PJM Generator Interconnection Request
Queue #W4-023
Kearny 138kV
Feasibility Study

695638

April 2012

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners,

W2-024 Kearny 138kV Feasibility Study Report

General

The Interconnection Customer (IC) has proposed a 300 MW peaking project to consist of 6 50 MW combustion turbines to be installed at the Kearny station. There will be two 3-winding generator step-up transformers. One secondary (13kV) winding of each transformer will have two generators connected and the other winding will have one generator connected. The IC has requested that there be only one interconnection from the two GSU's to the Kearny 230kV station. The in-service date for the project is May 31, 2014.

Attachment Facilities

Interconnection of the W4-023 project will require the installation of the following equipment in the Kearny 138kV station. See Figure #1.

Inside Plant:
Work includes installation of two (1) 230kV circuit breaker and disconnects switches, line disconnect switches, 138kV revenue metering, line CCVTs and wave trap.

Outside Plant
Work includes running a solid di-electric cable from the Kearny 230kv bus to the plant site that is assumed to be at the former Kearny 7/8 unit position.

The estimated cost for the direct connection requirements is **$15,000,000**.

Figure #1

Network Impacts

Queue project W4-023 was studied as a(n) 300.0 MW (300.0 MW of which was Capacity) injection into PSEG's system at the Kearny 230.0 kV substation. Project W4-023 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential transmission network impacts are as follows:

Generator Deliverability

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

1. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 88.96% to 90.0% (DC power flow) of its emergency rating (581 MVA) for the single contingency 'PS50'. This project contributes approximately 37.42 MW to the thermal violation.

```
CONTINGENCY 'PS50'
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217084 CKT 1     /* PENHORNT KNGLND G 230 230
  DISCONNECT BRANCH FROM BUS 217084 TO BUS 216909 CKT 1     /* KNGLND G BELLVILLE 230 230
  DISCONNECT BRANCH FROM BUS 216909 TO BUS 217098 CKT 1     /* BELLVILLE 220-2 220-1
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217001 CKT 1     /* PENHORNT HDSN7-12 230 230
  MOVE 100 PERCENT LOAD FROM BUS 216979 TO BUS 216978       /* KNGLND T2 T1
END
```

2. (PSEG) The Hoboken R-Bergen 230 kV line (from bus 217073 to bus 217100 ckt 1) loads from 80.82% to 81.91% (DC power flow) of its normal rating (398 MVA) for non contingency condition. This project contributes approximately 26.78 MW to the thermal violation.

3. (PSEG) The New Jersey Transit Meadows-Kingsland C 230 kV line (from bus 216943 to bus 217055 ckt 1) loads from 99.86% to 101.27% (DC power flow) of its emergency rating (826 MVA) for the single contingency 'PS72'. This project contributes approximately 72.18 MW to the thermal violation.

```
CONTINGENCY 'PS72'
  DISCONNECT BRANCH FROM BUS 217079 TO BUS 217000 CKT 1     /* ESSEX HUDSN1-6 230 230
END
```

4. (PSEG) The North Bergen-Bergen 138 kV line (from bus 217190 to bus 217156 ckt 1) loads from 95.19% to 108.89% (DC power flow) of its emergency rating (304 MVA) for the single contingency 'PS70'. This project contributes approximately 41.66 MW to the thermal violation.

```
CONTINGENCY 'PS70'
  REMOVE MACHINE 1 FROM BUS 217118                  /* BERGENGT
END
```

5. (PSEG) The Bergen Dummy Bus-East Rutherford 138 kV line (from bus 217157 to bus 216917 ckt 1) loads from 95.19% to 104.13% (DC power flow) of its emergency rating (350

