Generation Interconnection Feasibility Study Report

for

PJM Merchant Generation Interconnection Request Queue Position X3-028

Sullivan 765 kV

January/ 2013

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, the costs may be included in the study.

General

Grain Belt Express Clean Line, referred to as Developer in this document, proposes to interconnect 3500 MW at AEP's Sullivan 765 kV substation. Proposed interconnection location of X3-028 is shown in Figure 2. Planned in-service date is in fourth quarter of 2016.

The objective of this Feasibility Study is to provide preliminary cost estimates and a high level scope of network upgrades required to connect X3-028 to the AEP transmission system. This report includes both Attachment Facilities, required for interconnection, and Network Upgrades, required to resolve thermal or voltage constraints introduced or worsened by the interconnection. The network upgrades proposed have only been tested for violations that they are addressing and will be thoroughly tested during the impact study stage to ensure that the network upgrades do not in turn trigger new constraints on the transmission system.

There is usually a variance in results of AEP Transmission Planning's feasibility analysis when compared with PJM's. The reasons are described below:

1. AEP performs an AC analysis whereas PJM performs a DC analysis during the feasibility stage.

2. AEP runs all the available category B and category C contingencies including Category C3 contingencies, whereas PJM only analyzes Category B and common mode Category C outages.

3. PJM utilizes redispatch as an option to control facility loadings where applicable; however, AEP does not utilize this technique for the purposes of a high level feasibility study.

4. This report will be divided into an AEP section and a PJM Section due to the number of violations reported. There is also an appendix which discusses the Pioneer Project which affects this project.

The differences between AEP and PJM analysis are ratified during the impact study stage.

Point of Interconnection

X3-028 will interconnect with the AEP's Transmission system at the Sullivan 765 kV Substation.

Attachment Facilities

It is assumed that the Developer will be responsible for the converter station and the tie between AEP's 765 kV Sullivan station and Developer's converter station. 765 kV circuit breakers will be required at Sullivan substation (see Figure 1) to interconnect the project. Upgrades at Sullivan station would also include 765 kV metering, SCADA, and associated equipment in accordance with AEP current standards and practices. The cost estimates are preliminary in nature as they have been computed without engaging engineering and project management at AEP.

Cost

- 765 kV work at Sullivan station
  $9,000,000
- Relay package
  $2,500,000

Total Attachment Facilities Cost $11,500,000

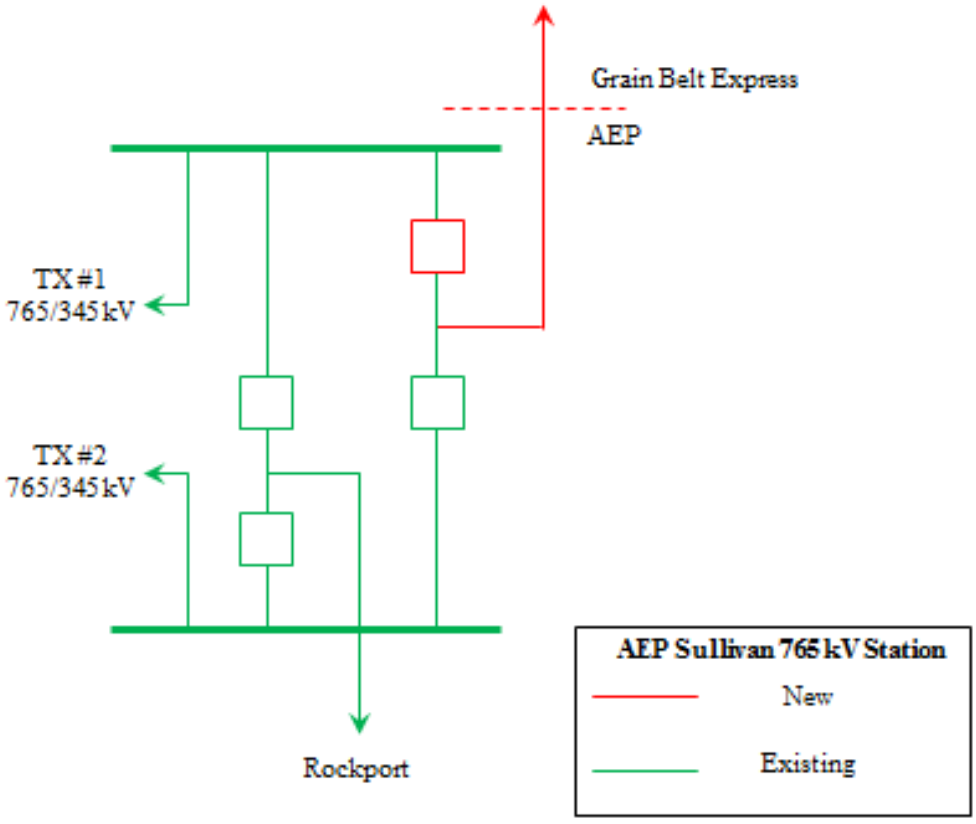

Figure 1. Single Line Diagram

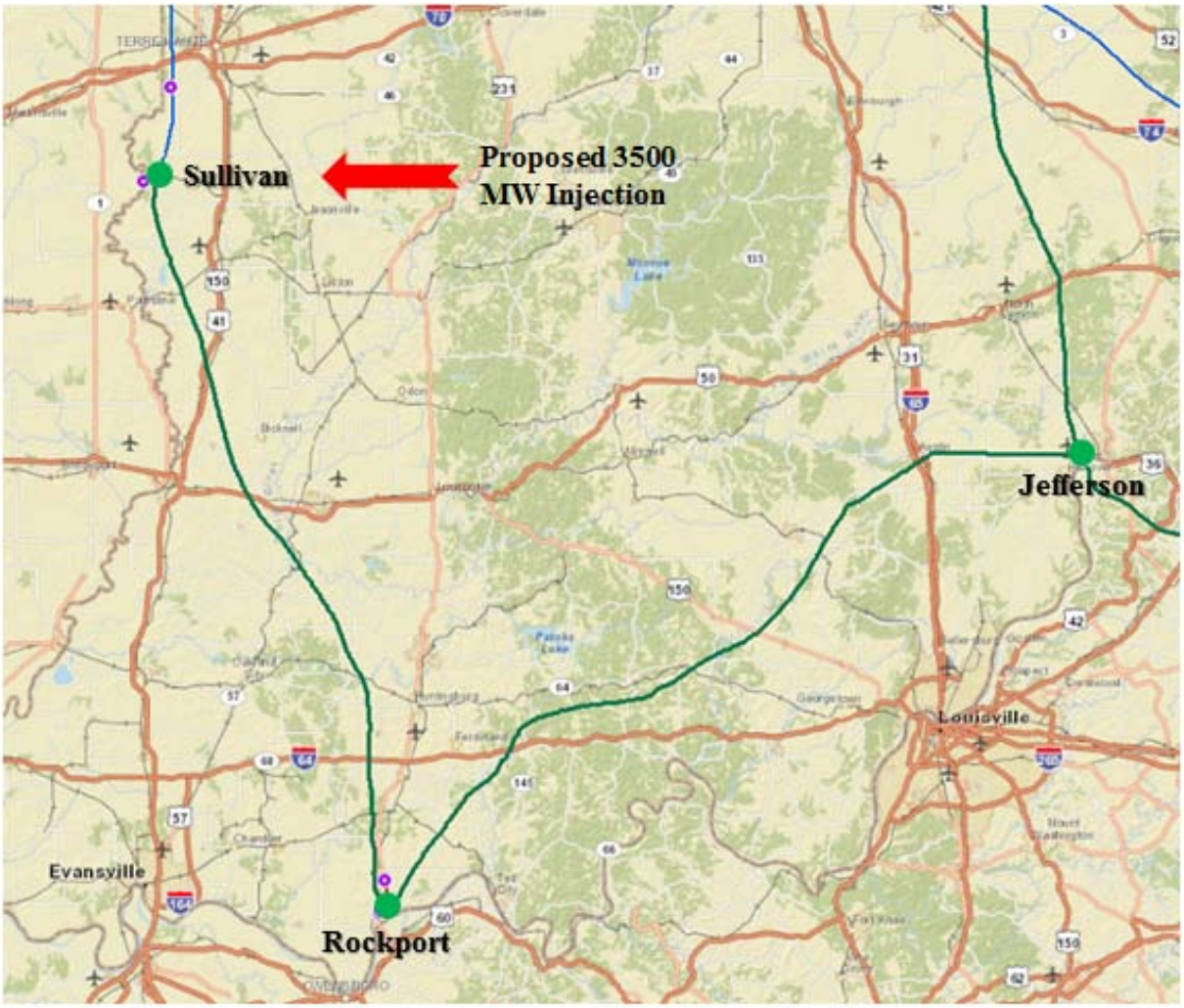

Figure 2. Single Line Diagram

Revenue Metering and SCADA Requirements

For PJM: IC will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

For AEP

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers.

PJM Analysis

Network Impacts

Queue project X3-028 was studied as a(n) 3500.0 MW (3500 MW of which was Capacity) injection into AEP's system at Sullivan 765 kV substation. Project X3-028 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Generator Deliverability

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

1. (BG&E) The Howard 2332-Granite 2326 & 2332 230 kV line (from bus 220954 to bus 220973 ckt 1) loads from 98.10% to 100.34% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 16.33 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

2. (AEP) The Sullivan-Breed 765/345 kV transformer (from bus 243210 to bus 243213 ckt 3) loads from 0.09% to 188.9% (DC power flow) of its emergency rating (1852 MVA) for the single contingency '16_B2'. This project contributes approximately 3500.00 MW to the thermal violation.

```
CONTINGENCY '16_B2'
  OPEN BRANCH FROM BUS 243209 TO BUS 243210 CKT 1          / 243209 05ROCKPT 765 243210 05SULLVA 765 1
  OPEN BRANCH FROM BUS 243210 TO BUS 243213 CKT 1          / 243210 05SULLVA 765 243213 05BREED 345 1
  OPEN BRANCH FROM BUS 243210 TO BUS 243213 CKT 2          / 243210 05SULLVA 765 243213 05BREED 345 2
END
```

3. (AEP) The Darwin-V3-032 TAP 345 kV line (from bus 243216 to bus 894660 ckt 1) loads from 82.83% to 162.13% (DC power flow) of its emergency rating (971 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 770.07 MW to the thermal violation.

```
CONTINGENCY '05JEFRSO _05ROCKPT _122'
  DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1     /* 765/765KV, AREA 205/205.
END
```

4. (AEP) The Mountaineer-Belmont 765 kV line (from bus 242516 to bus 242920 ckt 1) loads from 92.12% to 94.5% (DC power flow) of its emergency rating (4055 MVA) for the single contingency 'AMOS_WELTONSP'. This project contributes approximately 96.53 MW to the thermal violation.

```
CONTINGENCY 'AMOS_WELTONSP'
  DISCONNECT BRANCH FROM BUS 242508 TO BUS 235634 CKT 1
END
```

5. (PJM) The EMORY GR500-Conastone 500 kV line (from bus 200101 to bus 200004 ckt 1) loads from 89.07% to 91.41% (DC power flow) of its emergency rating (2901 MVA) for the

single contingency 'PJM67'. This project contributes approximately 67.81 MW to the thermal violation.

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

6. (PJM) The EMORY GR500-Conastone 500 kV line (from bus 200101 to bus 200004 ckt 1) loads from 82.29% to 85.09% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 65.46 MW to the thermal violation.

7. (DVP/AP) The Mount Storm 500 kV-T157_TAP 500 kV line (from bus 314917 to bus 292556 ckt 1) loads from 95.41% to 96.67% (DC power flow) of its emergency rating (2598 MVA) for the single contingency 'WELTONSP_KEMPTOWN'. This project contributes approximately 32.59 MW to the thermal violation.

```
CONTINGENCY 'WELTONSP_KEMPTOWN'
  DISCONNECT BRANCH FROM BUS 235634 TO BUS 235636 CKT 1
END
```

8. (BG&E/PL) The Graceton-Safe Harbor Units 3-4 Tap 230 kV line (from bus 220964 to bus 208071 ckt 1) loads from 93.54% to 96.49% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 14.41 MW to the thermal violation.

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

9. (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 92.41% to 93.84% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 6.99 MW to the thermal violation.

10. (BG&E/PECO) The Graceton-Cooper 230 kV line (from bus 220964 to bus 214089 ckt 1) loads from 74.13% to 76.25% (DC power flow) of its normal rating (379 MVA) for non contingency condition. This project contributes approximately 8.05 MW to the thermal violation.

