PJM Generation Interconnection Request
Queue Y3-098
Island Road 230kV
Feasibility Study

Network Impacts for Option 1

The Queue Project #Y3-098 was studied as a 735.0MW (Capacity735.0MW) injection at the **Island Road 230 kV** substation in the PECO area. Project #Y3-098 was evaluated for compliance with reliability criteria for summer peak conditions in 2017. Potential network impacts were as follows:

Generator Deliverability

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

1. (PECO - PECO) The EDDYSTN3 230/138 kV transformer (from bus 213586 to bus 213584 ckt 8) loads from 98.91% to 100.17% (**DC power flow**) of its emergency rating (461 MVA) for the single line contingency outage of 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'. This project contributes approximately 35.96 MW to the thermal violation.

```
CONTINGENCY 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'
 DISCONNECT BUS 214203                    /* CHICHST1 138.00 $ DELCO $ CHICH-T9 $ T
 END/*       $ DELCO $ CHICH-T9 $ T
```

2. (PECO - PECO) The PARRISH8-MASTER2 230 kV line (from bus 213858 to bus 214144 ckt 2) loads from 72.56% to 100.86% (**DC power flow**) of its normal rating (736 MVA) for non-contingency condition. This project contributes approximately 208.3 MW to the thermal violation.

3. (PECO - PECO) The EDDYSTN2-EDDYSTN1 138 kV line (from bus 213584 to bus 213582 ckt 1) loads from 85.71% to 102.38% (**DC power flow**) of its emergency rating (256 MVA) for the single line contingency outage of '220-89/* $ PHILLY $ 220-89 $ L'. This project contributes approximately 42.69 MW to the thermal violation.

```
CONTINGENCY '220-89/* $ PHILLY $ 220-89 $ L'
 DISCONNECT BUS 214074                    /* GRAYSFRY4 230.00 $ PHILLY $ 220-89 $ L
 DISCONNECT BUS 213986                    /* TUNNEL2 230.00 $ PHILLY $ 220-89 $ L
 END/*       $ PHILLY $ 220-89 $ L
```

4. (PECO - PECO) The GRAYSFRY8-GRAYSFRY7 230 kV line (from bus 214078 to bus 214077 ckt Z) loads from 77.91% to 102.77% (**DC power flow**) of its emergency rating (1387 MVA) for the single line contingency outage of 'GRAYS395/* $ PHILLY $ GRAYS395 $ K'. This project contributes approximately 344.74 MW to the thermal violation.

```
CONTINGENCY 'GRAYS395/* $ PHILLY $ GRAYS395 $ K'
```

```
 TRIP BRANCH FROM BUS 214072 TO BUS 214073 CKT Z              /* GRAYSFRY2 230.00 GRAYSFRY3 230.00 $ PHILLY
$ GRAYS395 $ K
 END/*       $ PHILLY $ GRAYS395 $ K
```

5. (PECO - PECO) The DELAWARE-TUNA 69 kV line (from bus 213556 to bus 213982 ckt 1) loads from 65.98% to 105.78% (**DC power flow**) of its emergency rating (124 MVA) for the single line contingency outage of '220-89/* $ PHILLY $ 220-89 $ L'. This project contributes approximately 49.36 MW to the thermal violation.

```
CONTINGENCY '220-89/* $ PHILLY $ 220-89 $ L'
 DISCONNECT BUS 214074                        /* GRAYSFRY4 230.00 $ PHILLY $ 220-89 $ L
 DISCONNECT BUS 213986                        /* TUNNEL2 230.00 $ PHILLY $ 220-89 $ L
 END/*       $ PHILLY $ 220-89 $ L
```

6. (PECO - PECO) The DELAREAC-DELAWARE 69 kV line (from bus 213555 to bus 213556 ckt 1) loads from 65.98% to 105.78% (**DC power flow**) of its emergency rating (124 MVA) for the single line contingency outage of '220-89/* $ PHILLY $ 220-89 $ L'. This project contributes approximately 49.36 MW to the thermal violation.

```
CONTINGENCY '220-89/* $ PHILLY $ 220-89 $ L'
 DISCONNECT BUS 214074                        /* GRAYSFRY4 230.00 $ PHILLY $ 220-89 $ L
 DISCONNECT BUS 213986                        /* TUNNEL2 230.00 $ PHILLY $ 220-89 $ L
 END/*       $ PHILLY $ 220-89 $ L
```

7. (PECO - PECO) The SOUTHWK2-DELAREAC 69 kV line (from bus 213955 to bus 213555 ckt 1) loads from 65.98% to 105.78% (**DC power flow**) of its emergency rating (124 MVA) for the single line contingency outage of '220-89/* $ PHILLY $ 220-89 $ L'. This project contributes approximately 49.36 MW to the thermal violation.

```
CONTINGENCY '220-89/* $ PHILLY $ 220-89 $ L'
 DISCONNECT BUS 214074                        /* GRAYSFRY4 230.00 $ PHILLY $ 220-89 $ L
 DISCONNECT BUS 213986                        /* TUNNEL2 230.00 $ PHILLY $ 220-89 $ L
 END/*       $ PHILLY $ 220-89 $ L
```