MVA) for the single contingency 'BERG-FAIR'. This project contributes approximately 31.31 MW to the thermal violation.

```
CONTINGENCY 'BERG-FAIR'    /* BRGN-FAIRLAWN 138
  TRIP LINE FROM BUS 217158 TO BUS 217156          /* BRGN1-BRGN1DMY 138 138
  TRIP LINE FROM BUS 217158 TO BUS 217006          /* BRGN1DMY-BGN26A 138 26
  TRIP LINE FROM BUS 217158 TO BUS 217007          /* BRGN1DMY-BGN26B 138 26
  TRIP LINE FROM BUS 217158 TO BUS 217151          /* BRGN1DMY-SADDLBRK 138 138
  TRIP LINE FROM BUS 217151 TO BUS 217024          /* SADDLBRK 138 13
  TRIP LINE FROM BUS 217151 TO BUS 217027          /* SADDLBRK 138 13
  TRIP LINE FROM BUS 217151 TO BUS 217014          /* SADDLBRK-FAIRLN 138 138
  TRIP LINE FROM BUS 217014 TO BUS 217105          /* FAIRLAWN 132-2
  MOVE 44 PERCENT LOAD FROM BUS 217024 TO BUS 217026    /* SADDLBRK T1 T2
  MOVE 28 PERCENT LOAD FROM BUS 217024 TO BUS 217043    /* SADDLBRK T1 E RTHFRD T20
  MOVE 28 PERCENT LOAD FROM BUS 217024 TO BUS 217025    /* SADDLBRK T1 T3
  MOVE 54 PERCENT LOAD FROM BUS 217027 TO BUS 217025    /* SADDLBRK T4 T3
  MOVE 23 PERCENT LOAD FROM BUS 217027 TO BUS 217102    /* SADDLBRK T4 CLIFTN T1
  MOVE 23 PERCENT LOAD FROM BUS 217027 TO BUS 217103    /* SADDLBRK T4 CLIFTN T2
END
```

6. (PSEG) The Bergen Dummy Bus-East Rutherford 138 kV line (from bus 217157 to bus 216917 ckt 1) loads from 94.20% to 103.04% (DC power flow) of its normal rating (243 MVA) for non contingency condition. This project contributes approximately 21.47 MW to the thermal violation.

7. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 96.27% to 97.46% (DC power flow) of its normal rating (365 MVA) for non contingency condition. This project contributes approximately 26.78 MW to the thermal violation.

8. (PSEG) The Saddle Brook-Fairlawn 138 kV line (from bus 217151 to bus 217014 ckt 1) loads from 99.23% to 110.97% (DC power flow) of its emergency rating (253 MVA) for the single contingency 'BERG-ERTH'. This project contributes approximately 29.70 MW to the thermal violation.

```
CONTINGENCY 'BERG-ERTH'    /* BERGEN-E RUTHERFORD 138KV
  TRIP LINE FROM BUS 217157 TO BUS 216917
  TRIP LINE FROM BUS 217158 TO BUS 217006 CKT 1
  TRIP LINE FROM BUS 217157 TO BUS 217008 CKT 3
  TRIP LINE FROM BUS 216917 TO BUS 217044 CKT 1
  MOVE 54 PERCENT LOAD FROM BUS 217042 TO BUS 217043    /* EST RUTH T10 EST RUTH T20
  MOVE 23 PERCENT LOAD FROM BUS 217042 TO BUS 217024    /* EST RUTH T20 SADDLE BRK T1
  MOVE 23 PERCENT LOAD FROM BUS 217042 TO BUS 217005    /* EST RUTH T20 RIDGEFLD T-40
END
```

9. (PSEG) The Saddle Brook-Fairlawn 138 kV line (from bus 217151 to bus 217014 ckt 1) loads from 89.07% to 100.79% (DC power flow) of its normal rating (162 MVA) for non contingency condition. This project contributes approximately 18.99 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

Several circuit breakers in the Kearny 138 kV station (listed below) are over 80 kA, and the developer is responsible for mitigating actions to bring it down from 80 kA. There are no circuit breakers on the market capable of interrupting greater than 80kA of fault duty, therefore, PJM and PSE&G will investigate other solutions to mitigating the Kearny 138kV short circuit problem in the Impact Study should th IC choose to proceed with the project.

BUS_NO	BUS	BREAKER	RATINGTYPE	DUTY_P	DUTY_A	BKR_CAPA	ISC	X/R	3LG_AMPS	3LG_X/R	1LG_AMPS	1LG_X/R	RATED_AMPS
4993	KRNY 230.kV	BKR 1	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR10	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR11	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR3	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR4	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR6	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR7	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR9	S	107.2	85744.5	80000	75460.6	29.7	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR2	S	103.9	83091.8	80000	72942.8	30.1	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR5	S	103.9	83110.1	80000	72960.2	30.1	75460.6	29.7	74425.1	26.7	80000
4993	KRNY 230.kV	BKR8	S	95.2	76183.2	80000	67729.8	28.3	75460.6	29.7	74425.1	26.7	80000