11. (BG&E) The Columbia-Howard 2312 230 kV line (from bus 221010 to bus 220953 ckt 1) loads from 93.92% to 95.84% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EB'. This project contributes approximately 18.11 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1         / 200003 BRIGHTON 500 200004 CNASTONE 500 1
```

END

12. (AEP/IPL) The Breed-Wheatland (Enron) Plant 345 kV line (from bus 243213 to bus 254539 ckt 1) loads from 32.60% to 131.77% (DC power flow) of its emergency rating (956 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 948.04 MW to the thermal violation.

CONTINGENCY '05JEFRSO _05ROCKPT _122'
DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 765/765KV, AREA 205/205.*
END

13. (AEP) The V3-032 TAP-Eugene 345 kV line (from bus 894660 to bus 243221 ckt 1) loads from 84.33% to 163.64% (DC power flow) of its emergency rating (971 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 770.07 MW to the thermal violation.

CONTINGENCY '05JEFRSO _05ROCKPT _122'
DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 765/765KV, AREA 205/205.*
END

14. (AEP) The Kanawha-Carbondale 138 kV line (from bus 242689 to bus 242580 ckt 1) loads from 92.80% to 94.81% (DC power flow) of its emergency rating (251 MVA) for the single contingency 'AMOS_WELTONSP'. This project contributes approximately 5.04 MW to the thermal violation.

CONTINGENCY 'AMOS_WELTONSP'
DISCONNECT BRANCH FROM BUS 242508 TO BUS 235634 CKT 1
END

15. (FE) The Lakeview-Greenfield 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 95.64% to 99.28% (DC power flow) of its emergency rating (243 MVA) for the single contingency 'B_LINE_SY_21B'. This project contributes approximately 8.85 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_21B' / LINE 02DAV-BE TO 02HAYES 345 CK 1*
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 / 02DAV-BE 345.00 02HAYES 345.00*
END

16. (PL) The South Akron Transformer 3-South Akron Bus 230 kV line (from bus 208079 to bus 208078 ckt 1) loads from 80.96% to 82.95% (DC power flow) of its emergency rating (588 MVA) for the single contingency 'PJM17'. This project contributes approximately 11.74 MW to the thermal violation.

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

17. (PJM) The Rock Springs-Keeney 500 kV line (from bus 200051 to bus 200010 ckt 1) loads from 98.66% to 100.02% (DC power flow) of its emergency rating (3014 MVA) for the single contingency 'PJM40'. This project contributes approximately 41.19 MW to the thermal violation.

CONTINGENCY 'PJM40'
DISCONNECT BRANCH FROM BUS 200013 TO BUS 200024 CKT 1 / PEACHBTM LIMERICK 500 500*
END

18. (AEP) The Sullivan-Breed 765/345 kV transformer (from bus 243210 to bus 243213 ckt 2) loads from 58.17% to 136.19% (DC power flow) of its emergency rating (1680 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 1310.79 MW to the thermal violation.

CONTINGENCY '05JEFRSO _05ROCKPT _122'
DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 765/765KV, AREA 205/205.*
END

19. (AP) The T157_TAP-Doubs 500kV 500 kV line (from bus 292556 to bus 235105 ckt 1) loads from 95.86% to 97.11% (DC power flow) of its emergency rating (2598 MVA) for the single contingency 'WELTONSP_KEMPTOWN'. This project contributes approximately 32.48 MW to the thermal violation.

CONTINGENCY 'WELTONSP_KEMPTOWN'
DISCONNECT BRANCH FROM BUS 235634 TO BUS 235636 CKT 1
END

20. (AEP) The Muskingum River-Muskingum River 345/138 kV transformer (from bus 242940 to bus 243045 ckt A) loads from 94.49% to 95.69% (DC power flow) of its emergency rating (421 MVA) for the single contingency '4926_B1'. This project contributes approximately 5.05 MW to the thermal violation.

CONTINGENCY '4926_B1'
REMOVE UNIT 3 FROM BUS 243045 / 243045 05MUSKNG 138
END

21. (PJM) The U2-74 TAP-Rock Springs 500 kV line (from bus 293025 to bus 200051 ckt 1) loads from 93.61% to 95.27% (DC power flow) of its emergency rating (2611 MVA) for the single contingency 'PJM40'. This project contributes approximately 43.52 MW to the thermal violation.

CONTINGENCY 'PJM40'
DISCONNECT BRANCH FROM BUS 200013 TO BUS 200024 CKT 1 / PEACHBTM LIMERICK 500 500*
END

~~22. (CPLE/DVP) The Person 230-Halifax 230 kV 230 kV line (from bus 304070 to bus 314697 ckt 1) loads from 88.74% to 91.91% (DC power flow) of its emergency rating (608 MVA) for the single contingency '8CARSON _8DBGEN _014_X2-076A'. This project contributes approximately 19.30 MW to the thermal violation.~~

~~*CONTINGENCY '8CARSON _8DBGEN _014_X2-076A'*~~
~~*DISCONNECT BRANCH FROM BUS 314902 TO BUS 909840 CKT 1 /* 500/500KV, AREA 345/340.*~~
~~*END*~~

23. (CE) The Pontiac Mid-Point-Dresden (Red) 345 kV line (from bus 270853 to bus 270717 ckt 1) loads from 92.01% to 93.54% (DC power flow) of its normal rating (1245 MVA) for non

contingency condition. This project contributes approximately 18.98 MW to the thermal violation.

~~24. (PL) The Safe Harbor Units 3-4 Tap-Manor Substation 230 kV line (from bus 208071 to bus 208019 ckt 1) loads from 77.78% to 79.02% (DC power flow) of its normal rating (463 MVA) for non-contingency condition. This project contributes approximately 5.77 MW to the thermal violation.~~

25. (AEP) The Sullivan-Breed 765/345 kV transformer (from bus 243210 to bus 243213 ckt 1) loads from 48.99% to 114.68% (DC power flow) of its emergency rating (1650 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 1083.92 MW to the thermal violation.

```
CONTINGENCY '05JEFRSO _05ROCKPT _122'
  DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1     /* 765/765KV, AREA 205/205.
END
```

26. (AEP) The Selma Parker-SELMAPRK 138/69 kV transformer (from bus 243373 to bus 246901 ckt 1) loads from 76.00% to 83.5% (DC power flow) of its emergency rating (81 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 6.08 MW to the thermal violation.

```
CONTINGENCY '05JEFRSO _05ROCKPT _122'
  DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1     /* 765/765KV, AREA 205/205.
END
```

27. (BG&E) The Granite 2311 & 2312-North West 2311 & 2310 230 kV line (from bus 220972 to bus 220962 ckt 1) loads from 89.96% to 92.65% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 16.68 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'     / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

28. (AEP/AMIL) The Breed-Casey West 345 kV East Bus 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 57.66% to 138.5% (DC power flow) of its emergency rating (1466 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 1185.14 MW to the thermal violation.

```
CONTINGENCY '05JEFRSO _05ROCKPT _122'
  DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1     /* 765/765KV, AREA 205/205.
END
```

29. (FE) The Ottawa-Lakeview 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 92.60% to 95.21% (DC power flow) of its emergency rating (339 MVA) for the single contingency 'B_LINE_SY_21B'. This project contributes approximately 8.85 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_21B' / LINE 02DAV-BE TO 02HAYES 345 CK 1*
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 / 02DAV-BE 345.00 02HAYES 345.00*
END

30. (AEP) The Breed-Dequine 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 96.81% to 153.21% (DC power flow) of its emergency rating (972 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 548.24 MW to the thermal violation.

CONTINGENCY '05JEFRSO _05ROCKPT _122'
DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 765/765KV, AREA 205/205.*
END

~~31. (PL) The Millwood Transformer #2-Millwood Transformer #1 230 kV line (from bus 208031 to bus 208030 ckt 1) loads from 85.24% to 87.11% (DC power flow) of its emergency rating (588 MVA) for the single contingency 'PJM17'. This project contributes approximately 10.99 MW to the thermal violation.~~

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

~~32. (AEP) The Rockport-Jefferson 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 59.21% to 95.91% (DC power flow) of its emergency rating (4055 MVA) for the single contingency '667_B2_TOR1697'. This project contributes approximately 1488.48 MW to the thermal violation.~~

~~*CONTINGENCY '667_B2_TOR1697'*~~
~~*OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1 / 243213 05BREED 345 243217 05DEQUIN 345 1*~~
~~*END*~~

33. (CE) The Latham Tap Of Kincaid-Pontiac Midpoint Line. Ip T-W4-005 TAP 345 kV line (from bus 270804 to bus 905040 ckt 1) loads from 98.66% to 100.43% (DC power flow) of its emergency rating (1334 MVA) for the single contingency '345-L8001___-S'. This project contributes approximately 23.57 MW to the thermal violation.

CONTINGENCY '345-L8001___-S' / CONTINGENCY # 734
TRIP BRANCH FROM BUS 270853 TO BUS 348847 CKT 1 / PONTI; R 345 7BROKAW T1 345
END

34. (AEP) The Breed-Darwin 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 82.74% to 161.97% (DC power flow) of its emergency rating (972 MVA) for the single contingency '05JEFRSO _05ROCKPT _122'. This project contributes approximately 770.07 MW to the thermal violation.

CONTINGENCY '05JEFRSO _05ROCKPT _122'
DISCONNECT BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 765/765KV, AREA 205/205.*
END

35. (CE) The Blue Mound (Blue)-Pontiac Mid-Point 345 kV line (from bus 270668 to bus 270852 ckt 1) loads from 95.86% to 97.38% (DC power flow) of its emergency rating (1528

MVA) for the single contingency '345-L8001___-S'. This project contributes approximately 23.29 MW to the thermal violation.

```
CONTINGENCY '345-L8001___-S'    / CONTINGENCY # 734
  TRIP BRANCH FROM BUS 270853 TO BUS 348847 CKT 1          / PONTI; R 345 7BROKAW T1 345
END
```

36. (PL) The Millwood Transformer #1-South Akron Transformer 3 230 kV line (from bus 208030 to bus 208079 ckt 1) loads from 98.81% to 100.81% (DC power flow) of its emergency rating (588 MVA) for the single contingency 'PJM17'. This project contributes approximately 11.78 MW to the thermal violation.

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

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

37. (AEP) The W BETHSD-BELMONT 69 kV line (from bus 245025 to bus 244980 ckt 1) loads from 97.63% to 100.09% (DC power flow) of its emergency rating (32 MVA) for the tower contingency '476'. This project contributes approximately 0.78 MW to the thermal violation.

```
CONTINGENCY '476'
  OPEN BRANCH FROM BUS 242931 TO BUS 242946 CKT 1          / 242931 05BEVERL 345 242946 05TIDD 345 1
  OPEN BRANCH FROM BUS 242937 TO BUS 242948 CKT 1          / 242937 05KAMMER 345 242948 05WBELLA 345 1
  OPEN BRANCH FROM BUS 242946 TO BUS 242948 CKT 1          / 242946 05TIDD 345 242948 05WBELLA 345 1
  OPEN BRANCH FROM BUS 242948 TO BUS 243143 CKT 1          / 242948 05WBELLA 345 243143 05WBELLA 138 1
END
```

38. (BG&E) The Pumphrey-Pumphrey 230/115 kV transformer (from bus 220974 to bus 221037 ckt 1) loads from 93.36% to 95.2% (DC power flow) of its emergency rating (485 MVA) for the tower contingency 'WCHPL_BRNDN'. This project contributes approximately 8.92 MW to the thermal violation.

```
CONTINGENCY 'WCHPL_BRNDN'    /* WAUGH CHAPEL TO BRANDON SHORES CKTS #2342 & #2343
  DISCONNECT BRANCH FROM BUS 220955 TO BUS 220960 CKT 42    /* CKT #2342 W. CHAPEL TO BRANDON SHORES
  DISCONNECT BRANCH FROM BUS 220955 TO BUS 220960 CKT 43    /* CKT #2343 W. CHAPEL TO BRANDON SHORES
END
```

39. (AEP) The OHIO CTR-DRESDEN8 69 kV line (from bus 245338 to bus 245323 ckt 1) loads from 99.85% to 101.4% (DC power flow) of its emergency rating (76 MVA) for the tower contingency '478'. This project contributes approximately 1.18 MW to the thermal violation.

```
CONTINGENCY '478'
  OPEN BRANCH FROM BUS 243070 TO BUS 243094 CKT 1          / 243070 05OHIOCT 138 243094 05SCOSHC 138 1
  OPEN BRANCH FROM BUS 243070 TO BUS 243145 CKT 1          / 243070 05OHIOCT 138 243145 05WCOSHC 138 1
END
```

40. (PEPCO/BG&E) The Bowie 043-Bowiebc1 2341 230 kV line (from bus 223980 to bus 220956 ckt 1) loads from 95.47% to 96.63% (DC power flow) of its emergency rating (721

MVA) for the tower contingency 'HIRDG_BURTVL'. This project contributes approximately 8.37 MW to the thermal violation.