8. (PECO - PECO) The PENROSE-GRAYSFRY8 230 kV line (from bus 213879 to bus 214078 ckt 1) loads from 80.01% to 107.4% (**DC power flow**) of its emergency rating (1387 MVA) for the single line contingency outage of '220-46/* $ DELCO $ 220-46 $ L'. This project contributes approximately 379.85 MW to the thermal violation.

```
CONTINGENCY '220-46/* $ DELCO $ 220-46 $ L'
 DISCONNECT BUS 213925                        /* RIDLEY 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213809                        /* MORTON2 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213775                        /* MACDADE 230.00 $ DELCO $ 220-46 $ L
 END/*       $ DELCO $ 220-46 $ L
```

9. (PECO - PECO) The PRINTZ-RIDLEY 230 kV line (from bus 213912 to bus 213925 ckt 1) loads from 86.74% to 108.7% (**DC power flow**) of its emergency rating (1432 MVA) for the single line contingency outage of '220-95/* $ PHILLY $ 220-95 $ L'. This project contributes approximately 314.42 MW to the thermal violation.

```
CONTINGENCY '220-95/* $ PHILLY $ 220-95 $ L'
 DISCONNECT BUS 214078                        /* GRAYSFRY8 230.00 $ PHILLY $ 220-95 $ L
```

```
END/*       $ PHILLY $ 220-95 $ L
```

10. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 70.33% to 109.69% (**DC power flow**) of its emergency rating (572 MVA) for the single line contingency outage of 'MICK-DELCOTP'. This project contributes approximately 225.11 MW to the thermal violation.

```
CONTINGENCY 'MICK-DELCOTP'
 OPEN LINE FROM BUS 228401 TO BUS 213559 CIRCUIT 1          /
 END
```

11. (PECO - PECO) The ISLANDRD-PENROSE 230 kV line (from bus 213667 to bus 213879 ckt 1) loads from 83.15% to 110.54% (**DC power flow**) of its emergency rating (1387 MVA) for the single line contingency outage of '220-46/* $ DELCO $ 220-46 $ L'. This project contributes approximately 379.85 MW to the thermal violation.

```
CONTINGENCY '220-46/* $ DELCO $ 220-46 $ L'
 DISCONNECT BUS 213925                    /* RIDLEY 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213809                    /* MORTON2 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213775                    /* MACDADE 230.00 $ DELCO $ 220-46 $ L
 END/*       $ DELCO $ 220-46 $ L
```

12. (PECO - PECO) The ISLANDRD 230/69 kV transformer (from bus 213667 to bus 213668 ckt 6) loads from 84.43% to 112.82% (**DC power flow**) of its emergency rating (210 MVA) for the single line contingency outage of '220-95/* $ PHILLY $ 220-95 $ L'. This project contributes approximately 59.62 MW to the thermal violation.

```
CONTINGENCY '220-95/* $ PHILLY $ 220-95 $ L'
 DISCONNECT BUS 214078                    /* GRAYSFRY8 230.00 $ PHILLY $ 220-95 $ L
 END/*       $ PHILLY $ 220-95 $ L
```

13. (PECO - PECO) The TUNNEL-PARRISH9 230 kV line (from bus 213984 to bus 213859 ckt 1) loads from 77.03% to 117.06% (**DC power flow**) of its emergency rating (965 MVA) for the single line contingency outage of '220-70/* $ DELCO $ 220-70 $ L'. This project contributes approximately 386.3 MW to the thermal violation.

```
CONTINGENCY '220-70/* $ DELCO $ 220-70 $ L'
 DISCONNECT BUS 213512                    /* CONCORD4 230.00 $ DELCO $ 220-70 $ L
 DISCONNECT BUS 213737                    /* LENAPE8 230.00 $ DELCO $ 220-70 $ L
 END/*       $ DELCO $ 220-70 $ L
```

14. (PECO - PECO) The GRAYSFRY4-TUNNEL2 230 kV line (from bus 214074 to bus 213986 ckt 1) loads from 79.01% to 118.27% (**DC power flow**) of its emergency rating (984 MVA) for the single line contingency outage of '220-70/* $ DELCO $ 220-70 $ L'. This project contributes approximately 386.3 MW to the thermal violation.

```
CONTINGENCY '220-70/* $ DELCO $ 220-70 $ L'
 DISCONNECT BUS 213512                    /* CONCORD4 230.00 $ DELCO $ 220-70 $ L
 DISCONNECT BUS 213737                    /* LENAPE8 230.00 $ DELCO $ 220-70 $ L
 END/*       $ DELCO $ 220-70 $ L
```

15. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 72.41% to 117.83% (**DC power flow**) of its normal rating (456 MVA) for non-contingency condition. This project contributes approximately 206.87 MW to the thermal violation.

16. (PECO - PECO) The TUNNEL-PARRISH9 230 kV line (from bus 213984 to bus 213859 ckt 1) loads from 80.23% to 121.55% (**DC power flow**) of its normal rating (812 MVA) for non-contingency condition. This project contributes approximately 335.53 MW to the thermal violation.