In addition, the analysis found **24** new breakers, to be over-duty in the PSEG transmission area. The new over-duty breakers are listed below:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With w4-023	Duty Percent Without w4-023	Duty Percent Difference	Note
4990	HDSN7-12 230.kV	4HC	S	141.80%	92.80%	49.00%	New Over-duty
5054	ESSEX 230.kV	20H	S	127.70%	98.40%	29.30%	New Over-duty
5054	ESSEX 230.kV	21H	S	127.70%	98.40%	29.30%	New Over-duty
5054	ESSEX 230.kV	10H	S	123.40%	92.40%	31.00%	New Over-duty
5054	ESSEX 230.kV	11H	S	123.40%	92.40%	31.00%	New Over-duty
5054	ESSEX 230.kV	11HL	S	123.40%	92.40%	31.00%	New Over-duty
5012	N.MILFRD 230.kV	21H	S	115.40%	90.50%	24.90%	New Over-duty
5012	N.MILFRD 230.kV	22H	S	115.40%	90.50%	24.90%	New Over-duty
5012	N.MILFRD 230.kV	40H	S	115.40%	90.50%	24.90%	New Over-duty
5012	N.MILFRD 230.kV	42H	S	115.40%	90.50%	24.90%	New Over-duty
5037	BERGEN 230.kV	GSU1	S	112.40%	99.60%	12.80%	New Over-duty
5037	BERGEN 230.kV	GSU2	S	112.40%	99.60%	12.80%	New Over-duty
5037	BERGEN 230.kV	GSU3	S	111.40%	98.50%	12.90%	New Over-duty
5036	MAYWOOD 230.kV	11H	S	110.60%	63.80%	46.80%	New Over-duty
5048	NEWPRT R 230.kV	23H	S	110.50%	90.50%	20.00%	New Over-duty
5176	S WATER 230.kV	12H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	22H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	32H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	52H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	62H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	72H	S	108.70%	89.00%	19.70%	New Over-duty
5176	S WATER 230.kV	82H	S	108.70%	89.00%	19.70%	New Over-duty
4981	ALDENE 230.kV	42H	T	100.70%	99.30%	1.40%	New Over-duty
5027	WALDWICK 230.kV	10H	T	100.40%	98.70%	1.70%	New Over-duty

The average cost of replacing the circuit breakers is **$1.5 to $2.0** million each.

In addition, the analysis also showed a significant fault contribution (i.e. above 3%) to **28** circuit breakers, that were already identified as over-dutied. The circuit breakers are listed below:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With w4-023	Duty Percent Without w4-023	Duty Percent Difference	Note
5054	ESSEX 230.kV	22H	T	198.50%	137.80%	60.70%	Over 100%, > 3% contribution
5020	SADDLBRK 230.kV	21P	T	173.60%	109.20%	64.40%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	1HA	S	164.70%	140.50%	24.20%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	2HA	S	164.70%	140.50%	24.20%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	2HC	S	163.10%	119.90%	43.20%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	1HB	S	157.30%	134.30%	23.00%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	2HB	S	157.30%	134.30%	23.00%	Over 100%, > 3% contribution
5040	HUDSN1-6 230.kV	1HC	S	155.70%	131.30%	24.40%	Over 100%, > 3% contribution
5017	ROSELAND 230.kV	31H	S	152.00%	141.00%	11.00%	Over 100%, > 3% contribution
4990	HDSN7-12 230.kV	3HB	S	151.70%	110.70%	41.00%	Over 100%, > 3% contribution
4990	HDSN7-12 230.kV	4HA	S	151.70%	110.70%	41.00%	Over 100%, > 3% contribution
4990	HDSN7-12 230.kV	4HB	S	151.70%	110.70%	41.00%	Over 100%, > 3% contribution
5017	ROSELAND 230.kV	11H	S	148.80%	137.70%	11.10%	Over 100%, > 3% contribution
5037	BERGEN 230.kV	10H	T	147.00%	128.20%	18.80%	Over 100%, > 3% contribution
5037	BERGEN 230.kV	12H	S	145.50%	129.00%	16.50%	Over 100%, > 3% contribution
5037	BERGEN 230.kV	21H	S	145.50%	129.00%	16.50%	Over 100%, > 3% contribution
4990	HDSN7-12 230.kV	3HA	S	144.60%	105.70%	38.90%	Over 100%, > 3% contribution
4990	HDSN7-12 230.kV	3HC	S	142.30%	101.20%	41.10%	Over 100%, > 3% contribution
4954	ATHENIA 230.kV	21H	S	136.80%	127.90%	8.90%	Over 100%, > 3% contribution
4954	ATHENIA 230.kV	11H	S	132.70%	124.40%	8.30%	Over 100%, > 3% contribution
4954	ATHENIA 230.kV	31H	S	129.50%	119.30%	10.20%	Over 100%, > 3% contribution
4954	ATHENIA 230.kV	51H	S	127.30%	118.10%	9.20%	Over 100%, > 3% contribution
5017	ROSELAND 230.kV	82H	S	122.80%	114.00%	8.80%	Over 100%, > 3% contribution
5017	ROSELAND 230.kV	91H	S	122.80%	114.00%	8.80%	Over 100%, > 3% contribution
5017	ROSELAND 230.kV	22H	S	120.70%	111.90%	8.80%	Over 100%, > 3% contribution
5037	BERGEN 230.kV	11H	S	115.40%	102.40%	13.00%	Over 100%, > 3% contribution
5037	BERGEN 230.kV	20H	S	115.40%	102.40%	13.00%	Over 100%, > 3% contribution
4954	ATHENIA 230.kV	41H	S	109.00%	100.10%	8.90%	Over 100%, > 3% contribution