```
CONTINGENCY 'HIRDG_BURTVL'    /* HIGH RIDGE TO BURTONSVILLE CKTS #2314 & #2334
  DISCONNECT BUS 220983                    /* CKT #2314 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-2
  DISCONNECT BUS 220984                    /* CKT #2334 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-1
END
```

41. (AEP) The Gomingo-Monel 138 kV line (from bus 242652 to bus 242719 ckt 1) loads from 99.37% to 100.62% (DC power flow) of its emergency rating (388 MVA) for the tower contingency '417'. This project contributes approximately 4.85 MW to the thermal violation.

```
CONTINGENCY '417'
  OPEN BRANCH FROM BUS 242627 TO BUS 242688 CKT 1        / 242627 05E.LYNC 138 242688 05JOSHUA 138 1
  OPEN BRANCH FROM BUS 242688 TO BUS 242737 CKT 1        / 242688 05JOSHUA 138 242737 05OPOSSC 138 1
END
```

42. (AEP) The Ohio Central-OHIO CTR 138/69 kV transformer (from bus 243070 to bus 245338 ckt 1) loads from 98.63% to 100.16% (DC power flow) of its emergency rating (77 MVA) for the tower contingency '478'. This project contributes approximately 1.18 MW to the thermal violation.

```
CONTINGENCY '478'
  OPEN BRANCH FROM BUS 243070 TO BUS 243094 CKT 1        / 243070 05OHIOCT 138 243094 05SCOSHC 138 1
  OPEN BRANCH FROM BUS 243070 TO BUS 243145 CKT 1        / 243070 05OHIOCT 138 243145 05WCOSHC 138 1
END
```

43. (FE) The Brookside-Troy 138 kV line (from bus 238586 to bus 239216 ckt 1) loads from 96.19% to 100.24% (DC power flow) of its emergency rating (135 MVA) for the tower contingency 'C5-TWL-CR040'. This project contributes approximately 5.46 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'    /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1    /* 02DAV-BE 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

~~44. (FE) The Troy-Brighton 138 kV line (from bus 239216 to bus 239215 ckt 1) loads from 94.53% to 98.58% (DC power flow) of its emergency rating (135 MVA) for the tower contingency 'C5-TWL-CR040'. This project contributes approximately 5.46 MW to the thermal violation.~~

```
~~CONTINGENCY 'C5-TWL-CR040'    /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1    /* 02DAV-BE 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END~~
```

45. (FE) The 02CAMDEN-Firelands 138 138 kV line (from bus 239319 to bus 239318 ckt 1) loads from 91.55% to 95.6% (DC power flow) of its emergency rating (135 MVA) for the tower contingency 'C5-TWL-CR040'. This project contributes approximately 5.46 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'    /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1    /* 02DAV-BE 345.00 02HAYES 345.00
```

```
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1     /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

46. (AEP) The SPEIDEL-W BETHSD 69 kV line (from bus 245018 to bus 245025 ckt 1) loads from 97.95% to 100.4% (DC power flow) of its emergency rating (32 MVA) for the tower contingency '476'. This project contributes approximately 0.78 MW to the thermal violation.

```
CONTINGENCY '476'
  OPEN BRANCH FROM BUS 242931 TO BUS 242946 CKT 1          / 242931 05BEVERL 345 242946 05TIDD 345 1
  OPEN BRANCH FROM BUS 242937 TO BUS 242948 CKT 1          / 242937 05KAMMER 345 242948 05WBELLA 345 1
  OPEN BRANCH FROM BUS 242946 TO BUS 242948 CKT 1          / 242946 05TIDD 345 242948 05WBELLA 345 1
  OPEN BRANCH FROM BUS 242948 TO BUS 243143 CKT 1          / 242948 05WBELLA 345 243143 05WBELLA 138 1
END
```

47. (AEP) The North Delphos-North Delphos 138/69 kV transformer (from bus 243051 to bus 243175 ckt 1) loads from 99.56% to 100.88% (DC power flow) of its emergency rating (120 MVA) for the tower contingency '6677'. This project contributes approximately 1.58 MW to the thermal violation.

```
CONTINGENCY '6677'
  OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1          / 242989 05E LIMA 138 243017 05HAVILN 138 1
  OPEN BRANCH FROM BUS 242991 TO BUS 243051 CKT 1          / 242991 05E SIDE 138 243051 05NDELPH 138 1
END
```

48. (AEP/AP) The Tiltonsville-Windsor 138 kV line (from bus 243131 to bus 235428 ckt 1) loads from 91.10% to 93.36% (DC power flow) of its emergency rating (284 MVA) for the tower contingency 'AP_C5_25'. This project contributes approximately 6.40 MW to the thermal violation.

```
CONTINGENCY 'AP_C5_25'    /TIDD-WR_TIDD-COL
  OPEN BRANCH FROM BUS 235707 TO BUS 242946 CKT 1
  OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1
END
```

49. (PEPCO/BG&E) The Bowie 044-Bowiebc0 2340 230 kV line (from bus 223979 to bus 220959 ckt 1) loads from 97.88% to 99.06% (DC power flow) of its emergency rating (720 MVA) for the tower contingency 'HIRDG_BURTVL'. This project contributes approximately 8.51 MW to the thermal violation.

```
CONTINGENCY 'HIRDG_BURTVL'    /* HIGH RIDGE TO BURTONSVILLE CKTS #2314 & #2334
  DISCONNECT BUS 220983                    /* CKT #2314 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-2
  DISCONNECT BUS 220984                    /* CKT #2334 HIGH RIDGE – BURTONSVILLE & SANDY SPRINGS 230-1
END
```

50. (BG&E) The Howard 2332-Pumphrey 230 kV line (from bus 220954 to bus 220974 ckt 1) loads from 93.55% to 95.39% (DC power flow) of its emergency rating (485 MVA) for the tower contingency 'WCHPL_BRNDN'. This project contributes approximately 8.92 MW to the thermal violation.

```
CONTINGENCY 'WCHPL_BRNDN'    /* WAUGH CHAPEL TO BRANDON SHORES CKTS #2342 & #2343
  DISCONNECT BRANCH FROM BUS 220955 TO BUS 220960 CKT 42    /* CKT #2342 W. CHAPEL TO BRANDON SHORES
  DISCONNECT BRANCH FROM BUS 220955 TO BUS 220960 CKT 43    /* CKT #2343 W. CHAPEL TO BRANDON SHORES
END
```

51. (AEP) The Rockport-Jefferson 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 60.61% to 99.83% (DC power flow) of its emergency rating (4253 MVA) for the tower contingency '431_V3-032B'. This project contributes approximately 1668.17 MW to the thermal violation.

```
CONTINGENCY '431_V3-032B'
  OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1          / 243213 05BREED 345 243217 05DEQUIN 345 1
  OPEN BRANCH FROM BUS 894660 TO BUS 243221 CKT 1          / 243216 05DARWIN 345 243221 05EUGENE 345 1
END
```

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.)

52. (BG&E) The High Ridge 2316-Howard 2332 230 kV line (from bus 220941 to bus 220954 ckt 1) loads from 116.79% to 119.03% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EB'. This project contributes approximately 21.16 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

53. (PECO) The Nottingham Reactor-Nottingham 230 kV line (from bus 213846 to bus 213844 ckt 1) loads from 104.07% to 107.02% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.48 MW to the thermal violation.

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

54. (PENELEC) The X1-109 TAP-North Meshoppen 230 kV line (from bus 907910 to bus 200706 ckt 1) loads from 137.63% to 139.01% (DC power flow) of its emergency rating (549 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 7.56 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-XF-#133A_X1_018_A'     /* LEWISTOWN 230/115KV BANK #3 FAULT
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END
```

55. (PENELEC) The X1-109 TAP-North Meshoppen 230 kV line (from bus 907910 to bus 200706 ckt 1) loads from 139.46% to 140.9% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 7.03 MW to the thermal violation.

56. (PENELEC) The Roxbury-Roxbury 138/115 kV transformer (from bus 200532 to bus 200520 ckt 1) loads from 120.23% to 124.14% (DC power flow) of its emergency rating (138 MVA) for the single contingency 'PP1EB'. This project contributes approximately 5.40 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

57. (FE) The 02HAYES-Avery 138 kV line (from bus 239290 to bus 238549 ckt 1) loads from 135.87% to 138.77% (DC power flow) of its emergency rating (195 MVA) for the tower contingency 'C5-TWL-CR041'. This project contributes approximately 5.65 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'    /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1    /* 02BEAVER 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

58. (AEP) The Desoto-Desoto 345/138 kV transformer (from bus 243218 to bus 243278 ckt 1) loads from 101.53% to 102.82% (DC power flow) of its emergency rating (807 MVA) for the tower contingency '444'. This project contributes approximately 10.41 MW to the thermal violation.

```
CONTINGENCY '444'
  OPEN BRANCH FROM BUS 243218 TO BUS 243225 CKT 1          / 243218 05DESOTO 345 243225 05KEYSTN 345 1
  OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2          / 243218 05DESOTO 345 243232 05SORENS 345 2
  OPEN BRANCH FROM BUS 243218 TO BUS 243233 CKT 1          / 243218 05DESOTO 345 243233 05TANNER 345 1
END
```

59. (BG&E/PL) The Conastone-Otter Creek Switchyard 230 kV line (from bus 220963 to bus 208048 ckt 1) loads from 150.91% to 154.44% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 19.00 MW to the thermal violation.

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

60. (BG&E) The Sandy Spring 2314-High Ridge 2316 230 kV line (from bus 220983 to bus 220941 ckt 1) loads from 101.64% to 103.6% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EB'. This project contributes approximately 18.47 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

~~61. (DP&L) The Sugarcreek-Bellbrook 138 kV line (from bus 253078 to bus 253007 ckt 1) loads from 103.01% to 104.81% (DC power flow) of its emergency rating (375 MVA) for the tower contingency '493'. This project contributes approximately 6.78 MW to the thermal violation.~~

```
~~CONTINGENCY '493'~~
```

~~OPEN BRANCH FROM BUS 249566 TO BUS 253006 CKT 1 / 249566 08FOSTER 345 253006 09BATH 345 1~~
~~OPEN BRANCH FROM BUS 253027 TO BUS 253079 CKT 1 / 253027 09GREENE 345 253079 09SUGRCK 345 1~~
~~END~~

62. (AEP) The Keystone-Sorenson 345 kV line (from bus 243225 to bus 243232 ckt 1) loads from 114.82% to 116.3% (DC power flow) of its emergency rating (897 MVA) for the single contingency '4814_B2'. This project contributes approximately 13.31 MW to the thermal violation.

CONTINGENCY '4814_B2'
OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2
END

63. (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 139.44% to 140.97% (DC power flow) of its emergency rating (608 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 9.34 MW to the thermal violation.

CONTINGENCY 'B_PN230-XF-#133A_X1_018_A' / LEWISTOWN 230/115KV BANK #3 FAULT*
DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END

64. (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 156.14% to 157.97% (DC power flow) of its normal rating (478 MVA) for non contingency condition. This project contributes approximately 8.74 MW to the thermal violation.

65. (AEP) The Waterford-Muskingum River 345 kV line (from bus 242947 to bus 242940 ckt 1) loads from 106.44% to 107.73% (DC power flow) of its emergency rating (1806 MVA) for the single contingency 'AMOS_WELTONSP'. This project contributes approximately 23.57 MW to the thermal violation.

CONTINGENCY 'AMOS_WELTONSP'
DISCONNECT BRANCH FROM BUS 242508 TO BUS 235634 CKT 1
END

66. (BG&E/PECO) The Graceton-Cooper 230 kV line (from bus 220964 to bus 214089 ckt 1) loads from 146.57% to 150.38% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.48 MW to the thermal violation.

