

#U1-013 Eddystone 700 MW  
**Generator Interconnection**

**This analysis was completed to assess the reliability impact for a new generator interconnecting to the PJM System as a Capacity Resource.**

### ***Network Impacts***

The U1-013 project was studied as a 700 MW Capacity injection into the Eddystone 230 kV bus. Project U1-013 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

## NETWORK IMPACTS

### **Generator Deliverability**

*(Normal System with all facilities in-service and Single, or N-1, contingencies for the Capacity portion only of the interconnection)*

1. The Master – North Philadelphia 230 kV line #220-44 loads from **82.2% to 102.8%** of its normal rating (760MVA) for non-contingency condition. This project contributes approximately **156.9 MW** to cause this thermal violation.
2. The Grays Ferry – Tunnel 230 kV line loads from **99.5% to 120.5%** of its normal rating (1239MVA) for non-contingency condition. This project contributes approximately **260.5 MW** to cause this thermal violation.
3. The Tunnel - Parrish 230kV line loads from **97.0% to 118.0%** of its normal rating (1239MVA) for non-contingency condition. This project contributes approximately **260.5 MW** to cause this thermal violation.

### **Multiple Facility Contingency**

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

4. The Parrish – Master 230 kV line #220-45 loads from **98.95% to 117.17%** of its emergency rating (874MVA) for tower line outage contingency PE506. This project contributes approximately **159.3 MW** to cause this thermal violation.
5. The Foulk - Concord 230 kV line loads from **97.85% to 100.23%** of its emergency rating (1335MVA) for tower line outage contingency PE500. This project contributes approximately **31.9 MW** to cause this thermal violation.

## Short Circuit Analysis

The following circuit breakers were found to be overdutied (fault current exceeds interrupting rating) as a result of the addition of Queue U1-013 generation:

6. Eddystone CB #365
7. Eddystone CB #785
8. Grays Ferry CB #275
9. Eddystone CB #235
10. Printz CB #125
11. Printz CB #215
12. Printz CB #225
13. Printz CB #315
14. Printz CB #115
15. Grays Ferry CB #115
16. Grays Ferry CB #705
17. Grays Ferry CB #985
18. Chichester CB #195
19. Grays Ferry CB #775

## Stability Analysis

Will be performed for the Impact Study.

## 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)*

20. The Printz – Ridley 230 kV line #220-46 loads from **135.70% to 161.30%** of its emergency rating (1432MVA) for the single line outage of Eddystone – Island Road 230 kV line #220-23 including Island Road 230-138 kV transformer #6 (Contingency PE23). This project contributes approximately **366.6 MW** to the thermal violation.
21. The Eddystone – Island Road 230 kV line loads from **127.67% to 148.09%** of its emergency rating (1410MVA) for the single contingency outage of the Morton – Ridley - MacDade 230 kV line #220-46 including Morton 230/13.8 kV transformer #2 and MacDade 230/13.8 kV transformer #1 (Contingency: PE46). This project contributes approximately **287.9 MW** to the thermal violation.
22. The Ridley – MacDade 230 kV line #220-46 loads from **120.38% to 136.97%** of its emergency rating (1432MVA) for the single contingency outage of the Eddystone – Island Road 230 kV #220-23 line including Island Road 230/13.8 transformer #7 (Contingency: PE23). This project contributes approximately **237.6 MW** to the thermal violation.

