X2-052 Dumont-Olive 345kV

Generation Interconnection

Local Network Impacts

Impact of the proposed generation facility on the AEP transmission system was assessed according to applicable reliability criteria and AEP planning criteria. The transmission system must meet system normal and contingency condition in accordance with AEP FERC Form 715 criteria.

Potential network impacts were as follows:

VIOLATIONS TRIGGERED BY PROPOSED IPP X2-052 THAT REQUIRE NETWORK UPGRADES

CATEGORY B @ CAPACITY OUTPUT

1. Muskingum River - Wolf Creek 138 kV #1 line overloads to 101.6% of its summer emergency rating of 205 MVA. To fix this overload, perform a sag study on this line at a total cost of **$50,000**.

   Contingency '37_B2_TOR12_woMOP'

   Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

   Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

   Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

   end

2. Muskingum River 345/138 kV Transformer #A overloads to 100.5% of its summer emergency rating of 543 MVA. To fix this overload, replace the transformer at a total cost of **$2,000,000**.

   Contingency '37_B2_TOR12_woMOP'

   Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

   Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

   Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

   End

3. East Lima - Haviland 138 kV line overloads to 103.4% of its summer emergency rating of 205 MVA. Without addition of this IPP, same facility loads to less than 95% of its summer emergency rating. To fix this overload, perform a sag study and upgrade wavetrap at remote end stations at a total cost of **$200,000**.

Contingency '5206_B2_TOR770_woMOAB'

Open branch from bus 242991 to bus 243051 ckt 1 / 242991 05E SIDE 138 243051 05NDELPH 138 1

Open branch from bus 242991 to bus 243108 ckt 1 / 242991 05E SIDE 138 243108 05STERLN 138 1

Open branch from bus 243330 to bus 247521 ckt 1 / 243330 05LINCOL 138 247521 T-131 138 1

Open branch from bus 243051 to bus 243175 ckt 1 / 243051 05NDELPH 138 243175 N DELPHO 69.0 1

Open branch from bus 242991 to bus 245822 ckt 1 / 242991 05E SIDE 138 245822 E.SIDE L 12.0 1

Open branch from bus 245874 to bus 243175 ckt 1 / 245874 E DELPHO 69.0 243175 N DELPHO 69.0 1

Open branch from bus 245878 to bus 243175 ckt 1 / 245878 FTJENNG8 69.0 243175 N DELPHO 69.0 1

Open branch from bus 243175 to bus 245902 ckt 1 / 243175 N DELPHO 69.0 245902 S DELPHO 69.0 1

end

CATEGORY C1, C2 or C5 @ CAPACITY OUTPUT

1. Bridgeview - Chandlers Mountain 138 kV line overloads to 100.1% of its summer emergency rating of 185 MVA. To fix this overload, perform at a sag study on this line at a total cost of **$200,000**.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

2. Newcomerstown - Hillview 138 kV line overloads to 106.6% of its summer emergency rating of 250 MVA. To fix this overload, upgrade Newcomerstown 138 kV bus at a total cost of **$50,000**.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

3. Muskingum River - Wolf Creek 138 kV #1 line overloads to 103.5% of its summer emergency rating of 205 MVA. To fix this overload, perform a sag study on this line at a total cost of **$50,000**.

Contingency '2942_C2_05KAMMER 765-PP'

Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

Open branch from bus 242925 to bus 243188 ckt 1 / 242925 05KAMMER 765 243188 05MLG1 26.0 1

Remove unit 1 from bus 243188 / 243188 05MLG1 26.0

end

4. Ohio Central - South Coshocton 138 kV line overloads to 102.9% of its summer emergency rating of 185 MVA. To fix this overload, perform a sag study on this line at a total cost of **$50,000**.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

5. Ohio Central - West Coshocton 138 kV line overloads to 101.4% of its summer emergency rating of 185 MVA. To fix this overload, perform a sag study on this line at a total cost of **$60,000**.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

6. Tilton - West Bellaire 138 kV line overloads to 103.3% of its summer emergency rating of 251 MVA. To fix this overload, perform a sag study on this line at a total cost of **$30,000**.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

7. Huntington Junction - Sorenson 138 kV line overloads to 108.7% of its summer emergency rating of 143 MVA. To fix this overload, perform a sag study on this line at a total cost of **$100,000**.