The W4-023 project will be allocated a portion of the cost to upgrade each of the circuit breakers listed above.

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)

10. (PSEG) The Hudson 7-12-Penhornt 230 kV line (from bus 217001 to bus 217069 ckt 1) loads from 101.45% to 102.31% (DC power flow) of its emergency rating (822 MVA) for the tower contingency '27PS'. This project contributes approximately 43.71 MW to the thermal violation.

```
CONTINGENCY '27PS'    /* HUD-ESSX 230KV & NJT MEADOWS-ATHENIA 230KV DCTL
  TRIP LINE FROM BUS 216900 TO BUS 216920
  TRIP LINE FROM BUS 216920 TO BUS 217055
  TRIP LINE FROM BUS 217055 TO BUS 216943
  TRIP LINE FROM BUS 217079 TO BUS 217000
  MOVE 100 PERCENT LOAD FROM BUS 216934 TO BUS 216936      /* COOK RD T1 T2
  MOVE 100 PERCENT LOAD FROM BUS 216935 TO BUS 216937      /* COOK RD T3 T4
  MOVE 100 PERCENT LOAD FROM BUS 216978 TO BUS 216979      /* KINGSLAND T1 T2
```

```
  MOVE 100 PERCENT LOAD FROM BUS 216961 TO BUS 216960       /* NJT MEADOWS WEST EAST
END
```

11. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 149.34% to 150.02% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.72 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

12. (PSEG) The Marion 1-Hudson 1-6 138/230 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 189.11% to 218.69% (DC power flow) of its emergency rating (296 MVA) for the tower contingency '27PS'. This project contributes approximately 95.68 MW to the thermal violation.

```
CONTINGENCY '27PS'     /* HUD-ESSX 230KV & NJT MEADOWS-ATHENIA 230KV DCTL
  TRIP LINE FROM BUS 216900 TO BUS 216920
  TRIP LINE FROM BUS 216920 TO BUS 217055
  TRIP LINE FROM BUS 217055 TO BUS 216943
  TRIP LINE FROM BUS 217079 TO BUS 217000
  MOVE 100 PERCENT LOAD FROM BUS 216934 TO BUS 216936       /* COOK RD T1 T2
  MOVE 100 PERCENT LOAD FROM BUS 216935 TO BUS 216937       /* COOK RD T3 T4
  MOVE 100 PERCENT LOAD FROM BUS 216978 TO BUS 216979       /* KINGSLAND T1 T2
  MOVE 100 PERCENT LOAD FROM BUS 216961 TO BUS 216960       /* NJT MEADOWS WEST EAST
END
```

13. (PSEG) The Marion 1-Hudson 1-6 138/230 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 134.81% to 162.41% (DC power flow) of its emergency rating (296 MVA) for the single contingency 'PS72'. This project contributes approximately 81.68 MW to the thermal violation.

```
CONTINGENCY 'PS72'
  DISCONNECT BRANCH FROM BUS 217079 TO BUS 217000 CKT 1     /* ESSEX HUDSN1-6 230 230
END
```

14. (BG&E) The BAGLEY13-Raphael Road 230 kV line (from bus 220999 to bus 220980 ckt 1) loads from 152.06% to 152.39% (DC power flow) of its emergency rating (674 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 17.92 MW to the thermal violation.

```
CONTINGENCY 'CNSTN_NWEST'     /* CONASTONE TO NORTHWEST CKTS #2310 & #2322
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 220962 CKT 1     /* CONASTONE TO NORTHWEST
CKT#2310
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 220961 CKT 1     /* CONASTONE TO NORTHWEST
CKT #2322
END
```

15. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 129.11% to 129.7% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 19.56 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

16. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 145.81% to 146.3% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM67'. This project contributes approximately 84.54 MW to the thermal violation.

```
CONTINGENCY 'PJM67'
  DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1     /* HUNTERTN CNASTONE 500 500
END
```

17. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 147.47% to 148.04% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 88.50 MW to the thermal violation.