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

67. (AEP) The Eugene-Dequine 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 120.71% to 150.03% (DC power flow) of its emergency rating (972 MVA) for the single

contingency '667_B2_TOR1697'. This project contributes approximately 284.97 MW to the thermal violation.

```
CONTINGENCY '667_B2_TOR1697'
  OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1          / 243213 05BREED 345 243217 05DEQUIN 345 1
END
```

68. (CE) The Cayuga Ridge (Blue)-Wilton Center (Blue) 345 kV line (from bus 270704 to bus 270926 ckt 1) loads from 136.12% to 138.11% (DC power flow) of its emergency rating (1280 MVA) for the single contingency '345-L8014_T_-S'. This project contributes approximately 25.52 MW to the thermal violation.

```
CONTINGENCY '345-L8014_T_-S'    / CONTINGENCY # 738
  TRIP BRANCH FROM BUS 270853 TO BUS 270717 CKT 1          / PONTI; R 345 DRESD; R 345
  TRIP BRANCH FROM BUS 275210 TO BUS 270853 CKT 1          / PONTI;2M 138 PONTI; R 345
  TRIP BRANCH FROM BUS 275210 TO BUS 272261 CKT 1          / PONTI;2M 138 PONTI; R 138
  TRIP BRANCH FROM BUS 275210 TO BUS 275310 CKT 1          / PONTI;2M 138 PONTI;2C 34.5
  CLOSE BRANCH FROM BUS 272260 TO BUS 272261 CKT 1         / PONTI; B 138 PONTI; R 138
END
```

69. (CE) The Pontiac Mid-Point-Cayuga Ridge (Blue) 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 133.37% to 135.45% (DC power flow) of its emergency rating (1234 MVA) for the single contingency '345-L8014_T_-S'. This project contributes approximately 25.73 MW to the thermal violation.

```
CONTINGENCY '345-L8014_T_-S'    / CONTINGENCY # 738
  TRIP BRANCH FROM BUS 270853 TO BUS 270717 CKT 1          / PONTI; R 345 DRESD; R 345
  TRIP BRANCH FROM BUS 275210 TO BUS 270853 CKT 1          / PONTI;2M 138 PONTI; R 345
  TRIP BRANCH FROM BUS 275210 TO BUS 272261 CKT 1          / PONTI;2M 138 PONTI; R 138
  TRIP BRANCH FROM BUS 275210 TO BUS 275310 CKT 1          / PONTI;2M 138 PONTI;2C 34.5
  CLOSE BRANCH FROM BUS 272260 TO BUS 272261 CKT 1         / PONTI; B 138 PONTI; R 138
END
```

70. (BG&E) The Howard 2312-Granite 2311 & 2312 230 kV line (from bus 220953 to bus 220972 ckt 1) loads from 114.95% to 117.43% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 18.11 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

71. (FE) The Avery-Skinrock 138 kV line (from bus 238549 to bus 239108 ckt 1) loads from 110.43% to 113.33% (DC power flow) of its emergency rating (194 MVA) for the tower contingency 'C5-TWL-CR041'. This project contributes approximately 5.61 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'    /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1    /* 02BEAVER 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

72. (AEP) The Muskingum River-Muskingum River 345/138 kV transformer (from bus 242940 to bus 243045 ckt A) loads from 115.19% to 117.46% (DC power flow) of its emergency rating

(421 MVA) for the tower contingency '474'. This project contributes approximately 9.56 MW to the thermal violation.

```
CONTINGENCY '474'
  OPEN BRANCH FROM BUS 242931 TO BUS 242946 CKT 1          / 242931 05BEVERL 345 242946 05TIDD 345 1
  OPEN BRANCH FROM BUS 242937 TO BUS 242940 CKT 1          / 242937 05KAMMER 345 242940 05MUSKNG 345 1
END
```

73. (PENELEC/PL) The Oxbow-Lackawanna Bus 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 136.58% to 138.12% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 9.50 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-XF-#133A_X1_018_A'     /* LEWISTOWN 230/115KV BANK #3 FAULT
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END
```

74. (PENELEC/PL) The Oxbow-Lackawanna Bus 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 151.60% to 153.42% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 8.88 MW to the thermal violation.

75. (AEP) The Desoto-Jay 138 kV line (from bus 243278 to bus 243319 ckt 1) loads from 115.20% to 117.07% (DC power flow) of its emergency rating (302 MVA) for the tower contingency '444'. This project contributes approximately 5.65 MW to the thermal violation.

```
CONTINGENCY '444'
  OPEN BRANCH FROM BUS 243218 TO BUS 243225 CKT 1          / 243218 05DESOTO 345 243225 05KEYSTN 345 1
  OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2          / 243218 05DESOTO 345 243232 05SORENS 345 2
  OPEN BRANCH FROM BUS 243218 TO BUS 243233 CKT 1          / 243218 05DESOTO 345 243233 05TANNER 345 1
END
```

76. (AEP) The West Bellaire-Tiltonsville 138 kV line (from bus 243143 to bus 243131 ckt 1) loads from 105.56% to 107.76% (DC power flow) of its emergency rating (251 MVA) for the tower contingency 'AP_C5_25'. This project contributes approximately 5.53 MW to the thermal violation.

```
CONTINGENCY 'AP_C5_25'    /TIDD-WR_TIDD-COL
  OPEN BRANCH FROM BUS 235707 TO BUS 242946 CKT 1
  OPEN BRANCH FROM BUS 242946 TO BUS 253965 CKT 1
END
```

~~77. (DP&L) The Bellbrook-Alpha 138 kV line (from bus 253007 to bus 253107 ckt 1) loads from 102.97% to 105.03% (DC power flow) of its emergency rating (330 MVA) for the tower contingency '493'. This project contributes approximately 6.78 MW to the thermal violation.~~

```
~~CONTINGENCY '493'~~
~~  OPEN BRANCH FROM BUS 249566 TO BUS 253006 CKT 1          / 249566 08FOSTER 345 253006 09BATH 345 1~~
~~  OPEN BRANCH FROM BUS 253027 TO BUS 253079 CKT 1          / 253027 09GREENE 345 253079 09SUGRCK 345 1~~
```

~~END~~

78. (CE) The Kincaid-U4-037 TAP 345 kV line (from bus 270797 to bus 891210 ckt 1) loads from 124.15% to 125.16% (DC power flow) of its emergency rating (1528 MVA) for the single contingency 'SPS-2102&2106__W4_005_B'. This project contributes approximately 15.45 MW to the thermal violation.

```
CONTINGENCY 'SPS-2102&2106__W4_005_B'    / CONTINGENCY # 770
  TRIP BRANCH FROM BUS 905040 TO BUS 270804 CKT 1          / BLUEM; B 345 LATHA; T 345
  TRIP BRANCH FROM BUS 270796 TO BUS 347962 CKT 1          / KINCA; B 345 7PAWNEE 345
  TRIP BRANCH FROM BUS 270804 TO BUS 270796 CKT 1          / LATHA; T 345 KINCA; B 345
  TRIP BRANCH FROM BUS 270804 TO BUS 348856 CKT 1          / LATHA; T 345 7LATHAM 345
  TRIP BRANCH FROM BUS 348856 TO BUS 348857 CKT 1          / 7LATHAM 345 4LATHAM 138
END
```

79. (AEP) The T-094A-T-094B 345 kV line (from bus 292290 to bus 292292 ckt 1) loads from 108.56% to 109.68% (DC power flow) of its emergency rating (999 MVA) for the single contingency '1260_B2_TOR1689B_MOAB_B'. This project contributes approximately 11.20 MW to the thermal violation.

```
CONTINGENCY '1260_B2_TOR1689B_MOAB_B'
  OPEN BRANCH FROM BUS 256019 TO BUS 292290 CKT 1          / 243212 05BENTON 345 256019 18PALISD 345 1
END
```

80. (CE) The Kincaid-Latham Tap Of Kincaid-Pontiac Midpoint Line. Ip T 345 kV line (from bus 270796 to bus 270804 ckt 1) loads from 134.82% to 135.99% (DC power flow) of its emergency rating (1334 MVA) for the single contingency '345-L2101___-S_U4-037B'. This project contributes approximately 15.70 MW to the thermal violation.

```
CONTINGENCY '345-L2101___-S_U4-037B'    / CONTINGENCY # 641
  TRIP BRANCH FROM BUS 891210 TO BUS 349700 CKT 1          / KINCA; R 345 7LANSVLAM 345
END
```

81. (PECO) The Cooper-Peach Bottom 230 kV line (from bus 214089 to bus 213869 ckt 1) loads from 144.09% to 147.9% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.48 MW to the thermal violation.

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

82. (BG&E) The Sandy Spring 2334-High Ridge 2316 230 kV line (from bus 220984 to bus 220941 ckt 1) loads from 103.73% to 105.67% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EB'. This project contributes approximately 18.41 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

83. (FE) The Johnson-Lorain Q-2 138 kV line (from bus 238845 to bus 238915 ckt 1) loads from 131.30% to 135.87% (DC power flow) of its emergency rating (193 MVA) for the tower contingency '513'. This project contributes approximately 8.83 MW to the thermal violation.

```
CONTINGENCY '513'
  OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 1          / 238551 02AVON 345 238569 02BEAVER 345 1
  OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 2          / 238551 02AVON 345 238569 02BEAVER 345 2
END
```

84. (AMIL/CE) The Brokaw 345 kV Bus 1-Pontiac Mid-Point 345 kV line (from bus 348847 to bus 270853 ckt 1) loads from 117.45% to 119.5% (DC power flow) of its emergency rating (1441 MVA) for the single contingency '345-L8002___-S'. This project contributes approximately 29.47 MW to the thermal violation.

```
CONTINGENCY '345-L8002___-S'    / CONTINGENCY # 735
  TRIP BRANCH FROM BUS 270852 TO BUS 270668 CKT 1          / PONTI; B 345 BLUEM; B 345
END
```

85. (CE) The Pontiac Mid-Point-Dresden (Red) 345 kV line (from bus 270853 to bus 270717 ckt 1) loads from 132.55% to 134.6% (DC power flow) of its emergency rating (1341 MVA) for the single contingency '345-L11212_B-S'. This project contributes approximately 27.43 MW to the thermal violation.

```
CONTINGENCY '345-L11212_B-S'    / CONTINGENCY # 425
  TRIP BRANCH FROM BUS 270926 TO BUS 270704 CKT 1          / WILTO; B 345 LORET; B 345
END
```

86. (PECO) The Peach Bottom-Nottingham Reactor 230 kV line (from bus 213869 to bus 213846 ckt 1) loads from 104.14% to 107.08% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 18.48 MW to the thermal violation.

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

87. (PL) The Safe Harbor Units 3-4 Tap-Manor Substation 230 kV line (from bus 208071 to bus 208019 ckt 1) loads from 107.20% to 109.57% (DC power flow) of its emergency rating (579 MVA) for the single contingency 'PJM17'. This project contributes approximately 13.74 MW to the thermal violation.

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

88. (CE) The W4-005 TAP-Blue Mound (Blue) 345 kV line (from bus 905040 to bus 270668 ckt 1) loads from 100.17% to 101.93% (DC power flow) of its emergency rating (1334 MVA) for the single contingency '345-L8001___-S'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '345-L8001___-S'    / CONTINGENCY # 734
  TRIP BRANCH FROM BUS 270853 TO BUS 348847 CKT 1          / PONTI; R 345 7BROKAW T1 345
END
```

89. (AEP) The Selma Parker-SELMAPRK 138/69 kV transformer (from bus 243373 to bus 246901 ckt 1) loads from 177.00% to 183.34% (DC power flow) of its emergency rating (81 MVA) for the tower contingency '403'. This project contributes approximately 5.13 MW to the thermal violation.

```
CONTINGENCY '403'
  OPEN BRANCH FROM BUS 242522 TO BUS 242525 CKT 1          / 242522 05AMOS 345 242525 05KANAWH 345 1
  OPEN BRANCH FROM BUS 242525 TO BUS 242528 CKT 1          / 242525 05KANAWH 345 242528 05SPORN 345 1
END
```

90. (BG&E) The Riverside 2317-Northeast 2315 & 2317 230 kV line (from bus 220966 to bus 220979 ckt 1) loads from 101.68% to 103.03% (DC power flow) of its emergency rating (632 MVA) for the single contingency 'BG_CKT2344'. This project contributes approximately 8.55 MW to the thermal violation.

```
CONTINGENCY 'BG_CKT2344'    /* BRANDON TO RIVERSIDE CKT #2344
  DISCONNECT BUS 220989                    /*CKT 2344 BRANDON – HAWKINS-SOLLERS
  DISCONNECT BUS 220990                    /*CKT 2344 HAWKINS-SOLLERS-RIVERSIDE
  DISCONNECT BUS 220977                    /* RIVERSIDE 230-1 H/S AND 2339 TO NORTHEAST
  DISCONNECT BUS 221230                    /*RIVERSIDE 230-1 & L/S BUS CONNECTION
END
```

91. (BG&E) The Sollers Point 2344-Riverside 2339 230 kV line (from bus 220990 to bus 220977 ckt 1) loads from 116.39% to 117.47% (DC power flow) of its emergency rating (1036 MVA) for the single contingency 'BG_RIV230-2'. This project contributes approximately 11.24 MW to the thermal violation.

```
CONTINGENCY 'BG_RIV230-2'    /* RIVERSIDE 230-2 TRANSFORMER & CKT 2345
  DISCONNECT BRANCH FROM BUS 220966 TO BUS 220988 CKT 1    /* CKT #2345 RIVERSIDE TO SOLLERS PT
  DISCONNECT BRANCH FROM BUS 220966 TO BUS 221231 CKT 1    /* RIVERSIDE 230-2 TRANSFORMER
  DISCONNECT BRANCH FROM BUS 221231 TO BUS 221147 CKT 1    /* RIVERSIDE 230-2 L/S BUS CONNECTION
END
```

92. (FE) The Ottawa-Lakeview 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 224.68% to 229.06% (DC power flow) of its emergency rating (339 MVA) for the tower contingency 'C5-TWL-CR040'. This project contributes approximately 14.84 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'    /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1    /* 02DAV-BE 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