Contingency '2979_C2'

Open branch from bus 243206 to bus 746001 ckt 1 / 243206 05DUMONT 765 746001 X1-020 765 1

Open branch from bus 243206 to bus 243219 ckt 2 / 243206 05DUMONT 765 243219 05DUMONT 345 2

Open branch from bus 243219 to bus 746004 ckt 2 / 243219 05DUMONT 345 746004 X2-052 345 2

end

8. Harrison - Circleville 138 kV line overloads to 106.4% of its summer emergency rating of 179 MVA. To fix this overload, upgrade risers and switch at Harrison station at a total cost of **$250,000**.

Contingency '6773_C2_05BIXBY 345-301W'

Open branch from bus 243454 to bus 246888 ckt 1 / 243454 05BIXBY 345 246888 05BIERSR 345 1

Open branch from bus 243454 to bus 243473 ckt 1 / 243454 05BIXBY 345 243473 05BIXBY 138 1

Open branch from bus 243454 to bus 243473 ckt 2 / 243454 05BIXBY 345 243473 05BIXBY 138 2

end

9. Harrison - Obetz Tap 138 kV line overloads to 103.3% of its summer emergency rating of 179 MVA. To fix this overload, upgrade risers at a total cost of **$50,000**.

Contingency '6773_C2_05BIXBY 345-301W'

Open branch from bus 243454 to bus 246888 ckt 1 / 243454 05BIXBY 345 246888 05BIERSR 345 1

Open branch from bus 243454 to bus 243473 ckt 1 / 243454 05BIXBY 345 243473 05BIXBY 138 1

Open branch from bus 243454 to bus 243473 ckt 2 / 243454 05BIXBY 345 243473 05BIXBY 138 2

end

10. Layman - Wolf Creek 138 kV line overloads to 122.7% of its summer emergency rating of 205 MVA. To fix this overload, perform a sag study and upgrade risers at Layman and Wolf Creek stations at a total cost of **$150,000**.

Contingency '5031_C2_05KAMMER 765-PP2'

Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

end

11. LaPorte Junction - Olive 138 kV line overloads to 101.2% of its summer emergency rating of 163 MVA. The AEP portion can be addressed by performing a sag study at a total cost of

$10,000. However, PJM will need to coordinate with Midwest ISO and NIPSCo to address the NIPSCo facilities. AEP only owns a small section of this line.

12. Contingency '6399_C2_05NEWCAR 138-P'

13. Open branch from bus 243349 to bus 243248 ckt 1 / 243349 05NEWCAR 138 243248 05BARODA 138 1

Open branch from bus 243349 to bus 243359 ckt 1 / 243349 05NEWCAR 138 243359 05PINERD 138 1

Open branch from bus 243349 to bus 255152 ckt 1 / 243349 05NEWCAR 138 255152 17MAPLE 138 1

Open branch from bus 243349 to bus 243353 ckt 1 / 243349 05NEWCAR 138 243353 05OLIVE 138 1

Open branch from bus 243349 to bus 246344 ckt 1 / 243349 05NEWCAR 138 246344 NWCARLIS 34.5 1

Open branch from bus 243349 to bus 255184 ckt 1 / 243349 05NEWCAR 138 255184 17TRALCK 138 1

end

14. Muskingum River - Wolf Creek 138 kV #2 line overloads to 121.3% of its summer emergency rating of 205 MVA. To fix this overload, perform a sag study and upgrade risers at Layman and Wolf Creek stations at a total cost of **$100,000**.

Contingency '5031_C2_05KAMMER 765-PP2'

Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

end

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT

Note: Under this category only violations are listed where a facility overload is **higher** for a Category C contingency at Energy output when compared with a Category B contingency at Energy output

1. Tidd - Beverly 345 kV line overloads to 100.7% of its summer emergency rating of 972 MVA. To fix this overload, perform at a sag study on this line at a total cost of **$245,000**.

Contingency '2934_C2_05KAMMER 345-DD'

Open branch from bus 242937 to bus 242940 ckt 1 / 242937 05KAMMER 345 242940 05MUSKNG 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

2. Kammer - Muskingum River 345 kV overloads to 107.3% of its summer emergency rating of 972 MVA. To fix this overload, perform a study on this line at a total cost of **$155,000**.

Contingency '2856_C2'

Open branch from bus 242920 to bus 242925 ckt 1 / 242920 05BELMON 765 242925 05KAMMER 765 1

Open branch from bus 242920 to bus 242516 ckt 1 / 242920 05BELMON 765 242516 05MOUNTN 765 1

Open branch from bus 242923 to bus 242516 ckt 1 / 242923 05GAVIN 765 242516 05MOUNTN 765 1

Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

end

3. Tidd - Carnegie 138 kV line overloads to 102.2% of its summer emergency rating of 250 MVA. To fix this overload, perform a study on this line and upgrades risers at a total cost of **$100,000**.