17. (PECO - PECO) The GRAYSFRY4-TUNNEL2 230 kV line (from bus 214074 to bus 213986 ckt 1) loads from 82.51% to 122.89% (**DC power flow**) of its normal rating (831 MVA) for non-contingency condition. This project contributes approximately 335.53 MW to the thermal violation.

Light Load Analysis

Not applicable.

Multiple Facility Contingency

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

1. (PECO - PECO) The EDDYSTN3 230/1 kV transformer (from bus 213586 to bus 213584 ckt 8) loads from 80.62% to 100.98% (**DC power flow**) of its emergency rating (461 MVA) for the line fault with failed breaker contingency outage of 'GRAYS295/* $ PHILLY $ GRAYS295 $ STBK'. This project contributes approximately 93.86 MW to the thermal violation.

```
CONTINGENCY 'GRAYS295/* $ PHILLY $ GRAYS295 $ STBK'
 DISCONNECT BUS 214073                    /* GRAYSFRY3 230.00 $ PHILLY $ GRAYS295 $ STBK
 DISCONNECT BUS 214074                    /* GRAYSFRY4 230.00 $ PHILLY $ GRAYS295 $ STBK
 TRIP BRANCH FROM BUS 213985 TO BUS 213986 CKT 2          /* TUNNEL 13.80 TUNNEL2 230.00 $ PHILLY $
GRAYS295 $ STBK
 END/*       $ PHILLY $ GRAYS295 $ STBK
```

2. (PECO - PECO) The EDDYSTN3 230/1 kV transformer (from bus 213586 to bus 213584 ckt 8) loads from 81.44% to 102.17% (**DC power flow**) of its emergency rating (461 MVA) for the line fault with failed breaker contingency outage of 'GRAYS275/* $ PHILLY $ GRAYS275 $ STBK'. This project contributes approximately 95.54 MW to the thermal violation.

```
CONTINGENCY 'GRAYS275/* $ PHILLY $ GRAYS275 $ STBK'
 DISCONNECT BUS 214074                    /* GRAYSFRY4 230.00 $ PHILLY $ GRAYS275 $ STBK
 DISCONNECT BUS 214075                    /* GRAYSFRY5 230.00 $ PHILLY $ GRAYS275 $ STBK
 TRIP BRANCH FROM BUS 213985 TO BUS 213986 CKT 2          /* TUNNEL 13.80 TUNNEL2 230.00 $ PHILLY $
GRAYS275 $ STBK
 END/*       $ PHILLY $ GRAYS275 $ STBK
```

3. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 80.42% to 116.58% (**DC power flow**) of its emergency rating (572 MVA) for the tower line contingency outage of 'W2275_O2241'. This project contributes approximately 206.84 MW to the thermal violation.

```
CONTINGENCY 'W2275_O2241'                    /* DOUBLE CIRCUIT TOWER W-2275(MICKLETON -
DEPTFORD) AND O-2241(MICKLETON - THOROFARE)
 TRIP BRANCH FROM BUS 219121 TO BUS 228401 CKT 1        /* TRIP O-2241(MICKLETON - THOROFARE) 230KV
 TRIP BRANCH FROM BUS 219109 TO BUS 228401 CKT 2        /* TRIP W-2275(MICKLETON - DEPTFORD) 230KV
 END
```

4. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 80.42% to 116.58% (**DC power flow**) of its emergency rating (572 MVA) for the tower line contingency outage of 'PS-O2241'. This project contributes approximately 206.84 MW to the thermal violation.

```
CONTINGENCY 'PS-O2241'                       /* MICKELTON - THOROFARE-NEW
 DISCONNECT BRANCH FROM BUS 228401 TO BUS 219121 CKT 1
 DISCONNECT BRANCH FROM BUS 228401 TO BUS 219109 CKT 2
 MOVE 100 PERCENT LOAD FROM BUS 219211 TO BUS 219212
 MOVE 100 PERCENT LOAD FROM BUS 219181 TO BUS 219180
 MOVE 100 PERCENT LOAD FROM BUS 219256 TO BUS 219255
 END
```

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

The proposed generation causes 12 new over-dutied breakers and contributes more than 3% to 7 existing over-dutied breakers on the PECO bulk electric transmission system. Further review also indicated that the Y3-098 queue project does not cause any new over-dutied breakers or contribute more than 3% to existing over-dutied breakers on the PECO 69kV transmission system under Option 1. Currently PECO has baseline projects that will replace 7 of these 19 identified over-dutied breakers. PECO estimates that the remaining 12 breakers will cost approximately $3.6 million and take 2 years to replace under Option 1.