93. (CE/AMIL) The U4-037 TAP-Lanesville 345 kV Bus 3586-3587 (KNC-LNVL-2101) 345 kV line (from bus 891210 to bus 349700 ckt 1) loads from 127.32% to 128.33% (DC power flow) of its emergency rating (1528 MVA) for the single contingency 'SPS-2102&2106__W4_005_B'. This project contributes approximately 15.45 MW to the thermal violation.

```
CONTINGENCY 'SPS-2102&2106__W4_005_B'    / CONTINGENCY # 770
  TRIP BRANCH FROM BUS 905040 TO BUS 270804 CKT 1          / BLUEM; B 345 LATHA; T 345
  TRIP BRANCH FROM BUS 270796 TO BUS 347962 CKT 1          / KINCA; B 345 7PAWNEE 345
  TRIP BRANCH FROM BUS 270804 TO BUS 270796 CKT 1          / LATHA; T 345 KINCA; B 345
```

```
  TRIP BRANCH FROM BUS 270804 TO BUS 348856 CKT 1          / LATHA; T 345 7LATHAM 345
  TRIP BRANCH FROM BUS 348856 TO BUS 348857 CKT 1          / 7LATHAM 345 4LATHAM 138
END
```

94. (FE) The 02HAYES-02HAYES 345/138 kV transformer (from bus 239289 to bus 239290 ckt 1) loads from 109.62% to 111.85% (DC power flow) of its emergency rating (573 MVA) for the tower contingency 'C5-TWL-CR041'. This project contributes approximately 12.82 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'    /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1    /* 02BEAVER 345.00 02HAYES 345.00
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-BE 345.00 02BEAVER 345.00
END
```

95. (PJM) The Conastone-Peach Bottom 500 kV line (from bus 200004 to bus 200013 ckt 1) loads from 135.77% to 137.94% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM76'. This project contributes approximately 78.42 MW to the thermal violation.

```
CONTINGENCY 'PJM76'
  REMOVE MACHINE 1 FROM BUS 200034                 /* PB2
END
```

96. (PJM) The Peach Bottom-Limerick 500 kV line (from bus 200013 to bus 200024 ckt 1) loads from 112.84% to 114.14% (DC power flow) of its emergency rating (2598 MVA) for the single contingency 'PJM27'. This project contributes approximately 33.72 MW to the thermal violation.

```
CONTINGENCY 'PJM27'
  OPEN LINE FROM BUS 200010 TO BUS 200051 CIRCUIT 1        /* KEENEY EHV - A29 COLL 500
END
```

97. (AP) The Collins Ferry-West Run 138 kV line (from bus 235800 to bus 235424 ckt 1) loads from 106.28% to 108.82% (DC power flow) of its emergency rating (214 MVA) for the single contingency '01HATFLD _01RONCO _059'. This project contributes approximately 5.45 MW to the thermal violation.

```
CONTINGENCY '01HATFLD _01RONCO _059'
  DISCONNECT BRANCH FROM BUS 235108 TO BUS 235774 CKT 1    /* 500/500KV, AREA 201/201.
END
```

98. (BG&E) The High Ridge 2316-Columbia 230 kV line (from bus 220941 to bus 221010 ckt 1) loads from 108.78% to 110.69% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EB'. This project contributes approximately 18.01 MW to the thermal violation.

```
CONTINGENCY 'PP1EB'    / NO PATH
  OPEN BRANCH FROM BUS 200101 TO BUS 235632 CKT 1          / 200003 BRIGHTON 500 200004 CNASTONE 500 1
END
```

99. (AP/PJM) The Kemptown-EMORY GR500 500 kV line (from bus 235632 to bus 200101 ckt 1) loads from 129.59% to 131.44% (DC power flow) of its emergency rating (2901 MVA) for

the single contingency 'PJM76'. This project contributes approximately 69.27 MW to the thermal violation.

```
CONTINGENCY 'PJM76'
 REMOVE MACHINE 1 FROM BUS 200034                /* PB2
END
```

100. (AP/PJM) The Kemptown-EMORY GR500 500 kV line (from bus 235632 to bus 200101 ckt 1) loads from 144.22% to 146.44% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 69.27 MW to the thermal violation.

101. (FE) The Beaver-Carlisle 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 115.00% to 117.43% (DC power flow) of its emergency rating (1030 MVA) for the tower contingency '513'. This project contributes approximately 25.02 MW to the thermal violation.