23. The Parrish – Master 230 kV line #220-45 loads from **101.24% to 122.88%** of its normal rating (736MVA) for a non-contingency, normal system condition. This project contributes approximately **159.3 MW** to the thermal violation.
24. The MacDade – Elmwood 230 kV line #220-40 loads from **119.88% to 137.62%** of its emergency rating (1339MVA) for the single contingency outage of the Eddystone – Island Road 230 kV #220-23 line including Island Road 230/13.8 transformer #7 (Contingency: PE23). This project contributes approximately **237.6 MW** to the thermal violation.
25. The Island Road – Grays Ferry 230 kV line #220-75 loads from **114.72% to 134.46%** of its emergency rating (1374MVA) for the single contingency outage of the Morton – Ridley - MacDade 230 kV line #220-46 including Morton 230/13.8 kV transformer #2 and MacDade 230/13.8 kV transformer #1 (Contingency: PE46). This project contributes approximately **271.2 MW** to the thermal violation.
26. The Eddystone – Printz 230 kV line #220-78 loads from **122.61% to 153.51%** of its emergency rating (1193MVA) for the single contingency outage of the Eddystone – Island Road 230 kV #220-23 line including Island Road 230/13.8 transformer #7 (Contingency: PE23). This project contributes approximately **368.7 MW** to the thermal violation.
27. The Elmwood – Grays Ferry 230 kV line #220-37 loads from **115.08% to 132.83%** of its emergency rating (1339MVA) for the single contingency outage of the Eddystone – Island Road 230 kV #220-23 line including Island Road 230/13.8 transformer #7 (Contingency: PE23). This project contributes approximately **237.6 MW** to the thermal violation.
28. The Chichester – Saville 138 kV line #130-50 loads from **101.13% to 105.42%** of its emergency rating (323MVA) for the single contingency outage (PECOH). This project contributes approximately **13.9 MW** to the thermal violation.
29. The Mickleton – Monroe 230 kV line #2304 loads from **195.21% to 199.83%** of its emergency rating (446MVA) for the single contingency outage of the Mickleton – Monroe 230 kV line #2316 (Contingency: AE2\_A19). This project contributes approximately **20.6 MW** to the thermal violation.
30. The Mickleton – Monroe 230 kV line #2316 loads from **195.21% to 199.83%** of its emergency rating (446MVA) for the single contingency outage of the Mickleton – Monroe 230 kV line #2304 (Contingency: AE12). This project contributes approximately **20.6 MW** to the thermal violation.
31. The Master – North Philadelphia 230 kV line loads from **107.00% to 128.91%** of its emergency rating (882MVA) for the single contingency outage of the Concord

- Lenape 230 kV line #2270 including concord 230/34 kV transformer #1 and Lenape 230/34 kV transformer # 2 (Contingency: PE69). This project contributes approximately **193.3 MW** to the thermal violation.
32. The Grays Ferry - Tunnel 230 kV line loads from **118.85% to 142.42%** of its emergency rating (1395MVA) for the single contingency outage of the Concord – Lenape 230 kV line #2270 including concord 230/34 kV transformer #1 and Lenape 230/34 kV transformer # 2 (Contingency: PE69). This project contributes approximately **328.9 MW** to the thermal violation.
  33. The Tunnel – Parrish 230 kV line loads from **116.60% to 140.18%** of its emergency rating (1395MVA) for the single contingency outage of the Concord – Lenape 230 kV line #2270 including concord 230/34 kV transformer #1 and Lenape 230/34 kV transformer # 2 (Contingency: PE69). This project contributes approximately **328.9 MW** to the thermal violation.
  34. The North Meshoppen 230/115 kV transformer #3 loads from **218.37% to 223.53%** of its emergency rating (157MVA) for the single contingency outage of the North Meshoppen – East Towanda 230 kV line including North Meshoppen 230/115 kV transformer #4 (Contingency: PN47B). This project contributes approximately **8.1 MW** to the thermal violation.
  35. The Ridley - Morton 230 kV line loads from **135.64% to 160.08%** of its emergency rating (613MVA) for the single line contingency outage of the Foulk – Chichester 230kV line including the Foulk 230/13.8 kV transformer (Contingency: PE4). This project contributes approximately **149.8 MW** to the thermal violation.
  36. The Mickleton – Thorofare 230 kV line loads from **249.86% to 254.87%** of its emergency rating (566MVA) for the tower line outage contingency (4AE\_A19). This project contributes approximately **28.4 MW** to the thermal violation.
  37. The Chichester – Foulk 230 kV line # 220-04 loads from **100.63% to 103.01%** of its emergency rating (1335MVA) for the tower line contingency outage (PE500). This project contributes approximately **31.9 MW** to the thermal violation.
  38. The Conastone – North Northwest 500 kV line loads from **202.28% to 208.11%** of its emergency rating (2901MVA) for the tower line outage of the Conastone – Mt Carmel – North Northwest 230 kV lines #2322 and #2310. (Contingency: CNSTN\_NWEST\_NNWEST\_A). This project contributes approximately **169.1 MW** to the thermal violation.
  39. The Rock Springs – Peach Bottom 500 kV line loads from **106.42% to 110.16%** of its emergency rating (3112MVA) for the tower line outage (Contingency: 1PS). This project contributes approximately **116.5 MW** to the thermal violation.