18. (PSEG) The Essex-Hudson 1-6 230 kV line (from bus 217079 to bus 217000 ckt 1) loads from 120.19% to 121.83% (DC power flow) of its emergency rating (815 MVA) for the single contingency 'PS20'. This project contributes approximately 82.75 MW to the thermal violation.

```
CONTINGENCY 'PS20'
  DISCONNECT BRANCH FROM BUS 216900 TO BUS 216920 CKT 1     /* ATHENIA COOKRD C 230 230
  DISCONNECT BRANCH FROM BUS 216920 TO BUS 217055 CKT 1     /* COOKRD C KNGLND C 230 230
  DISCONNECT BRANCH FROM BUS 217055 TO BUS 216943 CKT 1     /* KNGLND C NJT MDW 230 230
  MOVE 56 PERCENT LOAD FROM BUS 216934 TO BUS 216936        /* COOKRD T1 T2
  MOVE 22 PERCENT LOAD FROM BUS 216934 TO BUS 217102        /* COOKRD T1 CLIFTN T1
  MOVE 22 PERCENT LOAD FROM BUS 216934 TO BUS 217103        /* COOKRD T1 CLIFTN T2
  MOVE 60 PERCENT LOAD FROM BUS 216935 TO BUS 216937        /* COOKRD T3 T4
  MOVE 20 PERCENT LOAD FROM BUS 216935 TO BUS 217103        /* COOKRD T3 CLIFTN T1
  MOVE 20 PERCENT LOAD FROM BUS 216935 TO BUS 216929        /* COOKRD T3 CDR GRV T2
  MOVE 58 PERCENT LOAD FROM BUS 216978 TO BUS 216979        /* KNGLND T1 T2
  MOVE 21 PERCENT LOAD FROM BUS 216978 TO BUS 217016        /* KNGLND T1 TURNPK T1
  MOVE 21 PERCENT LOAD FROM BUS 216978 TO BUS 217017        /* KNGLND T1 TURNPK T2
  MOVE 100 PERCENT LOAD FROM BUS 216961 TO BUS 216960       /* NJT MDW WEST EAST
END
```

19. (JCP&L) The W4-021 2 TAP-Freneau 230 kV line (from bus 905205 to bus 206292 ckt 1) loads from 117.58% to 117.88% (DC power flow) of its emergency rating (805 MVA) for the single contingency 'B_CNJ2-SX-#8'. This project contributes approximately 15.07 MW to the thermal violation.

```
CONTINGENCY 'B_CNJ2-SX-#8'     /* ATLANTIC - SOUTH RIVER (P1030) 230 KV
```

```
  DISCONNECT BRANCH FROM BUS 206286 TO BUS 295951 CKT 1     / BUS 206321 -> 295951 DUE TO
R11. FEB. 17, 2009.
END
```

20. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 117.91% to 118.43% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.72 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

21. (PSEG) The Kearny-New Jersey Transit Meadows 230 kV line (from bus 217087 to bus 216943 ckt 1) loads from 101.82% to 103.23% (DC power flow) of its emergency rating (826 MVA) for the single contingency 'PS72'. This project contributes approximately 72.18 MW to the thermal violation.

```
CONTINGENCY 'PS72'
  DISCONNECT BRANCH FROM BUS 217079 TO BUS 217000 CKT 1     /* ESSEX HUDSN1-6 230 230
END
```

22. (PSEG) The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 210.90% to 240.5% (DC power flow) of its emergency rating (456 MVA) for the tower contingency '27PS'. This project contributes approximately 147.62 MW to the thermal violation.

```
CONTINGENCY '27PS'     /* HUD-ESSX 230KV & NJT MEADOWS-ATHENIA 230KV DCTL
  TRIP LINE FROM BUS 216900 TO BUS 216920
  TRIP LINE FROM BUS 216920 TO BUS 217055
  TRIP LINE FROM BUS 217055 TO BUS 216943
  TRIP LINE FROM BUS 217079 TO BUS 217000
  MOVE 100 PERCENT LOAD FROM BUS 216934 TO BUS 216936       /* COOK RD T1 T2
  MOVE 100 PERCENT LOAD FROM BUS 216935 TO BUS 216937       /* COOK RD T3 T4
  MOVE 100 PERCENT LOAD FROM BUS 216978 TO BUS 216979       /* KINGSLAND T1 T2
  MOVE 100 PERCENT LOAD FROM BUS 216961 TO BUS 216960       /* NJT MEADOWS WEST EAST
END
```