```
CONTINGENCY '513'
 OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 1        / 238551 02AVON 345 238569 02BEAVER 345 1
 OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 2        / 238551 02AVON 345 238569 02BEAVER 345 2
END
```

Short Circuit

(Summary of impacted circuit breakers)

None Required

PJM Analysis with Reinforcements

New System Reinforcements				
Item (s)	**Description**	**Total Cost**	**Schedule**	**Contingency**
1	(BG&E) The Howard 2332-Granite 2326 & 2332 230 kV line: Scope: Line termination upgrades: Keep existing 1590 ACSR @ 125˚C rate line 648/802	$400,000	1 yr	'PP1EB'
2				16_B2'
3				05JEFRSO _05ROCKPT _122'
4				AMOS_WELTONSP'
5	(PJM) The EMORY GR500-Conastone 500 kV line: The two breaker bays at Conastone for the Brighton line are over the continuous rating. Upgrade the Conastone bay with two 4000A breakers, four 4000A breaker disconnects and a 4000 A line switch need to be either. $3M take . New rating 3710	$3,000,000	24-36 months to complete	'PJM67'
6	Same as 5			Non-Contingency Condition
7				'WELTONSP_KEMPTOWN'
8	(BG&E/PL) The Graceton-Safe Harbor Units 3-4 Tap 230 kV line: 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). BGE: Remove sag limitation rate to 550 MVA from Graceton to PA line - $500k Updated 3 years CPCN likely. Existing: Circuit 2303 is 795 kcm 30/19 ACSR @ 125 C. Assumptions: Length of this line section is 1.4 miles.	$23,200,000	Estimated in-service date: November 2013	'PJM17'

9	(PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line: PPL: Transmission Line Upgrade ($2,064,960) The proposed upgrade will consist of rebuilding approximately 0.9 miles of 1033 kcmil ACSR, (current ratings 494/624 MVA Summer Normal/Emergency based on conductor temperature at 125C) with new 1590 kcmil ACSR (new ratings 648/802MVA Summer Normal/Emergency conductor temperature at 125C). The existing structures will be removed and new steel monopoles will be installed for the upgraded 230kV circuit. Substation Upgrade ($120,000) In addition, there are some minor substation modifications required in the Juniata 230kV yard to accommodate the higher ampacity rating of the line. The scope of the work at Juniata is the replacement of the existing Lewistown disconnect switches. The existing switches are 1200A switches and will be replaced with 2000A switches to match the ratings of the new line. Note that this does not include rebuilding the remaining ~24.76 miles of the PenElec portion of the line or upgrade any substation terminal equipment required at the Lewistown 230kV substation. PenElec will need to provide comments on the proposed upgrade and the associated cost estimate. PENELEC: The Penelec portion of the line will be reconductored with high-temperature conductor along with terminal upgrades at Lewistown). The impedance of the line is not expected to change significantly. The new rating of the Penelec owned portion of this line will be 651/717.	2,184,960		Non-Contingency Condition
10	(BG&E/PECO) The Graceton-Cooper 230 kV line: BGE: Rebuild Cooper to Graceton 230kV line 1.85 miles to PA border. New rating would be 648/802. Estimated time: 54 months. Estimated cost $7.5 million. PECO: Reconductor Line 220-93 from Cooper Substation to Graceton Substation to get a minimum summer emergency rating of 725 MVA. The line is approximately 4 miles long. This cost is for the PECO portion only. The estimated cost to perform this work is $2.8M, and will require 24 months to complete.	$7,500,000	54 months	Non-Contingency Condition
11	(BG&E) The Columbia-Howard 2312 230 kV line: Rebuild 3.6 miles of double circuit line with bundled 1033.5 MCM conductor. The line rating should be 968/1227 MVA. Three – four years to complete with CPCN	$12,000,000	4 Years	'PP1EB'
12				'05JEFRSO _05ROCKPT _122'
13				05JEFRSO _05ROCKPT _122'
14				'AMOS_WELTONSP'
15	Add new Hayes-West Fremont No.2 138kV Line	$1,014,900		'B_LINE_SY_21B'
	Position to the Hayes 138 kV Substation @ Hayes SS.	$5,744,900		'B_LINE_SY_21B'
	Hayes-West Fremont #2 138 kV, New 28 Mile Line	$640,500		'B_LINE_SY_21B'
	OPGW fiber for 28 Miles	$727,100		'B_LINE_SY_21B'

	Create the West Fremont-Hayes 138 kV #2 Line by installing a 138 kV power circuit breaker and associated equipment at West Fremont Substation. This exit assumes a new breaker string is constructed for the first 138 kV exit to Hayes Substation @ West Fremont	$1,194,900		'B_LINE_SY_21B'
	Hayes Sub. Add new 138 kV Circuit Breaker for new line exit for new Hayes-Fremont 138 kV Line. Modify relaying for Groton 138 kV Substation	$2,114,400		'B_LINE_SY_21B'
	West Fremont Sub. Add two new 138 kV Circuit Breakers to create a new line exit for the new Hayes-West Fremont 138 kV Line	$9,475,100		'B_LINE_SY_21B'
	Groton Sub. Install new 138/69 kV substation near existing Bellevue – Greenfield 69 kV Line.	$104,300		'B_LINE_SY_21B'
	Nameplate and Drawing Modifications	$1,261,800		'B_LINE_SY_21B'
	Groton 138 kV Loop. Hayes – West Fremont 138 kV Loop proposed 138/69 kV Groton Substation.	$152,900		'B_LINE_SY_21B'
	Groton 69 kV Loop. Bellevue – Greenfield West 69 kV Loop proposed 138/69 kV Groton Substation	$24,757,100		'B_LINE_SY_21B'
	Hayes – west Fremont 138 kV, New 28 Mile Line. Install a new 138 kV Line between the proposed Hayes Substation and the existing West Fremont Substation. The exact route is to be determined after the route selection studies are completed.	$3,752,900		'B_LINE_SY_21B'
16	(PL) The South Akron Transformer 3-South Akron Bus 230 kV line: Change setting of CT from 1200 A to 2000 A, this would increase the S. Emergency rating to 624 MVA. The cost of this upgrade would be approximately $15,000	$15,000		'PJM17'
17	(PJM) The Rock Springs-Keeney 500 kV line: Rocksprings station need to be upgraded to accommodate additional flows on the Peach Bottom-Keeney path with the replacement of the line traps on 5014 and 5025 lines and the replacement of 500kV circuit breakers. Total estimated cost: $2.16M.	$2,160,000		PJM40'
18				'05JEFRSO _05ROCKPT _122'
19	(AP) The T157_TAP-Doubs 500kV 500 kV line: The T157 Tap-Doubs 500 kV line is limited by Dominion Virginia Power equipment on this facility. However, this line is presently being rebuilt on baseline upgrade ID b1507 with a projected in-service date of 6/1/2015. The emergency rating of the rebuilt line will be about 4300 MVA. Cost Estimate: $370 M	$370,000,000		'WELTONSP_KEMPTOWN'
20				4926_B1'
21	(PJM) The U2-74 TAP-Rock Springs 500 kV line: Rocksprings station needs to be upgraded to accommodate additional flows on the Peach Bottom-Keeney path with the replacement of the line traps on 5014 and 5025 lines and the replacement of 500kV circuit breakers. Total estimated cost: $2.16M	$2,160,000		'PJM40'
22	(CPLE/DVP) The Person 230-Halifax 230 kV 230 kV line: This line is being upgraded as part of the Duke/Progress merger (they are paying for it). PJM presented this uprate at the August TEAC, therefore it will not be a valid deficiency.	$0		'8CARSON _8DBGEN _014_X2-076A'

23	New Collins – Pontiac Mid Point – Meadow Lake 765 kV line: Cost: AEP - $10M; ComEd - $753M. Time: ComEd is proposing in-service dates of 5-10 years	$10,000,000		Non-Contingency Condition
	Pontiac Mid Point 765/345 kV autotransformers. Cost: ComEd - $60M. Time: ComEd is proposing in-service dates of 5-10 years	$60,000,000		Non-Contingency Condition
	Sullivan – Meadow Lake 765 kV line: 120 miles of new 765 kV line between Meadow Lake (New Reynolds) and Sullivan stations. Cost: AEP - $375M. Time: Expected to be in service in 2018	$375,000,000		Non-Contingency Condition
	Greentown – Meadow Lake 765 kV line; Meadow Lake 765/345 kV transformer (1) Cost: AEP - $330M. Time: Expected to be in service in 2018	$330,000,000		Non-Contingency Condition
	Greentown – Marysville 765 kV line. Cost: AEP - $530M. Time: Expected to be in service in 2018	$530,000,000		Non-Contingency Condition
	Marysville – Beaver 765 kV line; 765/345 kV transformer at Beaver. Cost: ATSI - $70M; AEP - $390M. Time: Expected to be in service in 2016/17	$390,000,000		Non-Contingency Condition
	250 MVAR Cap at Meadow Lake 765 kV sub. Cost: AEP - $12M. Time: Expected to be in service in 2017	$12,000,000		Non-Contingency Condition
	Greentown Station. Cost: AEP - $30M. Time: Expected to be in service in 2018	$30,000,000		Non-Contingency Condition
	Marysville Station. Cost: AEP - $30M. Time: Expected to be in service in 2018	$30,000,000		Non-Contingency Condition
	Marysville Station. Cost: AEP - $30M. Time: Expected to be in service in 2018	$30,000,000		Non-Contingency Condition
	Sullivan Station. Cost: AEP - $15M. Time: Expected to be in service in 2018	$15,000,000		Non-Contingency Condition
24	(PL) The Safe Harbor Units 3-4 Tap-Manor Substation 230 kV line: There is not a violation because the rating of this line in the case is incorrect; PPL provided higher ratings, 648/802 MVA.	$0		Non-Contingency Condition
25				05JEFRSO _05ROCKPT _122'
26				05JEFRSO _05ROCKPT _122'
27	(BG&E) The Granite 2311 & 2312-North West 2311 & 2310 230 kV line: Scope of Line Construction/Upgrade: Line is 8.7 miles long. Rebuild 230kV DBL Ckt with 2,167 ACSR @ 125˚C rate 799/974. Sub Work: Replace two 230kV breakers $1.5M at Granite. Cost: $23 Million, Total = $23.6M, Lead Time: 3-5 yrs	$23,000,000		'PP1EB'
28				'05JEFRSO _05ROCKPT _122'
29	Same as #15			B_LINE_SY_21B'
30				'05JEFRSO _05ROCKPT _122'
31	(PL) The Millwood Transformer #2-Millwood Transformer #1 230 kV line: There is not a violation because the rating of this line in the case is incorrect; PPL provided higher ratings, 830/954 MVA.	0		'PJM17'
32	Removed	0		667_B2_TOR1697'
33	Same as #23			'345-L8001___-S'

34				'05JEFRSO _05ROCKPT _122'
35	Same as #23			'345-L8001___-S'
36	(PL) The Millwood Transformer #1-South Akron Transformer 3 230 kV line: Upgrade the current1033 kcmil 54/7 (125 degrees C) line section to 1590kcmil 45/7 (125 degrees C). The cost of this upgrade would be approximately $25 Million.	$25,000,000		'PJM17'

Multiple Facility Contingencies				
37				'476'
38	(BG&E) The Pumphrey-Pumphrey 230/115 kV transformer: Remove the wire drop limitation at Pumphrey $200,000. 1 year to complete rate 525/640	$200,000		'WCHPL_BRNDN'
39				'478'
40	(PEPCO/BG&E) The Bowie 043-Bowiebc1 2341 230 kV line (from bus 223980 to bus 220956 ckt 1) loads from 95.47% to 96.63% (DC power flow) of its emergency rating (721 MVA) for the tower contingency 'HIRDG_BURTVL'. This project contributes approximately 8.37 MW to the thermal violation. Pepco equipment limits the line. Removing the limitation then the BGE rating is 799 SN/974 SE. PEPCO: Upgrading 3 - 230kV disconnect switches at Bowie will raise the normal rating to 799 MVA and the Emergency rating to 952 MVA. The estimated cost for this upgrade is approximately $371,000.00; Time: 6 months.	$371,000		'HIRDG_BURTVL'
41				'417'
42				'478'
43	Brookside – Henrietta 138 kV. Increase Operating temp to 212 F (Brookside – Troy Section)	$238,900		'C5-TWL-CR040'
44	(FE) The Troy-Brighton 138 kV line: The actual rating for the line is 173 MVA, with this rating there is no violation.	0		'C5-TWL-CR040'
45	Brookside – Henrietta 138 kV. Increase Operating temp to 212 F (Camden - Henrietta Section). Increase the maximum designed operating temperature to 212 F on the Camden Henrietta section of the Brookside – Henrietta 138 kV Line by deadending the conductors on (6) transmission towers.	$167,400		'C5-TWL-CR040'
46				'476'
47				'6677'
48				AP_C5_25'
49	(PEPCO/BG&E) The Bowie 044-Bowiebc0 2340 230 kV line (from bus 223979 to bus 220959 ckt 1) loads from 97.88% to 99.06% (DC power flow) of its emergency rating (720 MVA) for the tower contingency 'HIRDG_BURTVL'. This project contributes approximately 8.51 MW to the thermal violation. Pepco equipment limits the line. Removing the limitation then the BGE rating is 799 SN/974 SE. PEPCO: Upgrading 3 - 230kV disconnect switches at Bowie will raise the normal rating to 799 MVA and the Emergency rating to 952 MVA. The estimated cost for this upgrade is approximately $371,000.00; Time: 6 months	$371,000		'HIRDG_BURTVL'

Multiple Facility Contingencies				
50	(BG&E) The Howard 2332-Pumphrey 230 kV line: Wire drop limitation on the disconnect (ABSU) at Howard $200,000. Transmission line has sag limitations multiple spans line near obsolesce condition upgrading is not possible requires total rebuild Howard to Pumphrey Ckt $12M Three – four years to complete with CPCN.	$200,000		'WCHPL_BRNDN'
51				'431_V3-032B'

Contribution to Previously Identified Overloads				
52	(BG&E) The High Ridge 2316-Howard 2332 230 kV line: Rebuild line to accommodate double bundle 1272 ACSR - $ 24 M ~ 5 yrs. Existing: Circuit 2332-A is 1590 kcm ACSR @ 160 deg. C. Assumptions: ength of line is 8.9 miles 2+ year CPCN process required Existing tower removal included	$24,000,000		'PP1EB'
53	. (PECO) The Nottingham Reactor-Nottingham 230 kV line: Replace 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.	$1,700,000		'PJM17'
54	(PENELEC) The X1-109 TAP-North Meshoppen 230 kV line: Upgrade East Towanda (future X1-109) line terminal for summer LTE rating of 766 MVA at North Meshoppen SS. Replace 230kV disconnect switches for minimum summer LTE of 766 MVA at Canyon SS. Rebuild and reconductor approx. 21 miles. Remove existing H-frame structures, install new H-frame structures and reconductor with 1033 kcmil ACSS. Total Cost: $29,674,900.	$29,674,900		'B_PN230-XF-#133A_X1_018_A'
55	Same as #54			'B_PN230-XF-#133A_X1_018_A'
56	(PENELEC) The Roxbury-Roxbury 138/115 kV transformer: Install a standard 115kV Circuit Breaker with 3000A. Total Cost: $717,300.	$717,300		'PP1EB'
57	Upgrade line design temperature from 150 F to 212 F between the proposed Hayes Substation and Structure 2461 @ Hayes[W3-059A] 138 kV (formerly Avery – Greenfield 138 kV), Upgrade Line Design Temperature to 212 F.	$183,500		'C5-TWL-CR041'
58				'444'

Contribution to Previously Identified Overloads				
