Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-176

Marengo 138 kV

June 14, 2019

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.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B. 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 Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is

contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 2.2.2. of Manual 14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

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

The Interconnection Customer ("IC") for Queue AD2-176 Marengo 138 kV project has proposed a 100 MW Energy, 60 MW Capacity solar PV facility to be located in Kenosha County, Wisconsin (POI is in McHenry County, Illinois). It is stated in the Attachment N, the facility will be known as Marengo Solar. It is proposed in the Interconnection Request (Attachment N) that the point of interconnection to be studied is the 138kV bus at Marengo which has been determined to be not feasible in prior queued projects. This will be studied as a new interconnection substation on the Marengo to Belvidere section of 12204 (red) as the primary and 12205 (blue) Line as the secondary POI. The one line indicates this project will have its own 40 mile attachment line (not shared with any other facility).

The IC has proposed a service date for this project of December 31, 2021.

Impacts on the MISO member transmission systems are not included in this analysis, but will be included in the System Impact Study Phase. Winter peak analysis will be performed in the System Impact Study phase.

This Generation Interconnection Feasibility Study provides analysis results to aid the IC in assessing the practicality and cost of incorporating the facility into the PJM system. This study was limited to load flow analyses of probable contingencies. If the IC elects to pursue a System Impact Study, a more comprehensive analysis will be performed.

Primary Point of Interconnection (Option-1)

The Interconnection Customer (IC) AD2-176, a 100MW solar facility, proposes to interconnect with the ComEd transmission system by tying into the Belvidere-Marengo-Pleasant Valley 138kV Line 12204.

Attachment Facilities

The IC AD2-176 generator lead would interconnect to a new 138kV Interconnection Substation. This interconnection would require one 138kV line MOD, a dead-end structure and revenue metering as shown in the one-line diagram.

The cost for the attachment facilities is estimated at $1M.

Scope of Work	Cost Estimate
Installation of one 138kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1,000,000

Direct Connection Network Upgrades

In order to accommodate interconnection of AD2-176, a new 138kV Interconnection Substation would need to be built close to the Belvidere-Pleasant Valley 138kV Line 12204, and close to the Marengo Tap.

The scope of work includes the installation of three 138kV circuit breakers in a "breaker-and-a-half" bus configuration and cutting in the Interconnection Substation to Belvidere-Pleasant Valley 138kV Line 12204, as shown in the one-line diagram below.

The IC is responsible for constructing all of the facilities on the IC side of the point of interconnection outside of the substation. It is assumed for the purposes of this report that the IC will obtain the site for the Interconnection Substation and right-of-way between the Interconnection Substation and the 138kV transmission line.

In the event that the IC exercises the option to build the interconnecting substation, the IC will be required to construct all interconnection facilities that will be turned over to ComEd in accordance with ComEd published standards and the PJM Tariff.

ComEd would design, engineer and construct the tie in of the Interconnection Substation to the Belvidere-Pleasant Valley 138kV Line 12204.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following tables.

For Option to Build Direct Connection cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	N/A
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
ComEd oversight and testing	$ 1,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 3,000,000

For ComEd building the interconnecting substation cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	$15,000,000
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 17,000,000

ComEd would take approximately 24-months to construct the substation and transmission line work after the ISA / ICSA are signed.

Non-Direct Connection Network Upgrades

The integration of the new 138kV Interconnection Substation would require relay/communications/SCADA upgrades at the Belvidere TSS 122, Marengo TSS 123 and Pleasant Valley TSS 141. The ComEd cost is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at Belvidere TSS 122 substation	$ 750,000
Relay/communications/SCADA upgrades at Marengo TSS 123 substation	$ 750,000
Relay/communications/SCADA upgrades at Pleasant Valley TSS 141 substation	$ 750,000
Total Cost Estimate (see notes below on cost estimate)	$ 2,250,000

Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the IC.

2) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

3) These estimates are not a guarantee of the maximum amount payable by the IC and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, IC will be responsible for paying all actual costs of ComEd's work.

4) The IC is responsible for all engineering, procurement, testing and construction of all equipment on the IC's side of the Point of Interconnection (POI).

5) These cost estimates do not include cost of acquiring right-of-way for the transmission line and purchasing any additional land, if needed, for the line terminations. The need and cost of acquiring property and associated legal costs will be investigated during Facilities Study for this project.