Contingency '4743_C2'

Open branch from bus 235707 to bus 242946 ckt 1 / 235707 01WYLIE R 345 242946 05TIDD 345 1

Open branch from bus 242946 to bus 253965 ckt 1 / 242946 05TIDD 345 253965 15COLLIE 345 1

end

4. Kammer 345/138 kV Transformer #3 overloads to 107.3% of its summer emergency rating of 571 MVA. To fix this overload, replace the transformer at a total cost of **$2,000,000**.

Contingency '2933_C2_05KAMMER 345-DD1'

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 242937 to bus 243027 ckt 1B / 242937 05KAMMER 345 243027 05KAMMR2 138 1B

Open branch from bus 242948 to bus 243143 ckt 1 / 242948 05WBELLA 345 243143 05WBELLA 138 1

end

5. East Side - North Delphos 138 kV line overloads to 104.5% of its summer emergency rating of 192 MVA. To fix this overload, replace switch at North Delphos station at a total cost of **$300,000**.

Contingency '6655'

Open branch from bus 242989 to bus 243017 ckt 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1

Open branch from bus 243330 to bus 247521 ckt 1 / 243330 05LINCOL 138 247521 T-131 138 1

end

6. Hillview - West New Philadelphia 138 kV line overloads to 107.8% of its summer emergency rating of 290 MVA. To fix this overload, perform sag study on this line at a total cost of **$100,000**.

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

7. Muskingum River - South Caldwick 138 kV line overloads to 103% of its summer emergency rating of 205 MVA. To fix this overload, perform sag study on this line at a total cost of **$150,000**.

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

8. West Phlio - Zanesville 138 kV line overloads to 100.7% of its summer emergency rating of 179 MVA. To fix this overload, upgrade and replace risers at West Philo station at a total cost of **$100,000**.

Contingency '6404_C1_05OHIOCT 138-2'

Open branch from bus 242998 to bus 243070 ckt 1 / 242998 05EPOINT 138 243070 05OHIOCT 138 1

Open branch from bus 243070 to bus 243094 ckt 1 / 243070 05OHIOCT 138 243094 05SCOSHC 138 1

End

EXISTING VIOLATIONS WITH CONTRIBUTIONS FROM X2-052 THAT REQUIRE NETWORK UPGRADES – COST ALLOCATION OF THESE UPGRADES TO BE DETERMINED BY PJM IN THE IMPACT STUDY

Note: The cost shown reflects the total cost for the network upgrade. IPP X2-052 is contributing to this existing upgrade and therefore may not responsible for the total cost of the network upgrade. Cost allocation will be determined during Impact Study stage.

SYSTEM NORMAL @ CAPACITY OUTPUT

No problems identified

CATEGORY B @ CAPACITY OUTPUT

1. Waterford - Muskingum 345 kV line overloads to 113% of its summer normal rating of 1409 MVA. To fix this overload, rebuild one mile of the Waterford – Muskingum River 345 kV line and upgrade risers at a total cost of **$6,000,000**.

```
Contingency '37_B2_TOR12_woMOP'
  Open branch from bus 242920 to bus 242925 ckt 1  /  242920 05BELMON     765 242925 05KAMMER     765 1
  Open branch from bus 242920 to bus 242516 ckt 1  /  242920 05BELMON     765 242516 05MOUNTN     765
1
  Open branch from bus 242920 to bus 235102 ckt 1  /  242920 05BELMON     765 235102 01BELMNT     500 1
end
```

2. Newcomerstown 138/69 kV Transformer overloads to 104.6% of its summer emergency rating of 69 MVA. To fix this overload, replace and upgrade transformer at a total cost of **$700,000**.

```
Contingency '5161_B2_TOR732'
 Open branch from bus 243020 to bus 243056 ckt 1  /  243020 05HILLVI     138 243056 05NEWCOM     138 1
  Open branch from bus 243020 to bus 243156 ckt 1  /  243020 05HILLVI     138 243156 05WNPHIL     138 1
  Open branch from bus 243020 to bus 245230 ckt 1  /  243020 05HILLVI     138 245230 HILVIEWL    12.0 1
end
```

CATEGORY C1, C2, C5 @ CAPACITY OUTPUT

No problems identified.