59	(BG&E/PL) The Conastone-Otter Creek Switchyard 230 kV line: BG&E: Reconductor from Gorsuch Mills to the Pennsylvania State Line (change of ownership to PPL). The existing circuit 2302 conductor is 1,590 kcmil 45/7 ACSR from Conastone to Gorsuch Mills and 795 kcm 30/19 ACSR from Gorsuch Mills to the PA State Line. Assumptions: Reconductor with 1,590 kcm ACSR from Gorsuch Mills to PA line to match capability of remainder of line. • Length of this line section is 1.7 miles. • Towers can be reinforced instead of replaced. • Based on previous estimate by R.W.M. for PJM (B48) study on circuit 22008 The estimated cost of this upgrade is $700,000. Estimated construction time is 36 months. PPL: The magnitude cost estimate to rebuild PPL's portion of the Otter Creek - Conastone 230kV line is $0. 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 S0233 upgrade will consist of rebuilding approximately 12 miles of 795 kcmil 30/19 ACSR (current ratings 425/531MVA Summer Normal/Summer Emergency based on conductor temp @ 125 Deg C) with new 1590 kcmil 45/7 ACSR or equivalent (new ratings 653/793MVA Summer Normal/Summer Emergency based on conductor temp @ 125 Deg C). The new circuit will be designed for double circuit but built single circuit initially. Existing structures will need to be removed and rebuilt as part of this upgrade.	$700,000		'PJM17'
60	(BG&E) The Sandy Spring 2314-High Ridge 2316 230 kV line: Existing circuits using 1590 ACSR @ 160 degC Rebuild existing line using double bundle 1033 ACSR @ 125 degC (1227 MVA) = $10M, 5 yrs Assumptions: -Full structure replacement required -Existing structure removal included -Line length of 3.61 miles -2+ year CPCN process required	$10,000,000		'PP1EB'
61	(DP&L) The Sugarcreek-Bellbrook 138 kV line: The actual emergency rating for the line 419 MVA; with this rating there is no violation.	$0		'493'
62				'4814_B2'
63	(PENELEC) The North Meshoppen-Oxbow 230 kV line: Rebuild approximately 10.16 miles of transmission line will be required to support bundled conductor and upgrade terminal equipment at North Meshoppen and Oxbow substations. It is estimated to cost approximately $11,566,615 (excluding tax) and to take 4-5 years to complete after signed ISA.	$11,566,615		'B_PN230-XF-#133A_X1_018_A'
64	Same as #63			'B_PN230-XF-#133A_X1_018_A'

Contribution to Previously Identified Overloads				
65				'AMOS_WELTONSP'
66	(BG&E/PECO) The Graceton-Cooper 230 kV line: BGE: Rebuild Cooper to Graceton 230kV line 1.85 miles to PA border. New rating would be 648/802. Estimated time: 54 months. Estimated cost $7.5 million. Notes: Rebuild the entire 230Kv single conductor circuit will cost $7.5 million. 24-36 months to complete. CPCN require adds about 18 months total time 54 months PECO: Reconductor Line 220-93 from Cooper Substation to Graceton Substation to get a minimum summer emergency rating of 725 MVA. The line is approximately 4 miles long. This cost is for the PECO portion only. The estimated cost to perform this wrk is $2.8M, and will require 24 months to complete.	$10,300,000		'PJM17'
67	Same as #32 and was removed			667_B2_TOR1697'
68	Same as #23			'345-L8014_T_-S'
69	Same as #23			'345-L8014_T_-S'
70	(BG&E) The Howard 2312-Granite 2311 & 2312 230 kV line: Cost estimate: 500K. Replace wire drops and upgrade structures. 12-18 months New rating 825 MVA	$500,000		'PP1EB'
71	Avery – Shinrock 138 kV, Upgrade Line Design Temperature from 150 F to 212 F. Upgrade the line design temperature from 150 F to 212 F from Avery Substation to Greenfield Substation by replacing (4) H-Frame Structures	$248,700		'C5-TWL-CR041'
72				'474'
73	(PENELEC/PL) The Oxbow-Lackawanna Bus 230 kV line: Rebuild approximately 16.33 miles of transmission line would be required (estimated to cost approximately $19,596,000).	$19,596,000		'B_PN230-XF-#133A_X1_018_A'
74				Non-Contingency Condition
75				'444'
76				AP_C5_25'
77	(DP&L) The Bellbrook-Alpha 138 kV line: The actual emergency rating for this line is 374 MVA; with this rating there is no violation.	$0		'493'
78	Same as #23			'SPS-2102&2106__W4_005_B'
79				1260_B2_TOR1689B_MOAB_B'
80	Same as #23			345-L2101___-S_U4-037B'
81	(PECO) The Cooper-Peach Bottom 230 kV line: Reconductor Line 220-08 from PB Tap to Cooper Substation to get a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. The estimated cost to perform this work is $1.0M, and will require 24 months to complete.	$1,000,000		'PJM17'

Contribution to Previously Identified Overloads				
82	(BG&E) The Sandy Spring 2334-High Ridge 2316 230 kV line: Existing circuits using 1590 ACSR @ 160 degC Rebuild existing line using double bundle 1033 ACSR @ 125 degC (1227 MVA) = $10M, 5 yrs Assumptions: -Full structure replacement required -Existing structure removal included -Line length of 3.61 miles -2+ year CPCN process required	$10,000,000		'PP1EB'
83	Johnson – Lorain 138 kV, Reconductor 1.54 miles with 605 kcmil ACSS and 6-Wire 3.6 Mile Section. Reconductor approx. 1.54 miles with 605 kcmil ACSS conductor, replacing the existing 636 kcmil ACSR conductor. Six wire the 3.63 mile double circuit section of 636 kcmil ACSR and de-energize the 4/0 Copper conductor.	$810,700		'513'
	Jonson Substation. Replace 600 A Wave trap on Lorain Line Terminal	$80,500		'513'
	Lorain Substation. Upgrade line drops and meter on 138 kV Johnson Line terminal.	$43,500		'513'
84	Same as #23			'345-L8002___-S'
85	Same as #23			'345-L11212_B-S'
86	(PECO) The Peach Bottom-Nottingham Reactor 230 kV line: Reconductor Line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 741 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is $10M, and will require 48 months to complete.	$10,000,000		PJM17'
87	(PL) The Safe Harbor Units 3-4 Tap-Manor Substation 230 kV line: 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	$22,700,000		'PJM17'
88	Same as #23			'345-L8001___-S'
89				'403'
90	(BG&E) The Riverside 2317-Northeast 2315 & 2317 230 kV line: With the fail of the #34 transformer bank at riverside, the rating can now be increased because the current limiting component (1272 kcm 45/7 ACSR) can be removed from the rating. The rating increase does not require any construction activity.	$0		BG_CKT2344'
91	(BG&E) The Sollers Point 2344-Riverside 2339 230 kV line: Install 1 additional Harbor Crossing cable Hawkins Point to Sollers Point, re-rate new OH sections to 180C - $40.25 million, 8-10 years to design and complete	$40,250,000		'BG_RIV230-2'
92	Same as #15			'C5-TWL-CR040'
93				'SPS-2102&2106__W4_005_B'
94	345 – 138 kV No. 2 Trans Addition @ Hayes	$4,444,000		'C5-TWL-CR041'

Contribution to Previously Identified Overloads				
95	(PJM) The Conastone-Peach Bottom 500 kV line: 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 Bottom rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV line from Conastone to Pennsylvania line. Purchase 150' R/W. Total for project $46.8 million 5-7 years 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 time: up to 7years	$85,800,000		'PJM76'
96	(PJM) The Peach Bottom-Limerick 500 kV line: The reinforcement for this overload requires a project to replace the 5010 terminal equipment at Peach Bottom and Limerick substations to achieve a minimum emergency rating of 2944 MVA. The cost of this project is $2.7 million and duration of two years.	$2,700,000		'PJM27'
97	(AP) The Collins Ferry-West Run 138 kV line: There is a baseline upgrade project that was identified in the generation retirement studies. The baseline upgrade ID is b1989 with a projected in-service date of 6/1/2015. The emergency rating of the line will increase to 260 MVA. Cost Estimate: $0.32M	$32,000		'01HATFLD _01RONCO _059'
98	(BG&E) The High Ridge 2316-Columbia 230 kV line: $15M for the 4.4 mile 230kV line CPCN needed 4-5 years to build. Rebuild with bundle 1590 MCM rate 1604 SE	$15,000,000		PP1EB'
99	(AP/PJM) The Kemptown-EMORY GR500 500 kV line: The two breakers bay at Conastone for the Brighton line are over the continuous rating. Upgrade Conastone bay with two 4000A breakers, four 4000A breaker disconnects and a 4000 A line switch need to be either. $3M, this will take 24-36 months to complete. New rating 3710			'PJM76'
100	Same as #99			'PJM76'
101	(FE) The Beaver-Carlisle 345 kV line: Replace a wave trap at Beaver substation. The total cost for this work is $73,400 and taxes are $17,600 for a grand total of $91,000.	$91,000		'513'
	Total	**$2,637,247,775**		

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

Note: 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

As a result of the aggregate energy resources in the area, no violations were identified.

AEP Portion of System Analysis

Network Upgrades

SYSTEM NORMAL @ CAPACITY OUTPUT					
Item(s)	Violation	Description	Total Cost	Schedule	Contingency
1	Tilton - Windsor 138 kV line overloads to 105.2% (216 MVA) of its summer normal rating of 205 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	This is an AEP-APS tie line. AEP owns only 4.92 miles of this line. AEP recommends rebuilding 4.92 miles of this line at an estimated cost of $7,500,000. AEP recommends PJM to work with APS on this also, as upgrades on APS side may also be required to mitigate this overload.	$7,500,000		

CATEGORY B @ CAPACITY OUTPUT					
1	Breed – West Casey 345 kV line overloads to 185.1% (2466 MVA) of its summer normal rating of 1332 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	See Pioneer project listed in Appendix A.			363_B2_TOR1682'
2	Breed - Darwin 345 kV line overloads to 106.3% (1032 MVA) of its summer normal rating of 971 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	See Pioneer project listed in Appendix A.			363_B2_TOR1682'
3	PJM identified an overload of 153.21% of its summer normal rating of 972 MVA on Breed – Dequine 345 kV. Without addition of this MTX facility, the same facility loads to 96.81% of its summer normal rating.	See Pioneer project listed in Appendix A.			'363_B2_TOR1682'
4	Dequine - Eugene 345 kV line overloads to 108.6% (1055 MVA) of its summer normal rating of 971 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	See Pioneer project listed in Appendix A.			'667_B2_TOR1697'

CATEGORY B @ CAPACITY OUTPUT					
5	Dequine - Meadow Lake #1 345 kV line overloads to 117.5% (1141 MVA) of its summer normal rating of 971 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	See Pioneer project listed in Appendix A.			'363_B2_TOR1682'
6	Dequine - Meadow Lake #2 345 kV line overloads to 117.5% (1141 MVA) of its summer normal rating of 971 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	See Pioneer project listed in Appendix A.			
7	Desoto - Fall Creek 345 kV line overloads to 131% (1331 MVA) of its summer normal rating of 1016 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	Replace Desoto circuit terminal equipment at an estimated cost of $200,000. New SN and SE rating will be 1409 MVA.	$200,000		'363_B2_TOR1682'
8	Havilland 138/69 kV Transformer overloads to 102.2% (54 MVA) of its summer emergency rating of 53 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Upgrade Havilland 138/69 kV transformer at an estimated cost $1,000,000.	$1,000,000		'5206_B2_TOR770_woMOAB'
9	Highland 138/69 kV Transformer overloads to 100.8% (123 MVA) of its summer emergency rating of 122 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Upgrade Highland 138/69 kV transformer-- estimated cost $1,000,000.	$1,000,000		'161_B3'
10	Olive - Reynolds 345 kV line overloads to 123.1% (1197 MVA) of its summer normal rating of 971 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer normal rating.	See Pioneer project listed in Appendix A.			'363_B2_TOR1682'

CATEGORY C1, C2 or C5 @ CAPACITY OUTPUT					
1	Adam - Pennville 138 kV line overloads to 101.6% (208 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Perform sag study on Adam Pennville 138 kV line at an estimated cost of $35,000. Sag condition correction cost may range from $0 (no remediation required) to $9,500,000 (complete line rebuild required).	$35,000 to $9,500,000		444'
2	Greentown 765/138 kV Transformer overloads to 106.1% (837 MVA) of its summer emergency rating of 789 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	See Pioneer project listed in Appendix A.			'1733_C2'
3	Harrison - Circleville 138 kV overloads to 113.2% (202.6 MVA) of its summer emergency rating of 179 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Upgrade risers at a total estimated cost of $50,000	$50,000		'6773_C2_05BIXBY 345-301W'
4	Jay - Pennville 138 kV line overloads to 103.3% (212 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Perform sag study on Jay-Pennville 138 kV line at an estimated cost of $52,000. Sag condition correction cost may range from $0 (no remediation required) to $13,000,000 (complete line rebuild required).	$52,000 to $13,000,000		444'
5	Wolf creek 138/138 kV Transformer (1:1 Transformer) overloads to 155.3% (334 MVA) of its summer emergency rating of 215 MVA. Without addition of this MTX the same facility loads to less than 95% of its summer emergency rating.	Upgrade transformer 1:1 transformer at an estimated cost of $1,500,000.	$1,500,000		'2856_C2'

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT					
1	Ball Hollow - Caldwell 138 kV overloads to 106.8% (219 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform sag study at an estimated total cost of $22,000. Sag condition correction cost may range from $0 (no remediation required) to $5,500,000 (complete line rebuild required).	$22,000 to 5,500,000		'474'

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT					
2	Ball Hollow – Somerton 138 kV overloads to 105.5% (216 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform sag study at an estimated total cost of $70,000. Sag condition correction cost may range from $0 (no remediation required) to $17,500,000 (complete line rebuild required).	$70,000 to $17,500,000		'474'
3	Bluebell – Canton Central 138 kV line overloads to 103% (301 MVA) of its summer emergency rating of 292 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	This is an AEP-FE tie line and the limiting element is on the FE side. AEP recommends PJM to work with FE on this upgrade.		tbd	'4743_C2'
4	Breed - Wheatland 345 kV line overloads to 205.7% (1967 MVA) of its summer emergency rating of 956 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	See Pioneer project listed in Appendix A			'3183_C2_05ROCKPT 765-C'
5	Caldwell – Muskingum River 138 kV overloads to 115.2% (236 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform sag study at an estimated cost $218,000. Sag condition correction cost may range from $0 (no remediation required) to $54,500,000 (complete line rebuild required).	$218,000 to 54,000,000		'474'