40. The Monroe – New Freedom 230 kV line loads from **161.22% to 165.74%** of its emergency rating (725MVA) for the single contingency outage of the Gloucester – Eagle Point 230 kV line including Gloucester 230/26 kV transformer #1 (PS18). This project contributes approximately **32.8 MW** to the thermal violation.
41. The Northwest – Granite 230 kV line # 2326 loads from **122.17% to 125.85%** of its emergency rating (1105MVA) for the single contingency outage of the Kemptown – North Northwest 500 kV line (Contingency: PJM13B\_NNWEST\_B). This project contributes approximately **40.7 MW** to the thermal violation.
42. The Northwest – Granite 230 kV line # 2311 loads from **118.97% to 122.58%** of its emergency rating (1105MVA) for the single contingency outage of the Kemptown – North Northwest 500 kV line (Contingency: PJM13B\_NNWEST\_B). This project contributes approximately **39.9 MW** to the thermal violation.
43. The Peach Bottom - Conastone 500 kV (existing) circuit 1 line loads from **118% to 121.77%** of its emergency rating (2598MVA) for the single contingency outage of the Peach Bottom - Conastone 500kV new circuit 2 line (Contingency: PJM17\_2). This project contributes approximately **98.1 MW** to the thermal violation.
44. The Peach Bottom – Conastone 500 kV (new) circuit 2 line loads from **118% to 121.77%** of its emergency rating (2598MVA) for the single line contingency outage of the Peach Bottom - Conastone 500kV (existing) circuit 1 line (Contingency: PJM17). This project contributes approximately **98.1 MW** to the thermal violation.
45. The Peach Bottom – Conastone 500 kV (new) circuit 3 line loads from **229.62% to 236.48%** of its emergency rating (2598MVA) for the tower line outage of the Peach Bottom – Conastone (existing) circuit 1 and (new) circuit 2 lines (Contingency: CONAS\_PB). This project contributes approximately **178.2 MW** to the thermal violation.
46. The Delco Tap - Mickleton 230 kV line overload increases by about **14%** of its emergency rating (725MVA) for the single contingency outage of the Tunnel – Parrish 230 kV line #220-27 including Parrish 230/13.8 transformer #3 and Grays Ferry 230/13.8 transformer #1 (PE27). This project contributes approximately **106.2 MW** to the thermal violation.

## NETWORK UPGRADE REQUIREMENTS

### General Notes pertaining to cost allocation rules for overloads: (also see the PJM Tariff and Manual 14)

*The first project to cause an overload has cost responsibility.*

*If this Queue is not the first project to cause the overload, a threshold of;*

*(a) 1% increase in overloaded facility loading must be caused by the this Queue generation,*

**and**

*(b) This Queue's MW contribution of 5.0 MW or greater are both required for cost allocation responsibility.*

**And**

*If this Queue is not the first project to cause the overload but both conditions (a) and (b) above are met, then a threshold of Either of the following are also required for cost allocation responsibility;*

*(c) A 5% generator DFAX\* (5 MW contribution for a generation request size of 100 MW),*

**or**

*(d) This Queue's generation must cause an increase of 5% (230 kV) or 10% (500 kV) to the overloaded facility loading*

*\* DFAX may not be equal to this Queue's contribution divided by generator MW size in some cases.*

### **New System Reinforcements**

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

#### **1. Master – North Philadelphia 230 kV Line 2.8% Normal Overload Upgrade:**

The total estimated cost of the upgrade is **\$14,000,000**. The lead time required for construction is **48 months**. At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause this overload and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study.

**Upgrade description:** The Master – North Philadelphia (220-44) 230 kV line currently has a normal rating of 760 MVA. This overload would require the tear

down and rebuild of this line to obtain a rating of 1243N/1410E MVA (\$9.0M). The appropriate terminal equipment would also need to be replaced (\$5.0M).