Y3-098 Option 1- Connect at Island Road 230kV

New Over-Duty Breakers

BUS_NO	BUS	BREAKER	RATING TYPE	With DUTY_P	Without DUTY_P	With-Without DUTY_P	With DUTY_A	Without DUTY_A	With-Without DUTY_A	BKR_CAPA	COST	PECO Comments
214075	GRAYSFRY 230.kV	985	S	105	98.2	6.8	47469.5	44407.2	3062.3	45200	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	705	S	104.1	97.3	6.8	47043.2	43993.1	3050.1	45200	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	775	S	104.1	97.3	6.8	47043.2	43993.1	3050.1	45200	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	905	S	103.1	96.4	6.7	46597.8	43567.4	3030.4	45200	$300,000	New Over-duty
213489	CHICHSTR 230.kV	195	S	102.4	100	2.4	51175.1	49983.9	1191.2	50000	$300,000	New Over-duty
213855	PARRISH 230.kV	705	S	101.3	97.3	4	41037.7	39415.9	1621.8	40500	$300,000	New Over-duty
213855	PARRISH 230.kV	805	S	101.3	97.3	4	41037.7	39415.9	1621.8	40500	$300,000	New Over-duty
213906	PLYMTG 1 230.kV	695	S	100.9	100	0.9	56526.9	56008.4	518.5	56000	$300,000	New Over-duty
213906	PLYMTG 1 230.kV	475	S	100.8	99.8	1	56430.2	55915.2	515	56000	$300,000	New Over-duty
214007	WANEETA 138.kV	15	S	100.5	100	0.5	42223.7	42012.2	211.5	42000	Existing Baseline Project	New Over-duty Existing project b2130 replaces Waneeta 138kV Bkr #15 in 2017.
213579	EDDYSTN 230.kV	365	S	100.4	94.4	6	50177.5	47210.6	2966.9	50000	$300,000	New Over-duty
214007	WANEETA 138.kV	35	S	100.4	99.9	0.5	42183.9	41972.5	211.4	42000	Existing Baseline Project	New Over-duty Existing project b2131 replaces Waneeta 138kV Bkr #35 in 2017.
									Bkr Replacement Cost:		$3,000,000	

Y3-098 Option 1- Connect at Island Road 230kV Existing Over-Duty Breakers with Greater Than 3% Contribution												
BUS_NO	BUS	BREAKER	RATING TYPE	With DUTY_P	Without DUTY_P	With-Without DUTY_P	With DUTY_A	Without DUTY_A	With-Without DUTY_A	BKR_CAPA	COST	PECO Comments
213912	PRINTZ 230.kV	125	S	111.4	104.2	7.2	55704.2	52119.4	3584.8	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1015.2 upgrades Printz 230kV Bkr #125 in 2015.
213912	PRINTZ 230.kV	215	S	111.4	104.2	7.2	55701.6	52116.8	3584.8	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1340 upgrades Printz 230kV Bkr #215 in 2013.
213912	PRINTZ 230.kV	225	S	111.4	104.2	7.2	55704.2	52119.4	3584.8	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1338 upgrades Printz 230kV Bkr #225 in 2013.
213912	PRINTZ 230.kV	315	S	111.4	104.2	7.2	55701.6	52116.8	3584.8	50000	$300,000	Over 100%, > 3% contribution
213912	PRINTZ 230.kV	115	S	111.3	104.2	7.1	55673.2	52088.6	3584.6	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1015.1 upgrades Printz 230kV Bkr #115 in 2015.
214075	GRAYSFRY 230.kV	115	S	109.1	100.9	8.2	48004.7	44400.2	3604.5	44000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1398.12 replaces Grays Ferry 230kV Bkr # 115 in 2015.
214075	GRAYSFRY 230.kV	805	S	109.1	100.9	8.2	48004.6	44400.1	3604.5	44000	$300,000	Over 100%, > 3% contribution
									Bkr Replacement Cost:		$600,000	

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)

None

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

New System Reinforcements

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

Generator Deliverability

1. (PECO - PECO) The EDDYSTN3 230/138 kV transformer:
The installation of the Eddystone 9 transformer will remediate the minor overload on Eddystone 8 caused by this project. Estimated Cost: $0 (see baseline upgrade b2222)

2. (PECO - PECO) The PARRISH8-MASTER2 230 kV line:
Replace disconnect switches and station cable. Estimated Cost: $1 M; Estimated Time: 4 months

3. (PECO - PECO) The EDDYSTN2-EDDYSTN1 138 kV line:

Replace circuit breakers and reactor on 1-2 bus tie. Estimated cost: $2 M; Estimated Time 18-24 months

4. (PECO - PECO) The GRAYSFRY8-GRAYSFRY7 230 kV line:
Replace the circuit breaker and remove Doble links. Estimated Cost: $1 M; Estimated Time: 5 months

5, 6, 7. (PECO - PECO) The DELAWARE-TUNA 69 kV line, DELAREAC-DELAWARE 69 kV line, and SOUTHWK2-DELAREAC 69 kV line:
Reconductor the underground line. Estimated Cost: $25 M; Estimated Time: 2 years

8. (PECO - PECO) The PENROSE-GRAYSFRY8 230 kV line:
Replace the circuit breakers. Estimated Cost: $2 M; Estimated Time: 5 months

