	HDSN7-12 230.kV	6HB	S	101.50%	98.70%	2.80%	New Over-duty	81190.1	80000	79448
37	4961	BERGEN 138.kV	40P	S	101.30%	100.00%	1.30%	New Over-duty	63791.9	63000	57382
38	4990	HDSN7-12 230.kV	4HB	S	101.10%	98.00%	3.10%	New Over-duty	80874.0	80000	75238
39	5037	BERGEN 230.kV	Brgn19	S	100.70%	94.60%	6.10%	New Over-duty	80530.5	80000	76489
40	5176	S WATER 230.kV	S.Water3	S	100.40%	90.20%	10.20%	New Over-duty	80311.0	80000	80311

The following 29 circuit breakers have over 3% fault duty contribution due to the X2-050 project and will be allocated a portion of the cost for replacement.

No.	BUS _NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_ A	BKR _CAP A	ISC
1	5054	ESSEX 230.kV	22H	T	230.60%	209.70%	20.90%	Over 100%, > 3% contribution	106530.1	46198 .1	77976.6
2	5054	ESSEX 230.kV	20H	S	151.20%	138.20%	13.00%	Over 100%, > 3% contribution	95239.8	63000	83515.2
3	5054	ESSEX 230.kV	21H	S	151.20%	138.20%	13.00%	Over 100%, > 3% contribution	95239.8	63000	83515.2
4	5054	ESSEX 230.kV	11H	S	146.30%	134.60%	11.70%	Over 100%, > 3% contribution	92166.5	63000	81009.4
5	5054	ESSEX 230.kV	10H	S	145.90%	133.00%	12.90%	Over 100%, > 3% contribution	91891	63000	80127.3
6	5054	ESSEX 230.kV	11HL	S	145.90%	133.00%	12.90%	Over 100%, > 3% contribution	91891	63000	80127.3
7	4992	KRNY 1-3 230.kV	Krny3	S	142.70%	138.40%	4.30%	Over 100%, > 3% contribution	114190.3	80000	101455
8	4992	KRNY 1-3 230.kV	Krny4	S	142.70%	138.40%	4.30%	Over 100%, > 3% contribution	114190.3	80000	101455
9	4993	KRNY 4-6 230.kV	Krny1	S	142.20%	137.70%	4.50%	Over 100%, > 3% contribution	113756.6	80000	101495
10	4993	KRNY 4-6 230.kV	Krny10	S	142.20%	137.70%	4.50%	Over 100%, > 3% contribution	113756.6	80000	101495
11	4993	KRNY 4-6 230.kV	Krny6	S	142.20%	137.70%	4.50%	Over 100%, > 3% contribution	113756.6	80000	101495
12	4993	KRNY 4-6	Krny7	S	142.20%	137.70%	4.50%	Over 100%, >	113756.6	80000	101495