**Note: This upgrade is also a solution for number 31 below.**

2. **Grays Ferry – Tunnel 230 kV Line 20.5% Normal Overload Upgrade:**

The total estimated cost of the upgrade is **\$20,000,000**. The lead time required for construction is **48 months**. At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause this overload and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Grays Ferry – Tunnel (220-27gf-t) 230kV line currently has a normal rating of 1239 MVA. This overload would require the construction of a second aerial 230 kV line (\$5.0M). The substations would also need to be expanded (\$15M).

**Note: This upgrade is also a solution for number 32 below.**

3. **Tunnel – Parrish 230 kV Line 18% Normal Overload Upgrade:**

The total estimated cost of the upgrade is **\$33,000,000**. The lead time required for construction is **48 months**. At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause this overload and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Tunnel – Parrish (220-27p-t) 230kV line currently has a normal rating of 1239MVA. This overload would require the construction of a second 230kV line (underground).

**Note: This upgrade is also a solution for number 33 below.**

4. **Parrish – Master 230 kV Line 17.2% Contingency Overload Upgrade:**

The total estimated cost of the upgrade is **\$10,000,000**. The lead time required for construction is **36 months**. At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause this overload and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Parrish - Master (220-45) 230 kV line currently has an emergency rating of 874 MVA. This overload would require a line reconductoring (Amtrak right-of-way) at a cost of \$5.0M. The appropriate terminal equipment would also need to be replaced (\$5M).

**Note: This upgrade is also a solution for number 23 below.**

5. **Foulk – Concord 230 kV Line 0.23% Contingency Overload Upgrade:**

The total estimated cost of the upgrade is **\$2,000,000**. The lead time required for construction is **30 months**. At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause this overload and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Foulk – Concord (220-67) 230 kV line currently has an emergency rating of 1335 MVA. This overload would require the replacement of the appropriate terminal equipment.

Circuit breaker upgrades: numbers 6-19 below

At this point in time (at Queue U1-013 position) this Queue is identified to be the first to cause the overduty of the following breakers and will have a 100% cost allocation. If required, cost allocation will be performed for the Impact Study:

6. **Upgrade Eddystone CB #365 to 50kA rating:** - \$85,000 and 24 months
7. **Upgrade Eddystone CB #785 to 50kA rating:** - \$85,000 and 24 months
8. **Upgrade Grays Ferry CB #275 to 50kA rating:** - \$85,000 and 24 months
9. **Replace Eddystone CB #235 with a 63kA CB:** - \$250,000 and 30 months
10. **Replace Printz CB #125 with a 63kA CB:** - \$250,000 and 30 months
11. **Replace Printz CB #215 with a 63kA CB:** - \$250,000 and 30 months
12. **Replace Printz CB #225 with a 63kA CB:** - \$250,000 and 30 months
13. **Replace Printz CB #315 with a 63kA CB:** - \$250,000 and 30 months
14. **Replace Printz CB #115 with a 63kA CB:** - \$250,000 and 30 months
15. **Replace Grays Ferry CB #115 with a 63kA CB:** - \$250,000 and 30 months
16. **Upgrade Grays Ferry CB #705 to 50kA rating:** - \$85,000 and 24 months
17. **Upgrade Grays Ferry CB #985 to 50kA rating:** - \$85,000 and 24 months
18. **Replace Chichester CB #195 with a 63kA CB:** - \$250,000 and 30 months
19. **Upgrade Grays Ferry CB #775 to 50kA rating:** - \$85,000 and 24 months

## **Contribution to Previously Identified System Reinforcements**

*(This project contributes to the Network Impact causing the need for these Network Upgrades. This project will be allocated a cost to be determined during the Impact Study)*

### **20. Increased Overload (135.7% to 161.30%) to the Previously Overloaded Printz – Ridley 230 kV (220-46) Line:**

The total estimated cost of the upgrade is **\$55,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Printz – Ridley (220-46p-r) 230 kV line currently has an emergency rating of 1432 MVA. This overload would require the construction of a second 230 kV line underground (\$40M). The substations would also need to be expanded (\$15M).