CATEGORY C1, C2, C5 @ ENERGY OUTPUT

Note: Under this category only violations are listed where a facility overload is **higher** for a Category C contingency at Energy output when compared with a Category B contingency at Energy output

1. Kammer - Ormet 138 kV line overloads to 115% of its summer emergency rating of 296 MVA. To fix this overload, perform a sag study at a total cost of **$35,000**.

```
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
```

2. Kammer - West Bellaire 138 kV line overloads to 11.2% of its summer emergency rating of 296 MVA. To fix this overload, perform a sag study on this line at total cost of **$40,000**.

```
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
```

3. West Millersburg - Wooster 138 kV line overload to 107.4% of its summer emergency rating of 185 MVA. To fix this overload, perform a sag study on this line at a total cost of **$45,000**.

```
Contingency '4831_C2_05KAMMER 765-NN'
  Open branch from bus 242925 to bus 242930 ckt 1  /  242925 05KAMMER    765 242930 05SCANTO    765 1
  Open branch from bus 242925 to bus 235117 ckt 1  /  242925 05KAMMER    765 235117 01KAMMER    500
1
  Open branch from bus 242930 to bus 242943 ckt 3  /  242930 05SCANTO    765 242943 05SCANTO    345 3
  Open branch from bus 235111 to bus 235117 ckt 1  /  235111 01 502 J    500 235117 01KAMMER    500 1
  Open branch from bus 242943 to bus 243092 ckt 4  /  242943 05SCANTO    345 243092 05SCANTE    138 4
 end
```

4. Dumont - Stillwell 345 kV line overloads to 111.2% of its summer emergency rating of 1409 MVA. The AEP portion can be addressed by performing a sag study at a total cost of **$35,000**. However, PJM will need to coordinate with Midwest ISO and NIPSCo to address the NIPSCo facilities.

Contingency '641'

Open branch from bus 243229 to bus 270771 ckt 1 / 243229 05OLIVE 345 270771 G ACR; T 345 1

Open branch from bus 243229 to bus 274804 ckt 1 / 243229 05OLIVE 345 274804 UPNOR;RP 345 1

end

5. Olive - Green Acres 345 kV line overloads to 111.6% of its summer emergency rating of 971 MVA. The AEP portion can be addressed by performing a sag study at a total cost of **$185,000**. However, PJM will need to coordinate with ComEd and NIPSCo to address this jointly owned facility.

Contingency '1750_C2'

Open branch from bus 243206 to bus 270644 ckt 1 / 243206 05DUMONT 765 270644 WILTO; 765 1

Open branch from bus 243206 to bus 243219 ckt 1 / 243206 05DUMONT 765 243219 05DUMONT 345 1

end

6. Olive – University Park 345 kV line overloads to 118.6% of its summer emergency rating of 971 MVA. The AEP portion can be addressed by performing a sag study at a total cost of **$245,000**. However, PJM will need to coordinate with ComEd to address this jointly owned facility.

Contingency '6389_C2_05DUMONT 765-B'

Open branch from bus 243206 to bus 746001 ckt 1 / 243206 05DUMONT 765 746001 X1-020 765 1

Open branch from bus 243206 to bus 270644 ckt 1 / 243206 05DUMONT 765 270644 WILTO; 765 1

end

7. LaPorte Junction – Michigan City 138 kV line overloads to 112.7% of its summer emergency rating of 156 MVA. The AEP portion can be addressed by performing a sag study at a total cost of **$15,000**. However, PJM will need to coordinate with Midwest ISO and NIPSCo to address the NIPSCo facilities. AEP only owns a small section of this line.

Contingency '641'

Open branch from bus 243229 to bus 270771 ckt 1 / 243229 05OLIVE 345 270771 G ACR; T 345 1

Open branch from bus 243229 to bus 274804 ckt 1 / 243229 05OLIVE 345 274804 UPNOR;RP 345 1

End

8. Belmont 765/500 kV transformer overloads to 121.9% of its summer emergency rating of 2094 MVA. Without addition of this IPP, same facility overloads to 102.9% of its summer emergency rating. Since, AEP doesn't own this transformer, AEP recommends PJM to work with Allegheny Power to determine cost associated with this transformer replacement.

Contingency '4831_C2_05KAMMER 765-NN'

Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

end

PJM will determine, during the impact study, if any of these costs are to be shared among PJM Generation Interconnection queue projects.