No.	BUS _NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note	DUTY_ A	BKR _CAP A	ISC
		230.kV						3% contribution			
13	4993	KRNY 4-6 230.kV	Krny9	S	142.20%	137.70%	4.50%	Over 100%, > 3% contribution	113756.6	80000	101495
14	4992	KRNY 1-3 230.kV	Krny5	S	139.20%	134.80%	4.40%	Over 100%, > 3% contribution	111354.2	80000	98648.1
15	4993	KRNY 4-6 230.kV	Krny8	S	138.70%	134.20%	4.50%	Over 100%, > 3% contribution	110953.5	80000	98710.1
16	5048	NEWPRT R 230.kV	23H	S	135.40%	120.20%	15.20%	Over 100%, > 3% contribution	67711.4	50000	67711.4
17	4992	KRNY 1-3 230.kV	krny2	S	126.80%	123.00%	3.80%	Over 100%, > 3% contribution	101400.7	80000	90128.1
18	5037	BERGEN 230.kV	GSU1	S	126.20%	118.50%	7.70%	Over 100%, > 3% contribution	79511.3	63000	75398.8
19	5037	BERGEN 230.kV	GSU2	S	126.20%	118.60%	7.60%	Over 100%, > 3% contribution	79517	63000	75404.2
20	5037	BERGEN 230.kV	GSU3	S	125.20%	117.50%	7.70%	Over 100%, > 3% contribution	78853.6	63000	74775.1
21	5040	HUDSN1-6 230.kV	1HA	S	124.00%	117.30%	6.70%	Over 100%, > 3% contribution	99240	80000	89147.8
22	5040	HUDSN1-6 230.kV	3HA	S	124.00%	117.30%	6.70%	Over 100%, > 3% contribution	99240	80000	89147.8
23	5040	HUDSN1-6 230.kV	3HC	S	124.00%	117.30%	6.70%	Over 100%, > 3% contribution	99240	80000	89147.8
24	5040	HUDSN1-6 230.kV	1HC	S	121.50%	115.50%	6.00%	Over 100%, > 3% contribution	97183	80000	87233.4
25	5040	HUDSN1-6 230.kV	3HB	S	121.50%	115.50%	6.00%	Over 100%, > 3% contribution	97183	80000	87233.4
26	5040	HUDSN1-6 230.kV	2HC	S	118.50%	111.70%	6.80%	Over 100%, > 3% contribution	94831.3	80000	85187.5
27	5040	HUDSN1-6 230.kV	1HB	S	118.20%	111.90%	6.30%	Over 100%, > 3% contribution	94579.9	80000	89147.8
28	5040	HUDSN1-6 230.kV	2HA	S	118.20%	111.90%	6.30%	Over 100%, > 3% contribution	94579.9	80000	89147.8
29	5040	HUDSN1-6 230.kV	2HB	S	118.20%	111.90%	6.30%	Over 100%, > 3% contribution	94579.9	80000	89147.8

JCP&L

One circuit breaker in JCP&L territory is overdutied due to the installation of the X2-050 project.

BUS_NO	BUS	BREAKER	Rating Type	Duty % w reinforce	Duty % w/o reinforce	Duty Percent Difference	Note
2550	WHIPPANY 230.kV	AQ	S	100.30%	99.80%	0.50%	New Over-duty

The cost to replace the AQ 230kV circuit breaker at Whippany is $882,300.

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.)

8. (PSEG) The Kearny 4-6-Kearny 1-3 230 kV line (from bus 217061 to bus 217060 ckt 1) loads from 128.55% to 158.71% (DC power flow) of its emergency rating (482 MVA) for the **single contingency 'PS72'.** This project contributes approximately 218.10 MW to the thermal violation.

9. (PSEG) The Kearny 4-6-Kearny 1-3 230 kV line (from bus 217061 to bus 217060 ckt 1) loads from 119.66% to 147.2% (DC power flow) of its normal rating (360 MVA) for non contingency condition. This project contributes approximately 150.51 MW to the thermal violation.

10. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 124.54% to 126.63% (DC power flow) of its emergency rating (621 MVA) for the **single contingency 'PP1EB'**. This project contributes approximately 48.76 MW to the thermal violation.

11. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 156.56% to 161.38% (DC power flow) of its emergency rating (581 MVA) for the **tower contingency '24PS'**. This project contributes approximately 173.30 MW to the thermal violation.

12. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 127.82% to 131.85% (DC power flow) of its emergency rating (581 MVA) for the **single contingency 'PS50A'**. This project contributes approximately 145.18 MW to the thermal violation.

13. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 153.18% to 158.0% (DC power flow) of its normal rating (398 MVA) for non contingency condition. This project contributes approximately 118.90 MW to the thermal violation.

14. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 106.74% to 107.58% (DC power flow) of its emergency rating (941 MVA) for the **single contingency 'PP1EC'**. This project contributes approximately 58.07 MW to the thermal violation.

15. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 127.16% to 128.82% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

16. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 138.86% to 141.53% (DC power flow) of its emergency rating (617 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 40.33 MW to the thermal violation.

17. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 104.04% to 105.75% (DC power flow) of its emergency rating (531 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.55 MW to the thermal violation.

18. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 103.25% to 104.96% (DC power flow) of its emergency rating (728 MVA) for the **single contingency 'PP1EB'**. This project contributes approximately 47.09 MW to the thermal violation.

19. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 139.30% to 141.18% (DC power flow) of its emergency rating (2815 MVA) for the **single contingency 'PJM67'**. This project contributes approximately 226.03 MW to the thermal violation.

20. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 140.94% to 143.1% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 238.09 MW to the thermal violation.

21. (BG&E) The EMORY GRV230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 101.65% to 102.01% (DC power flow) of its emergency rating (1800 MVA) for the **single contingency 'BG_CKT2322A'**. This project contributes approximately 41.92 MW to the thermal violation.

22. (PSEG) The Bergen-Athenia 230 kV line (from bus 217100 to bus 216900 ckt 1) loads from 110.23% to 116.18% (DC power flow) of its normal rating (305 MVA) for non contingency condition. This project contributes approximately 112.37 MW to the thermal violation.

23. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 2) loads from 106.44% to 117.09% (DC power flow) of its emergency rating (789 MVA) for the **single contingency 'PS26'**. This project contributes approximately 132.59 MW to the thermal violation.

24. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 123.81% to 124.95% (DC power flow) of its emergency rating (2901 MVA) for the **tower contingency 'CNSTN_NWESTA'**. This project contributes approximately 204.88 MW to the thermal violation.

25. (PJM) The Conastone-Emory Grove 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 100.23% to 102.19% (DC power flow) of its emergency rating (2901 MVA) for the **single contingency 'CNSTN__230-4'**. This project contributes approximately 184.04 MW to the thermal violation.

26. (PJM) The Conastone-Emory Grove 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 114.32% to 116.68% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 179.27 MW to the thermal violation.

27. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 160.05% to 164.54% (DC power flow) of its emergency rating (624 MVA) for the **tower contingency '24PS'**. This project contributes approximately 173.30 MW to the thermal violation.

28. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 128.62% to 132.37% (DC power flow) of its emergency rating (624 MVA) for the **single contingency 'PS50A'**. This project contributes approximately 145.18 MW to the thermal violation.

29. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 161.36% to 165.97% (DC power flow) of its normal rating (415 MVA) for non contingency condition. This project contributes approximately 118.90 MW to the thermal violation.

30. (PJM/AP) The Emory Grove-Kemptown 500 kV line (from bus 200101 to bus 235632 ckt 1) loads from 107.14% to 107.58% (DC power flow) of its emergency rating (2901 MVA) for the **tower contingency 'CNSTN_NWESTB'**. This project contributes approximately 201.95 MW to the thermal violation.

31. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 166.62% to 171.43% (DC power flow) of its emergency rating (581 MVA) for the **tower contingency '24PS'**. This project contributes approximately 173.30 MW to the thermal violation.

32. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 132.87% to 136.9% (DC power flow) of its emergency rating (581 MVA) for the **single contingency 'PS50A'.** This project contributes approximately 145.18 MW to the thermal violation.

33. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 160.55% to 165.37% (DC power flow) of its normal rating (398 MVA) for non contingency condition. This project contributes approximately 118.90 MW to the thermal violation.

34. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 123.14% to 123.65% (DC power flow) of its emergency rating (819 MVA) for the **single contingency 'PP1EC'**. This project contributes approximately 57.38 MW to the thermal violation.

35. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 105.87% to 107.38% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 45.44 MW to the thermal violation.

36. (METED) The Three Mile Island-Jackson 1 230 kV line (from bus 204514 to bus 204502 ckt 1) loads from 107.57% to 108.61% (DC power flow) of its emergency rating (591 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 37.82 MW to the thermal violation.

37. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 128.64% to 130.3% (DC power flow) of its emergency rating (485 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 56.51 MW to the thermal violation.