### **21. Increased Overload (127.67% to 148.09%) to the Previously Overloaded The Eddystone – Island Road (220-23) 230kV Line:**

The total estimated cost of the upgrade is **\$85,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Eddystone – Island Road (220-23) 230 kV line currently has an emergency rating of 1410 MVA. This overload would require the construction of a second 230 kV line underground (\$70M). The substations would also need to be expanded (\$15M).

### **22. Increased Overload (120.38% to 136.97%) to the Previously Overloaded Ridley – MacDade (220-46r-mc) 230kV Line:**

The total estimated cost of the upgrade is **\$33,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Ridley – MacDade (220-46r-mc) 230 kV line currently has an emergency rating of 1432 MVA. This overload would require the construction of a second 230 kV line underground (\$18M). The substations would also need to be expanded (\$15M).

### **23. Increased Overload (101.24% to 122.88%) to the Previously Overloaded Parrish – Master 230 kV (220-45) line:**

**This overload is satisfied by previously identified upgrade for number 4 above.**

**24. Increased Overload (119.88% to 137.62%) to the Previously Overloaded MacDade – Elmwood (220-40) 230kV line:**

The total estimated cost of the upgrade is **\$67,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The MacDade – Elmwood (220-40) 230 kV line currently has an emergency rating of 1339 MVA. This overload would require the construction of a second 230 kV line underground (\$52M). The substations would also need to be expanded (\$15M).

**25. Increased Overload (114.72% to 134.46%) to the Previously Overloaded Island Road – Grays Ferry (220-75) 230kV line:**

The total estimated cost of the upgrade is **\$69,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Island Road – Grays Ferry (220-75) 230 kV line currently has an emergency rating of 1374 MVA. This overload would require the construction of a second 230 kV line underground (\$54M). The substations would also need to be expanded (\$15M).

**26. Increased Overload (122.61% to 153.51%) to the Previously Overloaded Eddystone – Printz (220-78) 230kV line:**

The total estimated cost of the upgrade is **\$16,000,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Eddystone – Printz (220-78) 230 kV line currently has an emergency rating of 1193 MVA. This overload would require the construction of a second aerial 230 kV line (\$1.0M). The substations would also need to be expanded (\$15M).

**27. Increased Overload (115.08% to 132.83%) to the Previously Overloaded Elmwood – Grays Ferry (220-37) 230kV line:**

The total estimated cost of the upgrade is **\$5,000,000**. The lead time required for construction is **30 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Elmwood – Grays Ferry (220-37) 230 kV line currently has an emergency rating of 1339 MVA. This overload would require the replacement of the appropriate terminal equipment.

**28. Increased Overload (101.13% to 105.42%) to the Previously Overloaded Chichester – Saville (130-50) 138kV line:**

The total estimated cost of the upgrade is **\$7,700,000**. The lead time required for construction is **48 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Chichester – Saville (130-50) 138 kV line currently has an emergency rating of 323 MVA. This overload would require a line reconductoring to reach a line rating of 456N/529E MVA.

**29. Increased Overload (195.21% to 199.83%) to the Previously Overloaded Mickleton - Monroe 230 kV (2304) line:**

The total estimated cost of the upgrade is **\$4,500,000**. The lead time required for construction is **30 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Mickleton-Monroe 230 kV (2304) line overload requires the reconductoring of the line with a high temperature ACSS/TW conductor.

**30. Increased Overload (195.21% to 199.83%) to the Previously Overloaded Mickleton - Monroe 230 kV (2316) line:**

The total estimated cost of the upgrade is **\$4,500,000**. The lead time required for construction is **30 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Mickleton-Monroe 230 kV (2316) line overload requires the reconductoring of the line with a high temperature ACSS/TW conductor.

31. **Increased Overload (107% to 128.91%) to the Previously Overloaded Master – North Philadelphia 230 kV line:**

This overload is also satisfied by the upgrade for number 1 above.

32. **Increased Overload (118.85% to 142.42%) to the Previously Overloaded Grays Ferry – Tunnel 230 kV line:**

This overload is also satisfied by the upgrade for number 2 above.

33. **Increased Overload (116.6% to 140.18%) to the Previously Overloaded Tunnel – Parrish 230 kV line:**

This overload is also satisfied by the upgrade for number 3 above.