Network Impacts for Primary POI

The Queue Project AD2-176 was evaluated as a 100.0 MW (Capacity 60.0 MW) injection tapping the Belvidere; R to Marengo; RT 138kV line in the ComEd area. AD2-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-176 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

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)

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 165.96% to 166.05% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 14.24 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
```

```
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 152.91% to 153.07% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

4. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 134.89% to 134.97% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 9.99 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

5. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.8% to 133.88% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 10.06 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1          / COLLI;2M 345 COLLI; 765
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1          / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1          / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 END
```

6. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.79% to 133.88% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT4-5__'. This project contributes approximately 10.07 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT4-5__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
```

```
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

7. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.79% to 133.87% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT3-4__'. This project contributes approximately 10.07 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT3-4__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

8. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.78% to 133.86% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 10.08 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1          / COLLI; 765 PLANO; 765
 END
```

9. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

10. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 152.9% to 153.06% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

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

To be determined

Short Circuit
(Summary of impacted circuit breakers)

No issues identified

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

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

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 162.8% to 162.89% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 14.6 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

2. (CE - MISO NIPS) The BURNHAM ;0R-17MUNSTER 345 kV line (from bus 270677 to bus 255109 ckt 1) loads from 130.87% to 130.97% (**DC power flow**) of its emergency rating (1195 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 12.01 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

3. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.77% to 133.85% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 10.06 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1              / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

Light Load Analysis - 2021

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

Short Circuit

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

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

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

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 165.96% to 166.05% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 14.24 MW to the thermal violation.

AEP / MISO:

1) **(N4058) Sag study results: Stillwell - Dumont 345 kV line work will include the replacement of tower 20 with a custom steel pole, replacement of tower 24 with a custom H-frame and the removal of swing angle brackets on 2 structures. Cost estimate is $1.613 million. New SE rating will be 1718 MVA limited by a Dumont wavetrap and possibly the conductor. This upgrade is driven by a prior queue. Per PJM cost allocation rules, AC1-002 LTF presently does not receive cost allocation for this upgrade. Note: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, AC1-002 LTF could receive cost allocation.**

2) **Additional AEP-end upgrade: Rebuild 8.6 miles of the AEP owned line and upgrade necessary Dumont terminal equipment (wavetrap) at a cost of $20 million. PJM Network Upgrade N4790. New AEP-end ratings to be 1409/2045 MVA (SN/SE). Limited by Dumont risers.**

3) **Additional AEP-end upgrade: In addition to upgrading the Dumont risers, a different conductor (compared to the prior upgrade) will need to be selected to achieve the desired rating. The new conductor would be 1272 dual ACSR conductor. The additional cost for this work scope is $2 million. The new AEP-end ratings to be 1690/2278 MVA SN/SE (limited by the conductor). PJM Network Upgrade N5064.**

4) **Additional AEP-end upgrade: AEP said it would cost $4.8 million to string a second Stillwell- Dumont 345 kV line on the existing tower. The $4.8 million is for 8.5 miles of the AEP portion. Would need a NIPSCO portion (2.87 miles) cost estimate.**

5) **MISO end – ratings are 1409/1779 MVA. MISO end upgrade: Rebuild NIPSCO portion of line (2.87 miles) at a cost of $6.5 million and upgrade Stillwell substation equipment at a cost of $1.5 million. Total cost is $8.0 million. New expected MISO end ratings will be 1582/1898 MVA SN/SE.**

6) **Additional MISO-end upgrade: Reconductor 2.87 miles of transmission conductor to bundled 954 ACSS, replace substation conductor to bundled 2500 AL, and replace wavetrap. $12 million. New MISO-end ratings to be 2550/2923 MVA SN/SE.**

2. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

COMED:

ComEd post contingency facility overloaded by this event is Tr. 93 @ Station 112 Wilton Center. The upgrade will be to build out the 765kV ring bus at Wilton Center, installation of two 765 kV Bus Tie Circuit Breakers (BT 6-8 & 8-2) along with a relocation of 765kV L11216 from bus 6 to bus 8. Preliminary estimate for upgrade is $12 million with an estimated construction time line of 30 months. Note, the rating for Tr. 93 at Wilton Center will remain current however with this upgrade the 112-65-BT5-6 contingency file will no longer include the Wilton Center Tr. 94 and will allow both transformers to remain in service eliminating the overload.

3. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 152.91% to 153.07% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

Same as Contribution to Previously Identified #2

4. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 134.89% to 134.97% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 9.99 MW to the thermal violation.

AEP:
A sag study will be required on the 40.64 mile section line to mitigate the overload. Depending on the sag study results, cost for the upgrade is expected to be between $1,62,560 (no remediations required just sag study) and $81.28 million (complete line reconductor/rebuild required).