38. (BG&E) The Emory Grove-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 101.69% to 102.05% (DC power flow) of its emergency rating (1800 MVA) for the **single contingency 'BG_CKT2310A'.** This project contributes approximately 42.08 MW to the thermal violation.

39. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 114.13% to 115.23% (DC power flow) of its emergency rating (1072 MVA) for the **single contingency 'PJM17'**. This project contributes approximately 74.16 MW to the thermal violation.

40. (PSEG) The North Bergen X-Bergen 230 kV line (from bus 217091 to bus 217100 ckt 1) loads from 125.46% to 129.86% (DC power flow) of its normal rating (247 MVA) for non contingency condition. This project contributes approximately 70.57 MW to the thermal violation.

New System Reinforcements

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

Note: Reinforcements are not usually provided for secondary POI, but a partial list is shown for the X2-050 project since these upgrades were already developed for the Primary POI. These are for information only.

	Contingency	Reinforcement	Schedule	Cost
1	'Non'	To be determined		
2	'PJM17'	Replace Line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 622 MVA. The estimated cost to perform this work is $1.9M, and will require 24 months to complete.	24 months	$1,900,000
3	'PS72'	This overload can be fixed by looping in P-2216 line into and out of Kearny. This is already an RTEP 2016 project. But due to this project, the reinforcement needs to be expedited. Total cost for this project will be $48M with a lead time of 36 months.	36 months	$48,000,000
4	'Non'	Same as #3		
5	'PJM17'	Reconductor Line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 622 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is $10M, and will require 48 months to complete.	48 months	$10,000,000
6	'Non'	To be determined		
7	'PS8A'	To be determined		
			Total	

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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.)

The reinforcements for Option #2 are the same as those for Option #1. The total cost for the contribution to previously identified overloads is $305,880,000 as shown in option #1. The numbering sequence changed from items #7 through #39 in Option #1, to items #8 through #40 in Option #2 due to the addition of another contingency.

Detailed tables for contingencies and the resulting overloads are provided for both options at the end of this report.

Option 1	
Contingency Name	**Description**
24PS	CONTINGENCY '24PS' /* HUDSON-PENHORN 230KV DCTL TRIP LINE FROM BUS 217072 TO BUS 217074 TRIP LINE FROM BUS 217074 TO BUS 217117 TRIP LINE FROM BUS 217001 TO BUS 217092 TRIP LINE FROM BUS 217092 TO BUS 217091 TRIP LINE FROM BUS 217001 TO BUS 217093 TRIP LINE FROM BUS 217093 TO BUS 216999 TRIP LINE FROM BUS 216999 TO BUS 217072 TRIP LINE FROM BUS 217091 TO BUS 217100 TRIP LINE FROM BUS 217001 TO BUS 216909 /* PENHORN - KNGLND G 230KV / BUS 217084 -> 216909 TRIP LINE FROM BUS 216909 TO BUS 217098 CKT 2 /* BELLEVILLE T2 MOVE 100 PERCENT LOAD FROM BUS 217037 TO BUS 217036 /* N. BERGEN T1 T2 MOVE 100 PERCENT LOAD FROM BUS 216977 TO BUS 216976 /* HOBOKEN T2 T1 MOVE 100 PERCENT LOAD FROM BUS 216979 TO BUS 216978 /* KNGLNDT2 LOAD TO KNGLNDT1 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
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	CONTINGENCY 'PJM17' DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1 /* CNASTONE PEACHBTM 500 500 END