9. (PECO - PECO) The PRINTZ-RIDLEY 230 kV line:
Replace 2 circuit breakers and 6 disconnect switches. Estimated Cost: $1.6 M; Estimated Time: 3 years

10, 15. (PECO - PECO) The MASTER1-N PHILA8 230 kV line:
Reconductor the line. Estimated Cost: $5 M; Estimated Time: 3 years

11. (PECO - PECO) The ISLANDRD-PENROSE 230 kV line:
Replace the circuit breaker and remove Doble links. Estimated Cost: $1 M; Estimated Time: 5 months

12. (PECO - PECO) The ISLANDRD 230/69 kV transformer:
Replace the transformer and station cable. Estimated Cost: $3 M; Estimated Time: 15 months

13, 16. (PECO - PECO) The TUNNEL-PARRISH9 230 kV line:
Reconductor the line. Estimated Cost: $5 M; Estimated Time: 3 years

14, 17. (PECO - PECO) The GRAYSFRY4-TUNNEL2 230 kV line:
Reconductor the line and replace the meters. Estimated Cost: $1 M; Estimated Time: 3 years

Multiple Facility Contingency

1, 2. (PECO - PECO) The EDDYSTN3 230/1 kV transformer:
The installation of the Eddystone 9 transformer will remediate the minor overload on Eddystone 8 caused by this project. Estimated Cost: $0 (see baseline upgrade b2222)

3, 4. (PECO - PECO) The MASTER1-N PHILA8 230 kV line:
Reconductor the line. Estimated Cost: $5 M; Estimated Time: 3 years (same as 10,15 in Generator Deliverability section above)

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)

None

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

Not Applicable

OPTION 2

Network Impacts

The Queue Project #Y3-098 was studied as a 735.0MW (Capacity735.0MW) injection at the Printz 230 kV substation in the PECO area. Project #Y3-098 was evaluated for compliance with reliability criteria for summer peak conditions in 2017. Potential network impacts were as follows:

Generator Deliverability

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

1. (PECO - PECO) The RIDLEY-MORTON2 230 kV line (from bus 213925 to bus 213809 ckt 1) loads from 77.4% to 100.53% (**DC power flow**) of its emergency rating (613 MVA) for the single line contingency outage of '220-04/* $ DELCO $ 220-04 $ L'. This project contributes approximately 141.75 MW to the thermal violation.

```
CONTINGENCY '220-04/* $ DELCO $ 220-04 $ L'
 DISCONNECT BUS 213627                    /* CHICHST1 230.00 FOULK8 230.00 $ DELCO $ 220-04 $ L
 END/*       $ DELCO $ 220-04 $ L
```

2. (PECO - PECO) The ISLANDRD-PENROSE 230 kV line (from bus 213667 to bus 213879 ckt 1) loads from 83.15% to 102.06% (**DC power flow**) of its emergency rating (1387 MVA) for the single line contingency outage of '220-46/* $ DELCO $ 220-46 $ L'. This project contributes approximately 262.2 MW to the thermal violation.

```
CONTINGENCY '220-46/* $ DELCO $ 220-46 $ L'
 DISCONNECT BUS 213925                    /* RIDLEY 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213809                    /* MORTON2 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213775                    /* MACDADE 230.00 $ DELCO $ 220-46 $ L
 END/*       $ DELCO $ 220-46 $ L
```

3. (PECO - PECO) The EDDYSTN2-EDDYSTN1 138 kV line (from bus 213584 to bus 213582 ckt 1) loads from 85.71% to 103.84% (**DC power flow**) of its emergency rating (256 MVA) for the single line contingency outage of '220-89/* $ PHILLY $ 220-89 $ L'. This project contributes approximately 46.42 MW to the thermal violation.

```
CONTINGENCY '220-89/* $ PHILLY $ 220-89 $ L'
 DISCONNECT BUS 214074                    /* GRAYSFRY4 230.00 $ PHILLY $ 220-89 $ L
 DISCONNECT BUS 213986                    /* TUNNEL2 230.00 $ PHILLY $ 220-89 $ L
 END/*       $ PHILLY $ 220-89 $ L
```

4. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 70.41% to 104.93% (**DC power flow**) of its emergency rating (572 MVA) for the single line contingency outage of 'MICK-DELCOTP'. This project contributes approximately 196.82 MW to the thermal violation.

```
CONTINGENCY 'MICK-DELCOTP'
 OPEN LINE FROM BUS 228401 TO BUS 213559 CIRCUIT 1          /
```

```
END
```

5. (PECO - PECO) The ELMWOOD8-GRAYSFRY2 230 kV line (from bus 213595 to bus 214072 ckt 1) loads from 87.82% to 107.32% (**DC power flow**) of its emergency rating (1260 MVA) for the single line contingency outage of '220-23/* $ DELCO $ 220-23 $ L'. This project contributes approximately 245.73 MW to the thermal violation.

```
CONTINGENCY '220-23/* $ DELCO $ 220-23 $ L'
 DISCONNECT BUS 213666                    /* ISLANDR6 230.00 $ DELCO $ 220-23 $ L
 END/*       $ DELCO $ 220-23 $ L
```