POTENTIAL VIOLATIONS TRIGGERED BY IPP X2-052 THAT DO NOT REQUIRE NETWORK UPGRADES BUT MAY RESULT IN CURTAILMENT

SYSTEM NORMAL @ ENERGY OUTPUT

1. Windsor - Tilton 138 kV line overloads to 129.1% of its summer normal rating.
2. Howard - Brookside 138 kV line overloads to 323.9% of its summer normal rating.
3. Howard - W3-085 138 kV line overloads to 112.9% of its summer normal rating.
4. Newcomerstown - South Coshocton 138 kV line overloads to 123.1% of its summer normal rating.
5. West Millersburg - South Millersburg 138 kV line overloads to 121.0% of its summer normal rating.
6. Bridgeview - Chandlers Mountain 138 kV line overloads to 127.7% of its summer normal rating.
7. Bethel Tap - West Dover 138 kV line overloads to 117.1% of its summer normal rating.
8. Buckhorn – South Millersburg 138 kV line overloads to 125.5% of its summer normal rating.
9. Newcomerstown - Haviland 138 kV line overloads to 142.6% of its summer normal rating.

10. Ohio Central - South Coshocton 138 kV line overloads to 122.2% of its summer normal rating.

11. Ohio Central - West Coshocton 138 kV line overloads to 111.9% of its summer normal rating.

12. New Carlisle - Trail Creek 138 kV line overloads to 105.2% of its summer normal rating.

13. College Corner - Collinsville 138 kV line kV line overloads to 99.9% of its summer normal rating.

CATEGORY B @ ENERGY OUTPUT

1. Kammer - Muskingum 345 kV line overloads to 113.2% of its summer emergency rating of 972 MVA. Without addition of this IPP, same facility overloads to 103.1% of its summer normal rating. To fix this overload, perform a sag study on this line at a total estimated cost of **$140,000.**

```
Contingency '6362_B3_05BELMON 765-1_woMOAB_MOP'

   Open branch from bus 242920 to bus 242925 ckt 1  /  242920 05BELMON     765 242925 05KAMMER     765
1

   Open branch from bus 242920 to bus 242516 ckt 1  /  242920 05BELMON     765 242516 05MOUNTN     765
1

   Open branch from bus 242920 to bus 235102 ckt 1  /  242920 05BELMON     765 235102 01BELMNT     500 1

   Open branch from bus 243045 to bus 243463 ckt 1  /  243045 05MUSKNG     138 243463 05WOLFCM     138
1

end
```

2. New Carlisle - Maple 138 kV line overloads to 131.7% of its summer emergency rating of 137 MVA. Without addition of this IPP, same facility overloads to 125.1% of its summer normal rating. To fix this overload, upgrade risers and perform a sag study on this line at a total estimated cost of **$140,000**.

```
Contingency '238_B3'

   Open branch from bus 243219 to bus 255113 ckt 1  /  243219 05DUMONT     345 255113 17STLWEL     345 1

   Open branch from bus 255100 to bus 255113 ckt 1  /  255100 17BABCOK     345 255113 17STLWEL     345 1

   Open branch from bus 255113 to bus 255180 ckt 1  /  255113 17STLWEL     345 255180 17STLWEL     138 1

end
```

3. Wolf Creek 138/138 kV Transformer (1:1 Transformer) overloads to 146% of its summer emergency rating of 215 MVA. Without addition of this IPP, same facility overloads to 123.3% of its summer emergency rating. To fix this overload, upgrade this 1:1 transformer at a total cost of **$500,000**.

Contingency '1284_B3_05BELMON 765-1_MOAB_woMOP'

Open branch from bus 242920 to bus 235102 ckt 1 / 242920 05BELMON 765 235102 01BELMNT 500 1

end

4. Newcomerstown 138/69 kV Transformer overloads to 135.7% of its summer emergency rating of 69 MVA. Without addition of this IPP, same facility overloads to 130% of its summer emergency rating. To fix this overload, upgrade this transformer at a total cost **$700,000**.

Contingency '5161_B2_TOR732'

Open branch from bus 243020 to bus 243056 ckt 1 / 243020 05HILLVI 138 243056 05NEWCOM 138 1

Open branch from bus 243020 to bus 243156 ckt 1 / 243020 05HILLVI 138 243156 05WNPHIL 138 1

end

5. Howard - North Bellville 138 kV line overloads to 112.7% of its summer emergency rating of 133 MVA. Without addition of this IPP, same facility overloads to 108.4% of its summer emergency rating. To fix this overload, perform a sag study on this line at a total cost of $**50,000**.