Option 1	
PJM67	CONTINGENCY 'PJM67' DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1 /* HUNTERTN CNASTONE 500 500 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
PS26	CONTINGENCY 'PS26' DISCONNECT BRANCH FROM BUS 217000 TO BUS 217117 CKT 1 /* HUDSN1-6 S WTRFRP 230 230 END
PS50A	CONTINGENCY 'PS50A' DISCONNECT BRANCH FROM BUS 217001 TO BUS 217092 CKT 1 /* PENHRN X HDSN7-12 230 230 DISCONNECT BRANCH FROM BUS 217092 TO BUS 217091 CKT 1 /* PENHRN X N.BRGN X 230 230 DISCONNECT BRANCH FROM BUS 217091 TO BUS 217100 CKT 1 /* N.BRGN X BERGEN 230 230 MOVE 100 PERCENT LOAD FROM BUS 217034 TO BUS 217035 /* PENHRN X T1 T2 MOVE 100 PERCENT LOAD FROM BUS 217037 TO BUS 217036 /* N.BRGN X T1 T2 MOVE 100 PERCENT LOAD FROM BUS 217003 TO BUS 217005 /* BRGN T30 T40 END
PS72	CONTINGENCY 'PS72' DISCONNECT BRANCH FROM BUS 217079 TO BUS 217000 CKT 1 /* ESSEX HUDSN1-6 230 230 END

Option 2	
Contingency Name	**Description**
24PS	CONTINGENCY '24PS' /* HUDSON-PENHORN 230KV DCTL TRIP LINE FROM BUS 217072 TO BUS 217074 TRIP LINE FROM BUS 217074 TO BUS 217117 TRIP LINE FROM BUS 217001 TO BUS 217092 TRIP LINE FROM BUS 217092 TO BUS 217091 TRIP LINE FROM BUS 217001 TO BUS 217093 TRIP LINE FROM BUS 217093 TO BUS 216999 TRIP LINE FROM BUS 216999 TO BUS 217072 TRIP LINE FROM BUS 217091 TO BUS 217100 TRIP LINE FROM BUS 217001 TO BUS 216909 /* PENHORN - KNGLND G 230KV / BUS 217084 -> 216909 TRIP LINE FROM BUS 216909 TO BUS 217098 CKT 2 /* BELLEVILLE T2 MOVE 100 PERCENT LOAD FROM BUS 217037 TO BUS 217036 /* N. BERGEN T1 T2

Option 2	
	MOVE 100 PERCENT LOAD FROM BUS 216977 TO BUS 216976 /* HOBOKEN T2 T1 MOVE 100 PERCENT LOAD FROM BUS 216979 TO BUS 216978 /* KNGLNDT2 LOAD TO KNGLNDT1 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
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	CONTINGENCY 'PJM17' DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1 /* CNASTONE PEACHBTM 500 500 END
PJM67	CONTINGENCY 'PJM67' DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1 /* HUNTERTN CNASTONE 500 500 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

Option 2	
PS26	CONTINGENCY 'PS26' DISCONNECT BRANCH FROM BUS 217000 TO BUS 217117 CKT 1 /* HUDSN1-6 S WTRFRP 230 230 END
PS50A	CONTINGENCY 'PS50A' DISCONNECT BRANCH FROM BUS 217001 TO BUS 217092 CKT 1 /* PENHRN X HDSN7-12 230 230 DISCONNECT BRANCH FROM BUS 217092 TO BUS 217091 CKT 1 /* PENHRN X N.BRGN X 230 230 DISCONNECT BRANCH FROM BUS 217091 TO BUS 217100 CKT 1 /* N.BRGN X BERGEN 230 230 MOVE 100 PERCENT LOAD FROM BUS 217034 TO BUS 217035 /* PENHRN X T1 T2 MOVE 100 PERCENT LOAD FROM BUS 217037 TO BUS 217036 /* N.BRGN X T1 T2 MOVE 100 PERCENT LOAD FROM BUS 217003 TO BUS 217005 /* BRGN T30 T40 END
PS72	CONTINGENCY 'PS72' DISCONNECT BRANCH FROM BUS 217079 TO BUS 217000 CKT 1 /* ESSEX HUDSN1-6 230 230 END
PS8A	CONTINGENCY 'PS8A' DISCONNECT BRANCH FROM BUS 218300 TO BUS 218343 CKT 1 /* LINDEN TOSCO 230 230 END