6. (PECO - PECO) The RIDLEY-MACDADE 230 kV line (from bus 213925 to bus 213775 ckt 1) loads from 90.44% to 107.6% (**DC power flow**) of its emergency rating (1432 MVA) for the single line contingency outage of '220-23/* $ DELCO $ 220-23 $ L'. This project contributes approximately 245.73 MW to the thermal violation.

```
CONTINGENCY '220-23/* $ DELCO $ 220-23 $ L'
 DISCONNECT BUS 213666                    /* ISLANDR6 230.00 $ DELCO $ 220-23 $ L
 END/*       $ DELCO $ 220-23 $ L
```

7. (PECO - PECO) The EDDYSTN2 138/1 kV transformer (from bus 999416 to bus 213584 ckt 8) loads from 98.89% to 110.53% (**DC power flow**) of its emergency rating (461 MVA) for the single line contingency outage of 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'. This project contributes approximately 53.64 MW to the thermal violation.

```
CONTINGENCY 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'
 DISCONNECT BUS 214203                    /* CHICHST1 138.00 $ DELCO $ CHICH-T9 $ T
 END/*       $ DELCO $ CHICH-T9 $ T
```

8. (PECO - PECO) The EDDYSTN3 230/1 kV transformer (from bus 213586 to bus 999416 ckt 8) loads from 98.91% to 110.55% (**DC power flow**) of its emergency rating (461 MVA) for the single line contingency outage of 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'. This project contributes approximately 53.64 MW to the thermal violation.

```
CONTINGENCY 'CHICH-T9/* $ DELCO $ CHICH-T9 $ T'
 DISCONNECT BUS 214203                    /* CHICHST1 138.00 $ DELCO $ CHICH-T9 $ T
 END/*       $ DELCO $ CHICH-T9 $ T
```

9. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 72.41% to 110.58% (**DC power flow**) of its normal rating (456 MVA) for non-contingency condition. This project contributes approximately 173.8 MW to the thermal violation.

10. (PECO - PECO) The TUNNEL-PARRISH9 230 kV line (from bus 213984 to bus 213859 ckt 1) loads from 77.03% to 111.61% (**DC power flow**) of its emergency rating (965 MVA) for the single line contingency outage of '220-70/* $ DELCO $ 220-70 $ L'. This project contributes approximately 333.7 MW to the thermal violation.

```
CONTINGENCY '220-70/* $ DELCO $ 220-70 $ L'
 DISCONNECT BUS 213512                    /* CONCORD4 230.00 $ DELCO $ 220-70 $ L
 DISCONNECT BUS 213737                    /* LENAPE8 230.00 $ DELCO $ 220-70 $ L
```

```
END/*       $ DELCO $ 220-70 $ L
```

11. (PECO - PECO) The GRAYSFRY4-TUNNEL2 230 kV line (from bus 214074 to bus 213986 ckt 1) loads from 79.01% to 112.93% (**DC power flow**) of its emergency rating (984 MVA) for the single line contingency outage of '220-70/* $ DELCO $ 220-70 $ L'. This project contributes approximately 333.7 MW to the thermal violation.

```
CONTINGENCY '220-70/* $ DELCO $ 220-70 $ L'
 DISCONNECT BUS 213512                  /* CONCORD4 230.00 $ DELCO $ 220-70 $ L
 DISCONNECT BUS 213737                  /* LENAPE8 230.00 $ DELCO $ 220-70 $ L
 END/*       $ DELCO $ 220-70 $ L
```

12. (PECO - PECO) The MACDADE3-ELMWOOD 230 kV line (from bus 213778 to bus 213593 ckt 1) loads from 93.21% to 112.71% (**DC power flow**) of its emergency rating (1260 MVA) for the single line contingency outage of '220-23/* $ DELCO $ 220-23 $ L'. This project contributes approximately 245.73 MW to the thermal violation.

```
CONTINGENCY '220-23/* $ DELCO $ 220-23 $ L'
 DISCONNECT BUS 213666                  /* ISLANDR6 230.00 $ DELCO $ 220-23 $ L
 END/*       $ DELCO $ 220-23 $ L
```

13. (PECO - PECO) The TUNNEL-PARRISH9 230 kV line (from bus 213984 to bus 213859 ckt 1) loads from 80.42% to 114.12% (**DC power flow**) of its normal rating (812 MVA) for non-contingency condition. This project contributes approximately 273.61 MW to the thermal violation.

14. (PECO - PECO) The GRAYSFRY4-TUNNEL2 230 kV line (from bus 214074 to bus 213986 ckt 1) loads from 82.7% to 115.63% (**DC power flow**) of its normal rating (831 MVA) for non-contingency condition. This project contributes approximately 273.61 MW to the thermal violation.