Contingency '5121_B2_TOR608'

Open branch from bus 238586 to bus 243024 ckt 1 / 238586 02BRKSID 138 243024 05HOWARD 138 1

end

6. Howard - North Lexington 138 kV line overloads to 1119% of its summer emergency rating of 179 MVA. Without addition of this IPP, same facility overloads to 115.9% of its summer emergency rating of 179 MVA. To fix this overload, upgrade risers and switches at a total cost of **$100,000.**

Contingency '5121_B2_TOR608'

Open branch from bus 238586 to bus 243024 ckt 1 / 238586 02BRKSID 138 243024 05HOWARD 138 1

end

CATEGORY C1, C2 or C5 @ ENERGY OUTPUT

Note: Under this category only violations are listed where a facility overload is **lower** for a Category C contingency at Energy output when compared with a Category B contingency at Energy output

1. Mountaineer - Belmont 765 kV line overloads to 99.7% of its summer emergency rating of 4253 MVA. Without addition of this IPP, same facility loads to less than 95% of its summer emergency rating.

   Contingency '4831_C2_05KAMMER 765-NN'

   Open branch from bus 242925 to bus 242930 ckt 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1

   Open branch from bus 242925 to bus 235117 ckt 1 / 242925 05KAMMER 765 235117 01KAMMER 500 1

   Open branch from bus 242930 to bus 242943 ckt 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3

   Open branch from bus 235111 to bus 235117 ckt 1 / 235111 01 502 J 500 235117 01KAMMER 500 1

   Open branch from bus 242943 to bus 243092 ckt 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4

   End

Network Impacts

Queue project X2-052 was studied as a(n) 1200.0 MW (1200.0 MW of which was Capacity) injection into AEP's system at the 50.0% tap between Dumont and Olive345.0 kV line. Project X2-052 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Potential transmission network impacts are as follows:

Generator Deliverability

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

- No problems identified.

Multiple Facility Contingency

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

1. (FE) The Hayes345/138 kV transformer (from bus 239289 to bus 239290 ckt 1) loads from 98.96% to 99.91% (DC power flow) of its emergency rating (573 MVA) for the tower

contingency 'C5-TWL-CR041', outage of the David Besse-Beaver and Beaver-Hayes 345kV circuits. This project contributes approximately 33.67 MW to the thermal violation.

Short Circuit

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

15.The analysis also has shown a significant fault contribution (i.e. above 3%) to 1 breaker, which was previously identified as over-dutied. The breaker is listed below:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With x2-052_AEP	Duty Percent Without x2-052_AEP	Duty Percent Difference	Note	DUTY_A	BKR_CAPA	ISC
0	05OLIVE 345.kV	E1	T	114.30%	102.60%	11.70%	Over 100%, > 3% contribution	55490.7	48568.2	40315.7

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.)

2. (PENELEC) The Roxbury-Roxbury 138/115 kV transformer (from bus 200532 to bus 200520 ckt 1) loads from 108.69% to 109.75% (DC power flow) of its emergency rating (138 MVA) for the single contingency 'PP1EB', loss of the Brighton-Conastone 500kV circuit. This project contributes approximately 9.04 MW to the thermal violation. The constraining element is the Roxbury 600 amp 115kV circuit breaker.

3. (BG&E/PL) The Conastone-Otter Creek Switchyard 230 kV line (from bus 220963 to bus 208048 ckt 1) loads from 133.02% to 133.99% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17', loss of the Conastone-Peach Bottom 500kV circuit. This project contributes approximately 32.62 MW to the thermal violation.

4. (AEP/NIPS) The Reynolds-Reynolds Substation Bus 345/138 kV transformer (from bus 243230 to bus 255173 ckt 1) loads from 118.17% to 119.52% (DC power flow) of its emergency rating (318 MVA) for the tower contingency '6484', loss of the Dequine-Meadow Lake circuits. This project contributes approximately 26.58 MW to the thermal violation.

5. (BG&E/PECO) The Graceton-Cooper 230 kV line (from bus 220964 to bus 214089 ckt 1) loads from 128.17% to 129.23% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17', loss of the Conastone-Peach Bottom circuit. This project contributes approximately 31.93 MW to the thermal violation.