Option 1													
X2-050 Generator Deliverability													
No	**Contingency**		**Affected Area**	**Facility Description**	**Bus**		**Circ**	**Loading**		**Rating**		**MW Contr**
	Type	**Name**			**From**	**To**		**Initial**	**Final**	**Type**	**MVA**	
1	N-1	PJM17	PECO	Nottingham-Nottingham Reactor 230 kV line	213844	213846	1	96.83	98.11	ER	627	56.51
2	Non	Non	PSEG	Hudson 1-6-South Waterfront 230 kV line	217000	217117	2	88.19	102.9	NR	512	75.34
3	Non	Non	PSEG	Hudson 1-6-South Waterfront 230 kV line	217000	217117	1	88.19	102.9	NR	512	75.34
4	N-1	PS72	PSEG	Essex-Kearny 4-6 230 kV line	217079	217061	1	89.62	142.3	ER	1000	531.85
5	Non	Non	PSEG	Essex-Kearny 4-6 230 kV line	217079	217061	1	74.13	124	NR	850	427.99
6	N-1	PJM17	PECO	Nottingham Reactor-Peach Bottom 230 kV line	213846	213869	1	96.7	97.99	ER	627	56.51

X2-050 Contribution to Previously Identified Overloads												
No	**Contingency**		**Affected Area**	**Facility Description**	**Bus**		**Circuit**	**Loading**		**Rating**		**MW Contr**
	Type	**Name**			**From**	**To**		**Initial**	**Final**	**Type**	**MVA**	
7	N-1	PS72	PSEG	Kearny 4-6-Kearny 1-3 230 kV line	217061	217060	1	128.6	179.6	ER	482	246.22
8	Non	Non	PSEG	Kearny 4-6-Kearny 1-3 230 kV line	217061	217060	1	119.7	166.1	NR	360	167.3
9	N-1	PP1EB	BG&E	North West 2311 & 2310-Granite 2311 & 2312 230 kV line	220962	220972	1	124.6	126.7	ER	621	48.76
10	DCTL	24PS	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	156.6	161.5	ER	581	178.27
11	N-1	PS50A	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	127.8	132	ER	581	149.74
12	Non	Non	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	153.2	158.2	NR	398	123.31
13	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	2	106.8	107.6	ER	941	58.07
14	N-1	PJM17	PECO/BG&E	Cooper-Graceton 230 kV line	214089	220964	1	127.2	128.9	ER	485	56.51
15	N-1	PJM17	PL/METED	Brunner Island Bus-Yorkana 230 kV line	207922	204515	1	138.9	141.5	ER	617	40.33
16	N-1	PJM17	PL/BG&E	Otter Creek Switchyard-Conastone 230 kV line	208048	220963	1	104.1	105.8	ER	531	56.55
17	N-1	PP1EB	BG&E	North West 2326 & 2322-Granite 2326 & 2332 230 kV line	220961	220973	1	103.3	105	ER	728	47.09
18	N-1	PJM67	PJM	Peach Bottom-Conastone 500 kV line	200013	200004	1	139.3	141.2	ER	2815	226.03
19	Non	Non	PJM	Peach Bottom-Conastone 500 kV line	200013	200004	1	140.7	142.8	NR	2490	238.09
20	N-1	BG_CKT2 322A	BG&E	EMORY GRV230-North West 2326 & 2322 230 kV line	220400	220961	1	101.8	102.2	ER	1800	41.92
21	Non	Non	PSEG	Bergen-Athenia 230 kV line	217100	216900	1	110.2	116	NR	305	108.83
22	N-1	PS26	PSEG	Hudson 1-6-South Waterfront 230 kV line	217000	217117	2	106.4	124.2	ER	789	140.12
23	DCTL	CNSTN_NWESTA	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	123.8	124.9	ER	2901	204.88