15. (PECO - PECO) The EDDYSTN3-ISLANDR6 230 kV line (from bus 213586 to bus 213666 ckt 1) loads from 96.89% to 116.96% (**DC power flow**) of its emergency rating (1387 MVA) for the single line contingency outage of '220-46/* $ DELCO $ 220-46 $ L'. This project contributes approximately 278.35 MW to the thermal violation.

```
CONTINGENCY '220-46/* $ DELCO $ 220-46 $ L'
 DISCONNECT BUS 213925                  /* RIDLEY 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213809                  /* MORTON2 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213775                  /* MACDADE 230.00 $ DELCO $ 220-46 $ L
 END/*       $ DELCO $ 220-46 $ L
```

16. (PECO - PECO) The PRINTZ-EDDYSTN4 230 kV line (from bus 213912 to bus 213588 ckt 1) loads from 51.78% to 119.7% (**DC power flow**) of its emergency rating (1079 MVA) for the single line contingency outage of '220-46/* $ DELCO $ 220-46 $ L'. This project contributes approximately 732.87 MW to the thermal violation.

```
CONTINGENCY '220-46/* $ DELCO $ 220-46 $ L'
 DISCONNECT BUS 213925                  /* RIDLEY 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213809                  /* MORTON2 230.00 $ DELCO $ 220-46 $ L
 DISCONNECT BUS 213775                  /* MACDADE 230.00 $ DELCO $ 220-46 $ L
```

```
END/*        $ DELCO $ 220-46 $ L
```

17. (PECO - PECO) The PRINTZ-RIDLEY 230 kV line (from bus 213912 to bus 213925 ckt 1) loads from 99.14% to 124.81% (**DC power flow**) of its emergency rating (1432 MVA) for the single line contingency outage of '220-23/* $ DELCO $ 220-23 $ L'. This project contributes approximately 367.57 MW to the thermal violation.

```
CONTINGENCY '220-23/* $ DELCO $ 220-23 $ L'
 DISCONNECT BUS 213666                          /* ISLANDR6 230.00 $ DELCO $ 220-23 $ L
 END/*        $ DELCO $ 220-23 $ L
```

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

Multiple Facility Contingency

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

1. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 80.42% to 111.19% (**DC power flow**) of its emergency rating (572 MVA) for the tower line contingency outage of 'W2275_O2241'. This project contributes approximately 176.0 MW to the thermal violation.

```
CONTINGENCY 'W2275_O2241'                       /* DOUBLE CIRCUIT TOWER W-2275(MICKLETON -
DEPTFORD) AND O-2241(MICKLETON - THOROFARE)
 TRIP BRANCH FROM BUS 219121 TO BUS 228401 CKT 1          /* TRIP O-2241(MICKLETON - THOROFARE) 230KV
 TRIP BRANCH FROM BUS 219109 TO BUS 228401 CKT 2          /* TRIP W-2275(MICKLETON - DEPTFORD) 230KV
 END
```

2. (PECO - PECO) The MASTER1-N PHILA8 230 kV line (from bus 214143 to bus 213819 ckt 1) loads from 80.42% to 111.19% (**DC power flow**) of its emergency rating (572 MVA) for the tower line contingency outage of 'PS-O2241'. This project contributes approximately 176.0 MW to the thermal violation.

```
CONTINGENCY 'PS-O2241'                          /* MICKELTON - THOROFARE-NEW
 DISCONNECT BRANCH FROM BUS 228401 TO BUS 219121 CKT 1
 DISCONNECT BRANCH FROM BUS 228401 TO BUS 219109 CKT 2
 MOVE 100 PERCENT LOAD FROM BUS 219211 TO BUS 219212
 MOVE 100 PERCENT LOAD FROM BUS 219181 TO BUS 219180
 MOVE 100 PERCENT LOAD FROM BUS 219256 TO BUS 219255
 END
```

3. (PECO - PECO) The PRINTZ-EDDYSTN4 230 kV line (from bus 213912 to bus 213588 ckt 1) loads from 51.88% to 119.81% (**DC power flow**) of its emergency rating (1079 MVA) for the line fault with failed breaker contingency outage of 'MORTO565/* $ DELCO $ MORTO565 $ STBK'. This project contributes approximately 732.87 MW to the thermal violation.

```
CONTINGENCY 'MORTO565/* $ DELCO $ MORTO565 $ STBK'
```

DISCONNECT BUS 214092 /* MIDDLE8A 230.00 $ DELCO $ MORTO565 $ STBK
DISCONNECT BUS 213807 /* MORTON 230.00 $ DELCO $ MORTO565 $ STBK
DISCONNECT BUS 213809 /* MORTON2 230.00 $ DELCO $ MORTO565 $ STBK
SET BUS 213808 LOAD TO 0 PERCENT /* MORTON 13.80 $ DELCO $ MORTO565 $ STBK
DISCONNECT BUS 213925 /* RIDLEY 230.00 $ DELCO $ MORTO565 $ STBK
TRIP BRANCH FROM BUS 213776 TO BUS 213775 CKT 1 /* MACDADE 13.80 MACDADE 230.00 $ DELCO $ MORTO565 $ STBK
END/* $ DELCO $ MORTO565 $ STBK

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

Under Option 2 with the Y3-098 queue project connected at the Printz 230kV bus, the proposed generation causes 14 new over-dutied breakers and contributes more than 3% to 7 existing over-dutied breakers on the PECO bulk electric transmission system. Further review also indicated that the Y3-098 queue project does not cause any new over-dutied breakers or contribute more than 3% to existing over-dutied breakers on the PECO 69kV transmission system under Option 2. Currently PECO has baseline projects that will replace 7 of these 21 identified over-dutied breakers. PECO estimates that the remaining 14 breakers will cost approximately $4.2 million and take 2 years to replace under Option 2.