(A) Sag study: 6 to 12 months.
(B) Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.

COMED:
ComEd 345kV L97008 SSTE rating is 1134 MVA. The post contingency flow exceeds the rating therefore an upgrade is required. The upgrade will be to mitigate the sag on the line. A preliminary estimate for this upgrade is $ 22.6 million with a construction timeline of 30 months. Upon completion of the upgrade the ratings will be 1334/1334/1391/1523 MVA (SN/SLTE/SSTE/SLD).

5. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.8% to 133.88% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 10.06 MW to the thermal violation.

Same as Contribution to Previously Identified #4

6. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.79% to 133.88% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT4-5__'. This project contributes approximately 10.07 MW to the thermal violation.

Same as Contribution to Previously Identified #4

7. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.79% to 133.87% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT3-4__'. This project contributes approximately 10.07 MW to the thermal violation.

Same as Contribution to Previously Identified #4

8. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.78% to 133.86% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 10.08 MW to the thermal violation.

Same as Contribution to Previously Identified #4

9. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

Same as Contribution to Previously Identified #2

10. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 152.9% to 153.06% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

Same as Contribution to Previously Identified #2

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 165.96% to 166.05% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 14.24 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*0.98*
932012	*AC2-007 E*	*1.82*
932881	*AC2-115 1*	*2.78*
932891	*AC2-115 2*	*2.78*
932921	*AC2-116*	*0.97*
932931	*AC2-117*	*5.89*
933341	*AC2-147 C*	*1.02*
933342	*AC2-147 E*	*1.66*
933361	*AC2-149 C*	*1.08*
933362	*AC2-149 E*	*1.77*
933381	*AC2-151 C*	*1.13*
933382	*AC2-151 E*	*1.84*
933411	*AC2-154 C*	*3.05*
933412	*AC2-154 E*	*4.98*
933431	*AC2-156 C*	*1.11*
933432	*AC2-156 E*	*1.81*
933511	*AC2-166 C*	*2.72*
933512	*AC2-166 E*	*3.*
933911	*AD1-013 C O1*	*2.14*
933912	*AD1-013 E O1*	*3.43*
933931	*AD1-016 C*	*1.08*
933932	*AD1-016 E*	*1.77*
934101	*AD1-039 1*	*9.01*
934111	*AD1-039 2*	*9.36*
934401	*AD1-064 C O1*	*3.74*
934402	*AD1-064 E O1*	*17.49*
934421	*AD1-066*	*1.25*
934431	*AD1-067 C*	*0.15*
934432	*AD1-067 E*	*0.64*
LTF	*AD1-092*	*13.13*
LTF	*AD1-093*	*22.7*

LTF	*AD1-094*	*4.38*
934651	*AD1-096 C*	*1.04*
934652	*AD1-096 E*	*1.7*
934701	*AD1-098 C O1*	*8.02*
934702	*AD1-098 E O1*	*5.85*
934721	*AD1-100 C*	*26.69*
934722	*AD1-100 E*	*124.96*
934871	*AD1-116 C*	*1.1*
934872	*AD1-116 E*	*1.8*
934881	*AD1-117 C*	*6.27*
934882	*AD1-117 E*	*4.18*
934941	*AD1-126 C*	*6.81*
934942	*AD1-126 E*	*4.54*
934971	*AD1-129 C*	*1.05*
934972	*AD1-129 E*	*0.7*
935001	*AD1-133 C O1*	*24.44*
935002	*AD1-133 E O1*	*16.29*
936181	*AD2-024 C O1*	*1.08*
936182	*AD2-024 E O1*	*1.77*
936291	*AD2-038 C O1*	*2.73*
936292	*AD2-038 E O1*	*18.27*
936371	*AD2-047 C O1*	*2.73*
936372	*AD2-047 E O1*	*29.38*
936461	*AD2-060*	*3.21*
936511	*AD2-066 C O1*	*9.81*
936512	*AD2-066 E O1*	*6.54*
936781	*AD2-101 C*	*5.91*
936782	*AD2-101 E*	*27.66*
936791	*AD2-102 C*	*14.04*
936792	*AD2-102 E*	*13.49*
936961	*AD2-130 C*	*1.86*
936962	*AD2-130 E*	*0.25*
937001	*AD2-134 C*	*3.18*
937002	*AD2-134 E*	*13.16*
937031	*AD2-137 C O1*	*4.13*
937032	*AD2-137 E O1*	*19.34*
937051	*AD2-140 C O1*	*4.17*
937052	*AD2-140 E O1*	*19.51*
937061	*AD2-141 C O1*	*4.14*
937062	*AD2-141 E O1*	*19.54*
937071	*AD2-142 C O1*	*8.34*
937072	*AD2-142 E O1*	*39.03*
937121	*AD2-148 C O1*	*4.22*
937122	*AD2-148 E O1*	*19.75*
937131	*AD2-149 C O1*	*4.22*