X2-050 Contribution to Previously Identified Overloads												
24	N-1	CNSTN__ 230-4	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	100.3	102.2	ER	2901	184.04
25	Non	Non	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	114.4	116.7	NR	2338	179.27
26	DCTL	24PS	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	160.1	164.7	ER	624	178.27
27	N-1	PS50A	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	128.6	132.5	ER	624	149.74
28	Non	Non	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	161.4	166.2	NR	415	123.31
29	DCTL	CNSTN_ NWESTB	PJM/AP	EMORY GR500-Kemptown 500 kV line	200101	235632	1	107.1	107.6	ER	2901	201.95
30	DCTL	24PS	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	166.6	171.6	ER	581	178.27
31	N-1	PS50A	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	132.9	137	ER	581	149.74
32	Non	Non	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	160.6	165.6	NR	398	123.31
33	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	1	123.2	123.7	ER	819	57.38
34	N-1	PJM17	PL/BG&E	Safe Harbor Units 3-4 Tap-Graceton 230 kV line	208071	220964	1	105.9	107.4	ER	485	45.44
35	N-1	PJM17	METED	Three Mile Island-Jackson 1 230 kV line	204514	204502	1	107.6	108.6	ER	591	37.82
36	N-1	PJM17	PECO	Peach Bottom-Cooper 230 kV line	213869	214089	1	128.7	130.4	ER	485	56.51
37	N-1	BG_CKT2 310A	BG&E	EMORY GRV230-North West 2311 & 2310 230 kV line	220400	220962	1	101.9	102.2	ER	1800	42.08
38	N-1	PJM17	PJM/METED	Three Mile Island-Three Mile Island 500/230 kV transformer	200016	204514	2	114.1	115.2	ER	1072	74.16
39	Non	Non	PSEG	North Bergen X-Bergen 230 kV line	217091	217100	1	125.5	129.9	NR	247	70.97

Option 2

X2-050 Generator Deliverability

No	Contingency		Affected Area	Facility Description	Bus		Circuit	Loading		Rating		MW Contr
	Type	Name			From	To		Initial	Final	Type	MVA	
1	Non	Non	PSEG	North Avenue.-Passaic Valley S.C. 138 kV line	216993	216992	1	83.41	122.5	NR	229	101.1
2	N-1	PJM17	PECO	Nottingham-Nottingham Reactor 230 kV line	213844	213846	1	96.79	98.08	ER	627	56.51
3	N-1	PS72	PSEG	Essex-Kearny 4-6 230 kV line	217079	217061	1	89.63	120.5	ER	1000	472.95
4	Non	Non	PSEG	Essex-Kearny 4-6 230 kV line	217079	217061	1	74.13	103.5	NR	850	384.01
5	N-1	PJM17	PECO	Nottingham Reactor-Peach Bottom 230 kV line	213846	213869	1	96.66	97.95	ER	627	56.51
6	Non	Non	PSEG	Passaic Valley S.C.-Bayonne Dummy Bus 138 kV line	216992	217160	1	81.23	126	NR	200	101.1
7	N-1	PS8A	PSEG	Linden 1-North Avenue. 138 kV line	217050	216993	1	98.61	125	ER	319	84.15