6. (FE) The Lakeview-Greenfield 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 274.16% to 276.7% (DC power flow) of its emergency rating (243 MVA) for the tower

contingency 'C5-TWL-CR040', loss of the Davis Besse-Beaver and Davis Besse-Hayes 345kV circuits. This project contributes approximately 38.39 MW to the thermal violation.

7. (FE) The Avery-Skinrock 138 kV line (from bus 238549 to bus 239108 ckt 1) loads from 104.78% to 106.0% (DC power flow) of its emergency rating (194 MVA) for the tower contingency 'C5-TWL-CR041', loss of the Davis Besse-Beaver and Davis Besse-Hayes 345kV circuits. This project contributes approximately 14.65 MW to the thermal violation.

8. (PECO) The Cooper-Peach Bottom 230 kV line (from bus 214089 to bus 213869 ckt 1) loads from 125.69% to 126.75% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17', loss of the Conastone-Peach Bottom 500kV circuit. This project contributes approximately 31.93 MW to the thermal violation.

9. (FE) The Johnson-Lorain Q-2 138 kV line (from bus 238845 to bus 238915 ckt 1) loads from 110.92% to 112.68% (DC power flow) of its emergency rating (193 MVA) for the tower contingency '513', outage of the Avon-Beaver 345kV circuits #1 & #2. This project contributes approximately 21.08 MW to the thermal violation.

10. (FE) The W3-059A TAP-Avery 138 kV line (from bus 904550 to bus 238549 ckt 1) loads from 131.78% to 133.0% (DC power flow) of its emergency rating (195 MVA) for the tower contingency 'C5-TWL-CR041', loss of the Davis Besse-Beaver and Davis Besse-Hayes 345kV circuits. This project contributes approximately 14.77 MW to the thermal violation.

11. (FE) The Ottawa-Lakeview 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 200.24% to 202.07% (DC power flow) of its emergency rating (339 MVA) for the tower contingency 'C5-TWL-CR040', loss of the Davis Besse-Beaver and Davis Besse-Hayes 345kV circuits. This project contributes approximately 38.39 MW to the thermal violation.

12. (AP/PJM) The Kemptown-Emory Grove 500 500 kV line (from bus 235632 to bus 200101 ckt 1) loads from 122.58% to 123.4% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 118.21 MW to the thermal violation.

13. (FE) The Beaver-Carlisle 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 102.68% to 103.7% (DC power flow) of its emergency rating (1030 MVA) for the tower contingency '513', outage of the Avon-Beaver 345kV circuits #1 & #2. This project contributes approximately 64.93 MW to the thermal violation.

14. (AEP/FE) The Howard-Brookside 138 kV line (from bus 243024 to bus 238586 ckt 1) loads from 246.74% to 247.82% (DC power flow) of its emergency rating (173 MVA) for the tower contingency 'C5-TWL-CR040', loss of the Davis Besse-Beaver and Davis Besse-Hayes 345kV circuits. This project contributes approximately 11.57 MW to the thermal violation.

New System Reinforcements

1. The overload on the Hayes 345/138kV transformer will be mitigated with implementation of the project required to alleviate loading on the Ottawa - Lakeview - Greenfield 138kV line, which entails the construction of a new 138kV line from West Fremont - Groton - Hayes. A 138/69kv source will be constructed at Groton and a normally open point from West Fremont to Bellevue will no closed on the underlying 69kV system. Estimated cost: **$48,158,300**.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

2. The overload on the Roxbury 138/115kV transformer can be alleviated by installing a standard 115kV Circuit Breaker with 3000A. Total Estimated Cost: **$717,300.**

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

BG&E

The BG&E portion of the Conastone - Otter Creek 230kV line can be upgraded by reconducting from Gorsuch Mills to the Pennsylvania State Line (change of ownership to PPL). The existing circuit 2302 conductor is 1,590 kcmil 45/7 ACSR from Conastone to Gorsuch Mills and 795 kcm 30/19 ACSR from Gorsuch Mills to the PA State Line.

Assumptions:

- Reconductor with 1,590 kcm ACSR from Gorsuch Mills to PA line to match capability of remainder of line.
- Length of this line section is 1.7 miles.
- Towers can be reinforced instead of replaced.

The estimated cost for the BG&E portion of this upgrade is **$700,000**. Estimated construction time is **36 months**.

PP&L

The PPL portion of the project can be upgraded by re-conductoring Conastone-Otter Creek with 1590 ACSR. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency).

Estimated cost: $**17M**

The reconductoring of this line is already underway. The estimated in-service date is October 2013.