34. **Increased Overload (218.37% to 222.53%) to the Previously Overloaded North Meshoppen 230/115 kV Transformer #3:**

The total estimated cost of the upgrade is **\$4,000,000**. The lead time required for construction is **24 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The North Meshoppen 230/115 kV transformer #3 rating is 146N/157E MVA. This overload would require the upgrade of the transformer and associated equipment (circuit breaker, substation conductor, CT circuits).

35. **Increased Overload (135.64% to 160.08%) to the Previously Overloaded Ridley – Morton (220-46r-m) 230 kV Line:**

The total estimated cost of the upgrade is **\$8,300,000**. The lead time required for construction is **42 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Ridley – Morton (220-46r-m) 230 kV line currently has an emergency rating of 613 MVA. This overload would require the addition of a second 230kV pipe type cable.

**36. Increased Overload (249.86% to 254.87%) to the Previously Overloaded Mickleton – Thorofare 230 kV Line:**

**Atlantic City Electric portion of the Mickleton – Thorofare Line:**

The total estimated cost of the upgrade is **\$4,100,000**. The lead time required for construction is **36 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Atlantic City Electric portion of the Mickleton – Thorofare 230kV line overload requires a rebuild and reconductor with a bundled conductor to alleviate the overload.

**PSE&G portion of the Mickleton – Thorofare Line:**

**TBD**

**37. Increased Overload (100.63% to 103.1%) to the Previously Overloaded Chichester – Foulk (220-04) 230 kV Line:**

The total estimated cost of the upgrade is **\$5,000,000**. The lead time required for construction is **30 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Chichester – Foulk (220-04) 230 kV line currently has an emergency rating of 1335 MVA limited by terminal equipment. This overload would require the replacement of the appropriate terminal equipment.

**38. Increased Overload (202.28% to 208.11%) to the Previously Overloaded Conastone – North Northwest 500 kV Line:**

The total estimated cost of the upgrade is **\$220,000,000**. The lead time required for construction is **120 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description:

Construct 2 new single circuit lines with the following assumptions:

- A new 200 ft. wide ROW paralleling the existing Conastone to Northwest ROW
- Total ROW length = 19.6 miles
- 3 - bundle 1,590 kcm conductor

- North Northwest substation will be located 4 miles north of Northwest substation

Additional substation work to include:

- Expand North Northwest and Conastone substations to accommodate 2 new lines.

**39. Increased Overload (106.42% to 110.16%) to the Previously Overloaded Rock Springs – Peach Bottom (5014) 500 kV line:**

The total estimated cost of the upgrade is **\$8,000,000**. The lead time required for construction is **36 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Rock Springs – Peach Bottom (5014) 500 kV line currently has an emergency rating of 3112 MVA. This overload would require the replacement of the appropriate terminal equipment.

**40. Increased Overload (161.22% to 165.74%) to the Previously Overloaded Monroe – New Freedom 230 kV Line:**

The total estimated cost of the upgrade is **\$16,600,000**. The lead time required for construction is **36 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Monroe – New Freedom 230 kV line overload requires a rebuild and reconductor of 6.91 miles with a bundled conductor.

**41. Increased Overload (122.17% to 125.85%) to the Previously Overloaded Northwest – Granite 230 kV (2326) Line:**

The total estimated cost of the upgrade is **\$16,600,000**. The lead time required for construction is **36 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Northwest – Granite 230 kV (2326) line overload would require the construction of a double circuit line with two 1033 ACSR conductors designed for 125°C operation with a new rating of 1240 MVA SE. The existing conductor is 1590 45/7 ACSR which is designed for 160°C operation. The line is 8.7 miles long.