Y3-098 Option 2- Connect at Printz 230kV
New Over-Duty Breakers

BUS_NO	BUS	BREAKER	RATING TYPE	With DUTY_P	Without DUTY_P	With-Without DUTY_P	With DUTY_A	Without DUTY_A	With-Without DUTY_A	BKR_CAPA	COST	PECO Comments
213579	EDDYSTN 230.kV	365	S	107.1	96.6	10.5	53542.1	48323.4	5218.7	50000	$300,000	New Over-duty
213912	PRINTZ 230.kV	CT2	S	103.9	94.9	9	65440.5	59805.1	5635.4	63000	$300,000	New Over-duty
213912	PRINTZ 230.kV	CT1	S	103.8	94.9	8.9	65410.9	59776.8	5634.1	63000	$300,000	New Over-duty
213912	PRINTZ 230.kV	ST	S	103.5	94.6	8.9	65191.8	59575.1	5616.7	63000	$300,000	New Over-duty
213489	CHICHSTR 230.kV	195	S	103.3	100	3.3	51673.8	49983.8	1690	50000	$300,000	New Over-duty
213579	EDDYSTN 230.kV	85	S	102.1	94.1	8	64343.6	59295.8	5047.8	63000	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	985	S	102	98.2	3.8	46091.8	44407.4	1684.4	45200	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	705	S	101	97.3	3.7	45669.3	43993.3	1676	45200	$300,000	New Over-duty
214075	GRAYSFRY 230.kV	775	S	101	97.3	3.7	45669.3	43993.3	1676	45200	$300,000	New Over-duty
213906	PLYMTG 1 230.kV	695	S	100.7	100	0.7	56380.9	56008.4	372.5	56000	$300,000	New Over-duty
213906	PLYMTG 1 230.kV	475	S	100.5	99.8	0.7	56284.2	55915.2	369	56000	$300,000	New Over-duty
214007	WANEETA 138.kV	15	S	100.4	100	0.4	42149.7	42012.2	137.5	42000	Existing Baseline Project	New Over-duty Existing project b2130 replaces Waneeta 138kV Bkr #15 in 2017.
214007	WANEETA 138.kV	35	S	100.3	99.9	0.4	42110	41972.5	137.5	42000	Existing Baseline Project	New Over-duty Existing project b2131 replaces Waneeta 138kV Bkr #35 in 2017.
214075	GRAYSFRY 230.kV	905	S	100.1	96.4	3.7	45234.5	43567.7	1666.8	45200	$300,000	New Over-duty
									Bkr Replacement Cost:		$3,600,000	

Y3-098 Option 2- Connect at Printz 230kV
Existing Over-Duty Breakers with Greater Than 3% Contribution

BUS_NO	BUS	BREAKER	RATING TYPE	With DUTY_P	Without DUTY_P	With-Without DUTY_P	With DUTY_A	Without DUTY_A	With-Without DUTY_A	BKR_CAPA	COST	PECO Comments
213912	PRINTZ 230.kV	125	S	122.1	111.3	10.8	61070.5	55656.8	5413.7	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1015.2 upgrades Printz 230kV Bkr #125 in 2015.
213912	PRINTZ 230.kV	215	S	122.1	111.3	10.8	61065.9	55652.3	5413.6	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1340 upgrades Printz 230kV Bkr #215 in 2013.
213912	PRINTZ 230.kV	225	S	122.1	111.3	10.8	61070.5	55656.8	5413.7	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1338 upgrades Printz 230kV Bkr #225 in 2013.
213912	PRINTZ 230.kV	315	S	122.1	111.3	10.8	61065.9	55652.3	5413.6	50000	$300,000	Over 100%, > 3% contribution
213912	PRINTZ 230.kV	115	S	121.7	110.9	10.8	60833.8	55438.2	5395.6	50000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1015.1 upgrades Printz 230kV Bkr #115 in 2015.
214075	GRAYSFRY 230.kV	115	S	104.6	100.9	3.7	46023.4	44400.3	1623.1	44000	Existing Baseline Project	Over 100%, > 3% contribution Existing project b1398.12 replaces Grays Ferry 230kV Bkr # 115 in 2015.
214075	GRAYSFRY 230.kV	805	S	104.6	100.9	3.7	46023.3	44400.3	1623	44000	$300,000	Over 100%, > 3% contribution
									Bkr Replacement Cost:		$600,000	

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)

None

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

To be determined

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

None

Contribution to Previously Identified System Reinforcements
(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Delivery of Energy Portion of Interconnection Request
PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

Not Applicable