X2-050 Contribution to Previously Identified Overloads												
No	Contingency		Affected Area	Facility Description	Bus		Circuit	Loading		Rating		MW Contr
	Type	Name			From	To		Initial	Final	Type	MVA	
8	N-1	PS72	PSEG	Kearny 4-6-Kearny 1-3 230 kV line	217061	217060	1	128.6	158.7	ER	482	218.1
9	Non	Non	PSEG	Kearny 4-6-Kearny 1-3 230 kV line	217061	217060	1	119.7	147.2	NR	360	150.51
10	N-1	PP1EB	BG&E	North West 2311 & 2310-Granite 2311 & 2312 230 kV line	220962	220972	1	124.5	126.6	ER	621	48.76
11	DCTL	24PS	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	156.6	161.4	ER	581	173.3
12	N-1	PS50A	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	127.8	131.9	ER	581	145.18
13	Non	Non	PSEG	Hoboken R-Bergen 230 kV line	217073	217100	1	153.2	158	NR	398	118.9
14	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	2	106.7	107.6	ER	941	58.07
15	N-1	PJM17	PECO/BG&E	Cooper-Graceton 230 kV line	214089	220964	1	127.2	128.8	ER	485	56.51
16	N-1	PJM17	PL/METED	Brunner Island Bus-Yorkana 230 kV line	207922	204515	1	138.9	141.5	ER	617	40.33
17	N-1	PJM17	PL/BG&E	Otter Creek Switchyard-Conastone 230 kV line	208048	220963	1	104	105.8	ER	531	56.55
18	N-1	PP1EB	BG&E	North West 2326 & 2322-Granite 2326 & 2332 230 kV line	220961	220973	1	103.3	105	ER	728	47.09
19	N-1	PJM67	PJM	Peach Bottom-Conastone 500 kV line	200013	200004	1	139.3	141.2	ER	2815	226.03
20	Non	Non	PJM	Peach Bottom-Conastone 500 kV line	200013	200004	1	140.9	143.1	NR	2490	238.09
21	N-1	BG_CKT 2322A	BG&E	EMORY GRV230-North West 2326 & 2322 230 kV line	220400	220961	1	101.7	102	ER	1800	41.92
22	Non	Non	PSEG	Bergen-Athenia 230 kV line	217100	216900	1	110.2	116.2	NR	305	112.37
23	N-1	PS26	PSEG	Hudson 1-6-South Waterfront 230 kV line	217000	217117	2	106.4	117.1	ER	789	132.59
24	DCTL	CNSTN_NWESTA	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	123.8	125	ER	2901	204.88
25	N-1	CNSTN__230-4	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	100.2	102.2	ER	2901	184.04
26	Non	Non	PJM	Conastone-EMORY GR500 500 kV line	200004	200101	1	114.3	116.7	NR	2338	179.27
27	DCTL	24PS	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	160.1	164.5	ER	624	173.3
28	N-1	PS50A	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	128.6	132.4	ER	624	145.18
29	Non	Non	PSEG	South Waterfront-Newport R 230 kV line	217117	217075	1	161.4	166	NR	415	118.9
30	DCTL	CNSTN_NWESTB	PJM/AP	EMORY GR500-Kemptown 500 kV line	200101	235632	1	107.1	107.6	ER	2901	201.95
31	DCTL	24PS	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	166.6	171.4	ER	581	173.3
32	N-1	PS50A	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	132.9	136.9	ER	581	145.18
33	Non	Non	PSEG	Newport R-Hoboken R 230 kV line	217075	217073	1	160.6	165.4	NR	398	118.9
34	N-1	PP1EC	BG&E	Conastone-EMORY GRV230 230 kV line	220963	220400	1	123.1	123.7	ER	819	57.38

X2-050 Contribution to Previously Identified Overloads												
35	N-1	PJM17	PL/BG&E	Safe Harbor Units 3-4 Tap-Graceton 230 kV line	208071	220964	1	105.9	107.4	ER	485	45.44
36	N-1	PJM17	METED	Three Mile Island-Jackson 1 230 kV line	204514	204502	1	107.6	108.6	ER	591	37.82
37	N-1	PJM17	PECO	Peach Bottom-Cooper 230 kV line	213869	214089	1	128.6	130.3	ER	485	56.51
38	N-1	BG_CKT 2310A	BG&E	EMORY GRV230-North West 2311 & 2310 230 kV line	220400	220962	1	101.7	102.1	ER	1800	42.08
39	N-1	PJM17	PJM/METED	Three Mile Island-Three Mile Island 500/230 kV transformer	200016	204514	2	114.1	115.2	ER	1072	74.16
40	Non	Non	PSEG	North Bergen X-Bergen 230 kV line	217091	217100	1	125.5	129.9	NR	247	70.57