23. (PSEG) The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 162.17% to 194.89% (DC power flow) of its emergency rating (456 MVA) for the single contingency 'KRNY-MARU'. This project contributes approximately 149.23 MW to the thermal violation.

```
CONTINGENCY 'KRNY-MARU'     /* KEARNY-MARION U 138KV
  TRIP LINE FROM BUS 217061 TO BUS 217137
END
```

24. (PSEG) The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 152.75% to 184.13% (DC power flow) of its normal rating (361 MVA) for non

contingency condition. This project contributes approximately 113.30 MW to the thermal violation.

25. (PSEG) The Marion 3-Hudson 7-12 138/230 kV transformer (from bus 217137 to bus 217001 ckt 1) loads from 107.54% to 133.82% (DC power flow) of its emergency rating (441 MVA) for the single contingency 'KRNY-MARN'. This project contributes approximately 115.92 MW to the thermal violation.

```
CONTINGENCY 'KRNY-MARN'     /* KEARNY-MARION N 138KV
  TRIP LINE FROM BUS 217058 TO BUS 217060
END
```

26. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 117.90% to 119.14% (DC power flow) of its emergency rating (490 MVA) for the single contingency 'PS50'. This project contributes approximately 37.42 MW to the thermal violation.

```
CONTINGENCY 'PS50'
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217084 CKT 1     /* PENHORNT KNGLND G 230 230
  DISCONNECT BRANCH FROM BUS 217084 TO BUS 216909 CKT 1     /* KNGLND G BELLVILLE 230 230
  DISCONNECT BRANCH FROM BUS 216909 TO BUS 217098 CKT 1     /* BELLVILLE 220-2 220-1
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217001 CKT 1     /* PENHORNT HDSN7-12 230 230
  MOVE 100 PERCENT LOAD FROM BUS 216979 TO BUS 216978       /* KNGLND T2 T1
END
```

27. (PSEG) The South Waterfront-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 121.44% to 122.82% (DC power flow) of its normal rating (315 MVA) for non contingency condition. This project contributes approximately 26.78 MW to the thermal violation.

28. (PSEG) The Marion 1-Homestead E 138 kV line (from bus 217058 to bus 216903 ckt 1) loads from 122.21% to 135.39% (DC power flow) of its emergency rating (316 MVA) for the single contingency 'PS70'. This project contributes approximately 41.66 MW to the thermal violation.

```
CONTINGENCY 'PS70'
  REMOVE MACHINE 1 FROM BUS 217118                    /* BERGENGT
END
```

29. (PSEG) The Bergen Dummy Bus-Saddle Brook 138 kV line (from bus 217158 to bus 217151 ckt 1) loads from 114.84% to 125.37% (DC power flow) of its emergency rating (282 MVA) for the single contingency 'BERG-ERTH'. This project contributes approximately 29.70 MW to the thermal violation.

```
CONTINGENCY 'BERG-ERTH'     /* BERGEN-E RUTHERFORD 138KV
  TRIP LINE FROM BUS 217157 TO BUS 216917
  TRIP LINE FROM BUS 217158 TO BUS 217006 CKT 1
```

```
  TRIP LINE FROM BUS 217157 TO BUS 217008 CKT 3
  TRIP LINE FROM BUS 216917 TO BUS 217044 CKT 1
  MOVE 54 PERCENT LOAD FROM BUS 217042 TO BUS 217043       /* EST RUTH T10 EST RUTH T20
  MOVE 23 PERCENT LOAD FROM BUS 217042 TO BUS 217024       /* EST RUTH T20 SADDLE BRK T1
  MOVE 23 PERCENT LOAD FROM BUS 217042 TO BUS 217005       /* EST RUTH T20 RIDGEFLD T-40
END
```

30. (PSEG) The Bergen Dummy Bus-Saddle Brook 138 kV line (from bus 217158 to bus 217151 ckt 1) loads from 123.91% to 135.21% (DC power flow) of its normal rating (168 MVA) for non contingency condition. This project contributes approximately 18.99 MW to the thermal violation.

31. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 117.89% to 118.41% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.72 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

32. (BG&E) The Graceton-Bagley13 230 kV line (from bus 220964 to bus 220999 ckt 1) loads from 135.11% to 135.4% (DC power flow) of its emergency rating (802 MVA) for the tower contingency 'CNSTN_NWEST'. This project contributes approximately 17.92 MW to the thermal violation.

```
CONTINGENCY 'CNSTN_NWEST'     /* CONASTONE TO NORTHWEST CKTS #2310 & #2322
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 220962 CKT 1     /* CONASTONE TO NORTHWEST
CKT#2310
  DISCONNECT BRANCH FROM BUS 220963 TO BUS 220961 CKT 1     /* CONASTONE TO NORTHWEST
CKT #2322
END
```

33. (PSEG) The Kearny 1-3-Kearny 4-6 138 kV line (from bus 217060 to bus 217061 ckt 1) loads from 155.64% to 217.83% (DC power flow) of its emergency rating (482 MVA) for the single contingency 'KRNY-MARN'. This project contributes approximately 299.75 MW to the thermal violation.

```
CONTINGENCY 'KRNY-MARN'     /* KEARNY-MARION N 138KV
  TRIP LINE FROM BUS 217058 TO BUS 217060
END
```

34. (PSEG) The Kearny 1-3-Kearny 4-6 138 kV line (from bus 217060 to bus 217061 ckt 1) loads from 116.51% to 168.26% (DC power flow) of its normal rating (360 MVA) for non contingency condition. This project contributes approximately 186.44 MW to the thermal violation.

35. (PSEG) The Newport R-Hoboken R 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 104.92% to 106.08% (DC power flow) of its emergency rating (521 MVA) for the single contingency 'PS50'. This project contributes approximately 37.42 MW to the thermal violation.

```
CONTINGENCY 'PS50'
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217084 CKT 1     /* PENHORNT KNGLND G 230 230
  DISCONNECT BRANCH FROM BUS 217084 TO BUS 216909 CKT 1     /* KNGLND G BELLVILLE 230 230
  DISCONNECT BRANCH FROM BUS 216909 TO BUS 217098 CKT 1     /* BELLVILLE 220-2 220-1
  DISCONNECT BRANCH FROM BUS 217069 TO BUS 217001 CKT 1     /* PENHORNT HDSN7-12 230 230
  MOVE 100 PERCENT LOAD FROM BUS 216979 TO BUS 216978       /* KNGLND T2 T1
END
```

36. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 118.92% to 120.05% (DC power flow) of its emergency rating (750 MVA) for the single contingency 'MAR_BERF'. This project contributes approximately 52.65 MW to the thermal violation.

```
CONTINGENCY 'MAR_BERF'     /* MARION-BERGEN F 230KV
  TRIP LINE FROM BUS 217000 TO BUS 216904
  TRIP LINE FROM BUS 216904 TO BUS 217100
  MOVE 60 PERCENT LOAD FROM BUS 216982 TO BUS 216980        /* HMSTD T1 HMSTD T2
  MOVE 20 PERCENT LOAD FROM BUS 216982 TO BUS 217035        /* HMSTD T1 PENHRN T2
  MOVE 20 PERCENT LOAD FROM BUS 216982 TO BUS 216981        /* HMSTD T1 HMSTD T4
  MOVE 100 PERCENT LOAD FROM BUS 216983 TO BUS 216981       /* HMSTD T3 HMSTD T4
END
```

37. (PSEG) The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 131.74% to 132.91% (DC power flow) of its normal rating (500 MVA) for non contingency condition. This project contributes approximately 36.07 MW to the thermal violation.

38. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 103.81% to 104.41% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.08 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

39. (PSEG) The Homestead E-North Bergen 138 kV line (from bus 216903 to bus 217190 ckt 1) loads from 103.83% to 117.53% (DC power flow) of its emergency rating (304 MVA) for the single contingency 'PS70'. This project contributes approximately 41.66 MW to the thermal violation.

```
CONTINGENCY 'PS70'
  REMOVE MACHINE 1 FROM BUS 217118                  /* BERGENGT
END
```

40. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 152.42% to 153.09% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 20.72 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

41. (PSEG) The Kearny 4-6-Marion 3 138 kV line (from bus 217061 to bus 217137 ckt 1) loads from 191.76% to 229.01% (DC power flow) of its emergency rating (370 MVA) for the single contingency 'KRNY-MARN'. This project contributes approximately 137.87 MW to the thermal violation.

```
CONTINGENCY 'KRNY-MARN'     /* KEARNY-MARION N 138KV
  TRIP LINE FROM BUS 217058 TO BUS 217060
END
```

42. (PSEG) The Kearny 4-6-Marion 3 138 kV line (from bus 217061 to bus 217137 ckt 1) loads from 156.84% to 185.79% (DC power flow) of its normal rating (293 MVA) for non contingency condition. This project contributes approximately 84.85 MW to the thermal violation.

43. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 125.60% to 125.99% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 15.53 MW to the thermal violation.

```
CONTINGENCY 'PJM17'
  DISCONNECT BRANCH FROM BUS 200004 TO BUS 200013 CKT 1     /* CNASTONE PEACHBTM 500 500
END
```

New System Reinforcements

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

1,2,7,18,26,27,35,36,37. Hudson - S. Waterfrnt 230kV Reinforcement includes building a new underground line between Hudson 230kV and South Waterfront 230kV. Estimated Cost: **$27M**.

3,10,12,13,21,22,23,24,33,34,41,42. BRH-4 Reinforcement is Branchburg-Roseland-Hudson Optiono 4 project. Its estimated in service date is 2015 but the project will need to be expedited in order to mitigate the overloads caused by this project. Estimated Cost: **$907M**.

4,5,6,8,9,25,28,29,30,39. *F & E circuit conversion includes converting the E-1305 and F-1306 line from Marion138kV to Homestead138kV to Bergen 138kV. Estimated Cost: **$7.3M**

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

11. The overload on the Cooper to Graceton 230kV 1.85 miles line can be alleviated by rebuilding from the PA border Graceton. New rating would be 648/802. Estimated time: 54 months. Estimated cost **$7.5 million**.

14,32. The overload on the Graceton-Raphael Road & Graceton-Bagley circuits can be mitigated by upgrading Graceton station to add 6-230kV breakers with an estimated cost of $**10,000,000** and Raphael Road station to add 6-230kV breakers with an estimated cost of **$10,000,000**. It also requires rebuilding Graceton to Raphael Rd to a double circuit 2-conductor bundled line with an estimated cost of **$30,000,000**. This work would take an estimate of 2-3 years for the substation work concurrently with 5-6 years for the line work.

15. The overload on the Otter Creek-Conastone 230kV circuit can be alleviated by the following work.

PPL Portion: PPL has recently submitted plans to PJM to rebuild the Otter Creek - Conastone 230kV line as part of a modernization project (submitted to PJM as supplemental project S0233). This project is tentatively scheduled to be complete by May 2013 (prior to the IPP's 2014 requested in-service date). The magnitude cost estimate to rebuild PPL's portion of the Otter Creek - Conastone 230kV line is **$0**.

BGE Portion: Rebuild Otter Creek to Conastone 230 kV 4.7 mile line (2302) to PA Border. The new rating is 648N/802E MVA. The estimated cost to perform this work is **$19M** and will require 60 months to complete.

16,17. The overload on the Peach Bottom-Conastone 500kV circuit can be alleviated by the following work.

BGE:

- 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 – Peach Botton rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV line from Conastone to the Pennsylvania line. Purchase 150’ R/W. Total for project **$46.8 million** 5-7 years

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]

Total cost: **85.8M**
Total time: up to 7years

19. The Williams-Freneau 230kV line overload can be alleviated by reconductoring the line from 1590 Kcmil 45/7 ACSR (7.77 mile DCT) to 1590 Kcmil 54/19 ACSS/AW-Bundled (7.37 mile DCT) for 1642/1850 MVA summer normal/emergency ratings. It also requires replacement of a disconnect switch (4000 amp) (1), bundled drop loop conductor at Freneau substation and at Williams substation. Total estimated cost is **$15,300,000**.

20. The overload on the Nottingham reactor can be alleviated by replacing the line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 741 MVA. The estimated cost to perform this work is **$1.7M** and will require 24 months to complete.

31. The overload on the Nottingham Reactor-Peach Bottom Tap 230kV line can be alleviated by reconductoring circuit 220-08 from Nottingham Reactor to the Peach Bottom Tap to get a minimum summer emergency rating of 741 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is **$10M** and will require 48 months to complete.

38. The overload on the Safe Harbor Units 3-4 Tap-Graceton 230kV overload can be alleviated by the following work.

PPL: A 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). Estimated cost: $22.7M. Estimated in-service date: November 2013

BGE: Line rated 559/674. There are substation limitations at Graceton that will be removed with project b0497

40. The overload on the Peach Bottom-Cooper 230kV circuit can be alleviated by reconductoring Line 220-08 from Peach Bottom Tap to Cooper Substation to get a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. The estimated cost to perform this work is **$1.0M**, and will require 24 months to complete.

43. The overload on the Brunner Island-Yorkana 230kV circuit can be alleviated by the following work.

PPL Portion: PPL EU will rebuild and upgrade approximately 0.6 miles of the 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**.

METED Portion: 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. 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.