4. The overload on the Reynolds 345/138kV transformer can be alleviated by replacing the transformer. The Reynolds transformer is owned by NIPSCO who is a member of the Midwest ISO. Co-ordination of cost estimates and upgrades between PJM and MISO is done during the Impact Study.

5. The overload on the Graceton-Cooper 230kV circuit can be alleviated by the following work.

PECO

The PECO portion of the circuit from Cooper Substation to Graceton Substationwill be reconductored to achieve a minimum summer emergency rating of 725 MVA. The PECO portion of the line is approximately 4 miles long. The estimated cost to reconductor the 4 miles is $**2.8M**, and will require 24 months to complete.

BG&E

The BGE portion of the circuit will be rebuilt as a double circuit line using 1033.5kcmil ACSR creating one circuit by connecting the two lines into one. The rating for 2 – 1033.5kcmil 45/7 ACSR (Ortolan) at 125°C is 968/1227MVA SN/SE. BG&E ownership is for 1.85 miles and will require the rebuild of 11 structures. The line will be built as a double circuit line with the conductors jumpered across at the terminal ends.

The line construction is estimated to be **$3,000,000**. Two circuit breakers ($400,000/breaker) would need to be replaced at Graceton for a cost of **$800,000**. An additional cost of **$200,000** will be incurred for 4 circuit breaker disconnects and for line connections. The project is estimated to take 30 months to complete: 12 months for the CPCN process & design and an additional 18 months for construction. The total cost of the project is estimated at **$4.0M**.

6,11. The overload on the Lakeview-Greenfield 138kV circuit can be alleviated by installing a new 138kV line between proposed Hayes substation to West Fremont substation and installing a new 138kV loop from future Hayes-WestFremont 138kV line to the proposed Bellevue area substation.Also, installing a new 69kV loop from existing Bellevue-Greenfiled 69kV line to proposed Bellevue area substation. Estimated cost: **$48,158,300**.

7. The overload on the Avery-Skinrock 138kv circuit can be alleviated by upgrading the line design temperature from 150 degrees F to 212 degrees F by replacing four (4) H frame structures. The estimated cost is **$248,700.**

8. The overload on the Cooper-Peach Bottom 230kV circuit can be alleviated by reconductoring the 220-08 line from the Peach Bottom Tap to Cooper Substation to achieve 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.

9. The overload on the Johnson-Lorain Q-2 138kV circuit can be alleviated by replacing the substation conductor at Lorain station. PJM estimates the cost of replacement is **$300,000**.

10. The overload on the W2-059 Tap-Avery 138kV line can be alleviated by upgrading the line design temperature between Avery Sub and Str 2461. The total cost of this upgrade is estimated to be **$101,800** (PJM Network Upgrade Number N**3217**).

12. The overload on the Kemptown-Emory Grove 500kV line can be alleviated by upgrading the Conastone bay with two 4000A circuit breakers, four 4000A circuit breaker disconnects and a 4000 A line switch. The estimated cost is **$3M** and it is estimated to take 24-36 months to complete. The new rating will be 3710 MW.

13. The overload on the Beaver-Carlisle 345kV circuit can be alleviated by replacement of the wave trap at Beaver substation. The total cost for this work is **$73,400**.

14. The overload on the Howard-Brookside 138kV line can be alleviated by the following.

FirstEnergy and AEP are working together to come up with an upgrade for the Howard-Brookside 138kV tie line.

One possible solution is listed below:

- Replace Howard switch:
  Estimated Cost (2009 Dollars): **$100,000**

- Reconductor and rebuild the Howard – Brookside 138 kV circuit (8 miles):
  Estimated Cost (2009 Dollars): **$ 12,000,000**
  - This estimate only includes the reconductoring and rebuild of the AEP 8 mile section of the circuit, it does not include First Energy's 13.74 miles.

- Replace Howard line riser:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace Howard wavetrap:
  Estimated Cost (2009 Dollars): **$50,000**

- Replace Howard metering CT:
  Estimated Cost (2009 Dollars): **$100,000**

- Reconductor and rebuild the FirstEnergy portion of the Howard-Brookside 138kV circuit (approximately 13.75 miles).
  Estimated cost by PJM: **$15,000,000**

15. The over-dutied condition of the Olive E1 circuit breaker can be alleviated by replacing the existing breaker with one of higher interrupting capability. PJM has estimated the cost to replace the breaker is **$750,000.**