6	Columbia – North East 138 kV line overloads to 105.3% (151 MVA) of its summer emergency rating of 143 MVA. Without addition of this MTX, same facility loads to less that 95% of its summer emergency rating.	This is an AEP-NIPSCO tie line and therefore, PJM-NIPSCO coordination will be required to determine exact cost for this network upgrade.	tbd	tbd	'6389_C2_05DUMONT 765-B'
7	East Point – Ohio Central 138 kV line overloads to 102.1% (260 MVA) of its summer emergency rating of 255 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Replace risers at Ohio Central station at a total estimated price of $50,000. New SN and SE rating will be 205 MVA and 284 MVA respectively.	$50,000		'6403_C1_05OHIOCT 138-1'
8	Eugene - Cayuga 345 kV line overloads to 190.4% (2639 MVA) of its summer emergency rating of 1386 MVA. Without addition of this MTX, same facility loads to	See Pioneer project upgrade listed above			'3183_C2_05ROCKPT 765-C'

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT					
	less than 95% of its summer emergency rating.				
9	Hummel Creek - Rock Creek 138 kV line overloads to 117% (187 MVA) of its summer emergency rating of 167 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Upgrade disconnect switch, risers and bus at Rock Creek station at an estimated cost of $300,000.	$300,000		'2978_C2'
10	North Interstate Tie – West New Philadelphia 138 kV line overloads to 102% (306 MVA) of its summer emergency rating of 300 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost of $50,000. Sag condition correction cost may range from $0 (no remediation required) to $12,500,000 (complete line rebuild required).	$50,000 to $12,500,000		'41_C1_05SCANTO 345-2'
11	North Strasburg – South Canton 138 kV line overloads to 103.3% (306 MVA) of its summer emergency rating of 296 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost $50,000. Sag condition correction cost may range from $0 (no remediation required) to $12,500,000 (complete line rebuild required).	$50,000 tp $12,500,000		'41_C1_05SCANTO 345-2'
12	North Strasburg - Strasburg 138 kV line overloads to 103.9% (307 MVA) of its summer emergency rating of 296 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost of $40,000. Sag condition correction cost may range from $0 (no remediation required) to $10,000,000 (complete line rebuild required).	$40,000 to 40,000,000		'41_C1_05SCANTO 345-2'
13	Olive - Meadow Lake 345 kV line overloads to 133.5% (1296 MVA) of its summer emergency rating of 971 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Pioneer project listed in Appendix A			'3002_C2_05ROCKP T 765-C2'
14	Olive - Reynolds 345 kV line overloads to 132.2% (1285 MVA) of its summer emergency rating of 972 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer	Pioneer project listed in Appendix A			'3182_C2_05ROCKP T 765-B'

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT					
	emergency rating.				
15	Philo – West Philo 138 kV line overloads to 104.5% (174 MVA) of its summer emergency rating of 167 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Rebuild line at an estimated cost of $1,000,000	$1,000,000		'6404_C1_05OHIOCT 138-2'
16	Poston – Strouds Run 138 kV line overloads to 101.7% (194 MVA) of its summer emergency rating of 191 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Upgrade CTs at Poston station at an estimated cost of $50,000. New SN and SE ratings will be 195 MVA and 245 MVA.	$50,000		'2893_C2_05MUSKN G 345-SE'
17	Reynolds - Meadow Lake 345 kV line overloads to 142.5% (1384 MVA) of its summer emergency rating of 971 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	See Pioneer project Network upgrade listed above			'3183_C2_05ROCKP T 765-C'
18	Strasburg - West Dover 138 kV line overloads to 106.5% (315.1 MVA) of its summer emergency rating of 296 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost of $25,000. Sag condition correction cost may range from $0 (no remediation required) to $6,250,000 (complete line rebuild required).	$25,000 to $6,250,000		'41_C1_05SCANTO 345-2'
19	Tidd - Beverley 345 kV line overloads to 124.2% (1207 MVA) of its summer emergency rating of 972 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost of $160,000. Sag condition correction cost may range from $0 (no remediation required) to $40,000,000 (complete line rebuild required).	$160,000 to $40,000,000		'3054_C2_05TIDD 345-BB'
20	Tidd - Collier 345 kV line overloads to 126.6% (1476 MVA) of its summer emergency rating of 1166 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	This is an AEP-DLCO tie line. AEP recommends PJM to work with DLCO on this upgrade also. Perform sag study at an estimated cost of $40,000.	$40,000		'4744_C2_05TIDD 345-CC2'

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT					
21	West Millersburg - Wooster 138 kV line overloads to 100.8% (186 MVA) of its summer emergency rating of 185 MVA. Without addition of this MTX, same facility loads to less than 95% of its summer emergency rating.	Perform a sag study at an estimated cost of $60,000. Sag condition correction cost may range from $0 (no remediation required) to $12,500,000 (complete line rebuild required).	$60,000 to $12,500,000		'3054_C2_05TIDD 345-BB'

Contributions to Previously Identified Reinforcements.

CATEGORY B @ CAPACITY OUTPUT					
1	Newcomerstown 138/69 kV Transformer overloads to 113.9% (79 MVA) of its summer emergency rating of 69 MVA. Without addition of this MTX, same facility overloads to 104.6% of its summer emergency rating.	Upgrade transformer at an estimated cost of $1,000,000.	$1,000,000		5161_B2_TOR732'

CATEGORY C1, C2, C5 @ CAPACITY OUTPUT					
1	Ohio Central - South Coshocton 138 kV line overloads to 106.2% (196.5 MVA) of its summer emergency rating of 185 MVA. Without addition of this MTX, same facility overloads to 102.9% of its summer emergency rating.	Perform sag study at an estimated cost of $50,000. Sag condition correction cost may range from $0 (no remediation required) to $12,500,000 (complete line rebuild required).	$50,000 to $12,500,000		6343_C2_05MUSKN G 345-SQ'
2	Harrison - Obet Tap 138 kV line overloads to 113.5% (203 MVA) of its summer emergency rating of 179 MVA. Without addition of this MTX, same facility overloads to 106.4% of its summer emergency rating.	Perform sag study at an estimated cost of $50,000. Sag condition correction cost may range from $0 (no remediation required) to $12,500,000 (complete line rebuild required).	$50,000 to $12,500,000		6773_C2_05BIXBY 345-301W'

CATEGORY C1, C2, C5 @ ENERGY OUTPUT					
1	Belmont 765/500 kV Transformer overloads to 147.1% (3081 MVA) of its summer emergency rating of 2094 MVA. Without addition of this MTX, same facility overloads to 121.2% of its summer emergency rating.	Since this transformer is owned by APS, AEP recommends PJM to work with APS on this upgrade.		tbd	'5037_C1_05KAMME R 765-2'

CATEGORY C1, C2, C5 @ ENERGY OUTPUT					
2	East Lima - Haviland 138 kV line overloads to 167.41% (343 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility overloads to 162.6% (333 MVA) of its summer emergency rating.	Perform sag study and upgrade wavetrap at remote ends at an estimated cost of $200,000. Sag condition correction cost may range from $0 (no remediation required) to $25,000,000 (complete line rebuild required).	$200,000 to $25,000,000		'6648'
3	Kammer - Muskingum River 345 kV overloads to 115.7% (1303 MVA) of its summer emergency rating of 972 MVA. Without addition of this MTX, same facility overloads to 107.3% of its summer emergency rating.	Perform sag study at an estimated cost of $155,000. Sag condition correction cost may range from $0 (no remediation required) to $38,750,000 (complete line rebuild required).	$155,000 to $38,750,000		'3048_C2_05TIDD 345-AA2'
4	Muskingum River - South Caldwell 138 kV line overloads to 125.1% (256 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility overloads to 103% of its summer emergency rating.	Perform sag study at an estimated cost of $155,000. Sag condition correction cost may range from $0 (no remediation required) to $38,750,000 (complete line rebuild required).	$155,000 to $38,750,000		'474'
5	Tidd - Carnegie 138 kV line overloads to 124% (310 MVA) of its summer emergency rating of 205 MVA. Without addition of this MTX, same facility overloads to 102.2% of its summer emergency rating.	Perform sag study and upgrade line risers at an estimated cost of $100,000. Sag condition correction cost may range from $0 (no remediation required) to $25,000,000 (complete line rebuild required).	$100,000 to $25,000,000		'4743_C2'
		Total	**$15,182,000 to $361,427,000**		

Schedule

The standard time required for construction for 765 kV facilities is 24 to 36 months after signing an interconnection agreement.

Conclusion 1: AEP Portion of the report

Final estimates will require an on-site review and coordination with the developers of X3-028. Estimates are based on 2012 dollars. The developer is responsible for all costs associated with this connection. The AEP Analysis costs above are reimbursable to AEP. Cost estimates provided above are based on current AEP standards and practices. These requirements are subject to change. For jointly owned facilities, AEP recommends PJM to also work with NIPSCO, First Energy, Duke, Allegheny Power and ComEd to verify cost estimates provided by AEP for their facilities.

Based upon the results of this project feasibility study, PJM Project #X3-028 connecting to the AEP Sullivan 765 kV station will require station and line attachment facilities at an estimated cost of $11,500,000. The project will also require Network Upgrades

Should the developer choose to avoid generation curtailment, additional network upgrades for certain Category C3 contingencies additional upgrades may also be required. Estimates for these additional network upgrades would be established as part of the Impact study.

As mentioned in the earlier sections, the cost of network upgrades will vary based on following:

- Result of sags studies. AEP has provided the cost of the sag studies and the cost of network upgrades involving sag studies may vary from $15,182,000 assuming that emergency rating of all the identified facilities can be increased after a sag study to $361,427,000 assuming that sag studies will show that all the identified transmission lines will need to be rebuilt. The scenario involving a complete rebuild is highly unlikely but AEP feels obligated to provide a complete exposure. Also, the $15,182,000 - $361,427,000 cost may be allocated to various projects in PJM queue based on PJM's analysis.

Pioneer project cost exposure could be from $330,000,000 to $600,000,000 based on the in-service date of Reynolds – Greentown 765 kV segment. Also, the remaining cost may be further allocated among MTXs in PJM queue based on PJM's analysis.

Conclusion 2: PJM Portion of the report

The PJM Analysis is divided into the three categories below.

1. New System Reinforcements
    a. Table items 1 through 36
2. Multiple Facility Contingencies
    a. Table items 37 through 51
3. Contributions to Previously Identified Overloads
    a. Table items 52 through 101

The reinforcements and costs are estimated and will be refined during the Impact Study and Facilities Study phases of the project. The "Contribution to Previously Identified Overloads" will also be allocated in the Impact Study phase of the project. This means that the X3-028 project, in some cases, will not bear the full cost responsibility for the reinforcement.

It is also important to note that not every PJM identified contingency has an associated reinforcement. PJM is still waiting for cost estimates from some of the Transmission Owners. These additional reinforcements will be identified during the impact study phase and allocated as applicable. Given the magnitude of the project, PJM felt it was prudent to release the report rather than wait until these additional estimates were obtained.

Summary

The table below summarizes the potential cost exposure for the X3-028 Project. There is no minimum number for PJM since the costs will be not allocated until the Impact Study phase of the project.

	Min	Max
AEP	$15,182,000	$361,427,000
Attachment Facilities	$11,500,000	$11,500,000
Pioneer Project	$330,000,000	$600,000,000
PJM	tbd	$2,637,247,775
	Total	**$3,610,174,775**

Appendix A

Pioneer Project Network Upgrade

Pioneer project was proposed by AEP and Duke as a joint venture to resolve anticipated reliability concerns in Indiana while ensuring integration of future renewable resources. The project was announced back in 2008 and has moved through various planning stages in Midwest ISO planning process. A segment of Pioneer Project was approved by Midwest ISO and is expected to be in-service by 2018. The other segment of Pioneer project is still under review.

In 2011, PJM determined that the project is needed to interconnect wind projects requesting interconnection to PJM's Meadow Lake station as well. However, in accordance with PJM's tariff, the developer(s) is responsible for all associated costs.

Pioneer project consists of (2) 765 kV segments:

1. Reynolds - Greentown765 kV line and a 765/345 kV transformer at Reynolds

   Cost of Reynolds – Greentown 165 kV line: $185,000,000

   Cost of station work at Greentown: $30,000,000

   Cost of station work at Reynolds: $55,000,000

2. Reynolds – Sullivan 765 kV line

   Cost of Reynolds – Sullivan 765 kV line: $300,000,000

   Cost of station work at Sullivan: $30,000,000

Total estimated cost for Pioneer project is $600,000,000.

Reynolds – Greentown 765 kV segment and the 765/345 kV transformer at Reynolds is slated for an in-service date in 2018 by Midwest ISO. If X3-028 in-service is after Reynolds – Greentown segment energizes, then X3-028 will only be responsible for the cost the remaining Sullivan – Reynolds 765 kV segment and work at Sullivan station. This cost may be further reduced by allocation to other MTXs in PJM interconnection queue. Such allocation will be determined by PJM.

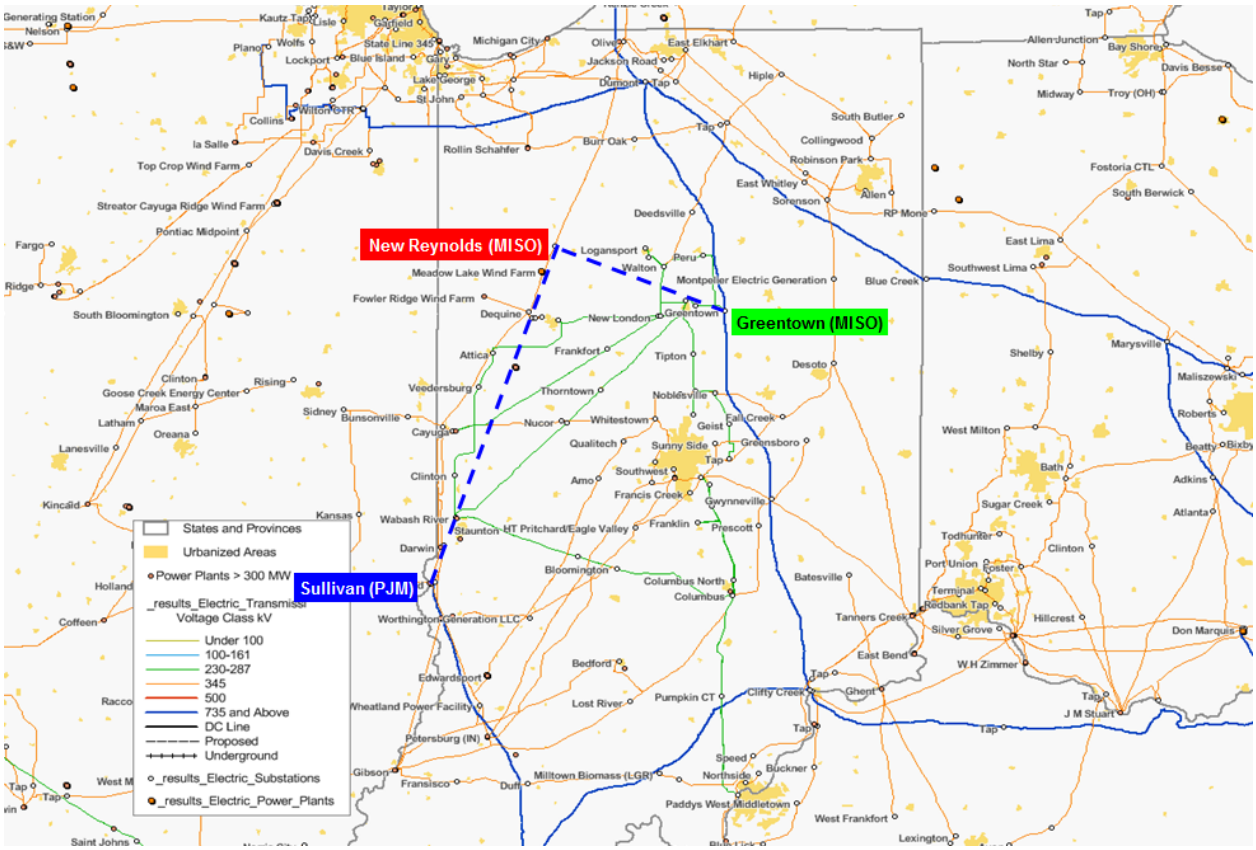

Figure: Pioneer Project