**Note: This upgrade is also a solution for number 42 below.**

42. **Increased Overload (118.97% to 122.58%) to the Previously Overloaded Northwest – Granite 230 kV (2311) Line:**

**This overload is also satisfied by the upgrade for number 41 above.**

43. 44 and 45. **Increased Overload to the Three Previously Overloaded Peach Bottom – Conastone 500 kV Lines:**

The total estimated cost of the upgrade is **\$515,800,000**. The lead time required for construction is **84 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

**Upgrade description:**

**BG&E portion of the Conastone – Peach Bottom lines:**

Conastone Substation - 3 - 4 years to complete – total estimate for this work is \$39M

- Rebuild 3 existing bays to 4000A (also add breaker in one of the existing bays)
- Build new 4000A bay and install 3 breakers
- Relocate Hunterstown 500kV line
- Replace 4 inch bus with 5 inch

Transmission Line Component - 7 years to build after notice to proceed - total estimate for this work is \$320.2M

- 2 - Double Circuit 500 kV OH lines from Conastone - Graceton - MD line
- 2 - UG 230 kV circuits from Conastone - Graceton \*
- 3 - UG 230 kV circuits from Graceton - MD line
- 1 - UG 115 kV circuit from Graceton - Five Forks
- Acquire additional 50 ft. wide R/W Graceton - MD line
- Remove existing OH lines/structures

\* assumes RTEP project b0497 Install a second Conastone - Graceton 230 kV circuit

**PECO portion of the Conastone – Peach Bottom line:**

Assumes 500 kV lines with ratings equal to the rating of the 4 inch diameter aluminum bus work at Peach Bottom, i.e. 3366 MVA normal and 4183 MVA emergency are able to be built.

- Relocate Peach Bottom to Graceton 220-08 line to underground to facilitate construction of additional 500kV lines in the Conastone to Peach Bottom right of way. The estimated cost to perform this work is \$29.6M

- The underground line will require parallel pipe type cables to achieve a rating of 800MVA. The estimated cost to perform this work is \$61M and 36 months to complete.

Note: the 220-08 line is an offsite source for the Peach Bottom Atomic Power Station and its integrity must be maintained.

- Remove existing 220-08 line towers to clear the north side of the right of way for 500kV construction. The estimated cost to perform this work is \$1.5M and 6 months to complete.
- Construct new double circuit 500kV line on the north side of the 300 foot wide Peach Bottom to Maryland state line right of way. The estimated cost to perform this work is \$17M and 30 months to complete after the removal of the existing 230 kV tower line.
- Remove existing 5012 line towers to clear the south side of the right of way for new higher capacity 500kV lines. The estimated cost to perform this work is \$1.5M and 6 months to complete.
- Construct second new double circuit 500kV line on the south side of the Peach Bottom to Maryland state line right of way. The estimated cost to perform this work is \$17M and 30 months to complete after the removal of the existing 500 kV tower line.
- Upgrade 5012 line substation equipment to achieve the new higher rating. The estimated cost to perform this work is \$3M and 18 months to complete.
- Expand the 500kV substations (North and South) at Peach Bottom to accommodate three additional 500kV lines. The estimated cost to perform this work is \$18M (\$6M per new line) and 30 months to complete.
- Build a third new (fourth overall) 500kV overhead line for an estimated cost of \$15.0M. The Peach Bottom 500kV substation also needs to be expanded for an estimated cost of \$10M. The total estimated cost of this portion of the upgrade is \$25.0M and the time estimate to build the upgrade is 8 years.

Note: The substation work may have to be coordinated with refueling outages at the Peach Bottom Atomic Power Station and that the overall project may overstress several 500 kV circuit breakers.

These estimates do not include the cost for the new right-of-way required to build the new lines. It should be noted that this right-of-way could be very difficult or even impossible to acquire. If the proper right-of-way is not available this project would be essentially infeasible based on the current system model.

46. **Increased Overload (14%) to the Previously Overloaded Delco Tap – Mickleton 230 kV Line:**

The total estimated cost of the upgrade is **\$108,100,000**. The lead time required for construction is **36 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Delco Tap – Mickleton 230 kV line overload would require the rebuild and reconductor of the line section with bundled conductor. The Delaware River crossing section of this line will also require a rebuild and reconductor.

47. **Increased Overload (180.09% to 186.15%) to the Previously Overloaded Raphael Road – Northeast 230 kV Line:**

The total estimated cost of the upgrade is **\$4,000,000**. The lead time required for construction is **60 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

Upgrade description: The Raphael Road – Northeast 230 kV line overload would require a line reconductoring (\$3.0M) as well as the replacement of the appropriate substation terminal equipment (\$1.0M).