937132	*AD2-149 E O1*	*19.75*
937141	*AD2-150 C O1*	*4.22*
937142	*AD2-150 E O1*	*19.75*
937181	*AD2-155 C O1*	*4.22*
937182	*AD2-155 E O1*	*19.75*
937311	*AD2-172 C*	*2.87*
937312	*AD2-172 E*	*3.97*
937321	*AD2-175 C*	*19.66*
937322	*AD2-175 E*	*13.1*
937331	*AD2-176 C O1*	*8.54*
937332	*AD2-176 E O1*	*5.69*
937401	*AD2-194 C1*	*4.54*
937411	*AD2-194 C2*	*4.53*
937402	*AD2-194 E1*	*4.54*
937412	*AD2-194 E2*	*4.53*
937531	*AD2-214 C*	*5.17*
937532	*AD2-214 E*	*2.43*
274832	*ANNAWAN ; 1U*	*12.73*
LTF	*BLUEG*	*0.15*
LTF	*CARR*	*0.91*
LTF	*CATAWBA*	*0.17*
274890	*CAYUG;1U E*	*16.05*
274891	*CAYUG;2U E*	*16.05*
LTF	*CBM-S1*	*4.13*
LTF	*CBM-W1*	*73.22*
LTF	*CBM-W2*	*62.78*
LTF	*CELEVELAND*	*0.46*
LTF	*CIN*	*3.09*
LTF	*CLIFTY*	*8.01*
LTF	*DEARBORN*	*3.83*
274859	*EASYR;U1 E*	*12.84*
274860	*EASYR;U2 E*	*12.84*
LTF	*G-007*	*2.36*
290051	*GSG-6; E*	*12.18*
LTF	*HAMLET*	*0.79*
LTF	*IPL*	*1.33*
940531	*J351*	*434.36*
951131	*J643*	*25.84*
981291	*J740 C*	*5.51*
981292	*J740 E*	*22.06*
938961	*J847*	*13.15*
275149	*KEMPTON ;1E*	*22.48*
290108	*LEEDK;1U E*	*28.29*
LTF	*MEC*	*45.53*
274850	*MENDOTA H;RU*	*6.29*

293061	*N-015 E*	*17.78*
293516	*O-009 E1*	*10.65*
293517	*O-009 E2*	*5.41*
293518	*O-009 E3*	*5.96*
293715	*O-029 E*	*11.38*
293716	*O-029 E*	*6.24*
293717	*O-029 E*	*5.74*
LTF	*O-066*	*15.17*
293644	*O22 E1*	*12.12*
293645	*O22 E2*	*23.53*
290021	*O50 E*	*22.63*
294392	*P-010 E*	*22.58*
294763	*P-046 E*	*10.95*
274888	*PILOT HIL;1E*	*22.48*
274830	*PWR VTREC;1U*	*7.11*
274831	*PWR VTREC;2U*	*7.11*
LTF	*RENSSELAER*	*0.71*
LTF	*ROSETON*	*5.17*
LTF	*ROWAN*	*0.47*
274789	*SE CHICAG;6U*	*1.39*
274790	*SE CHICAG;7U*	*1.39*
274791	*SE CHICAG;8U*	*1.39*
295111	*SUBLETTE E*	*3.17*
LTF	*TRIMBLE*	*0.06*
299993	*U3-031C*	*6.32*
903433	*W3-046*	*27.95*
905471	*W4-084*	*0.52*
274874	*WALNR;2U*	*2.79*
294502	*WALNR;2U E*	*11.15*
LTF	*WEC*	*9.34*
295109	*WESTBROOK E*	*6.52*
274687	*WILL CNTY;4U*	*79.77*
910542	*X3-005 E*	*1.01*
914641	*Y2-103*	*52.52*
915011	*Y3-013 1*	*4.38*
915021	*Y3-013 2*	*4.38*
915031	*Y3-013 3*	*4.38*
LTF	*Z1-043*	*33.46*
916502	*Z1-106 E1*	*1.47*
916504	*Z1-106 E2*	*1.47*
916512	*Z1-107 E*	*3.06*
916522	*Z1-108 E*	*2.9*
918051	*AA1-018 C*	*2.83*
918052	*AA1-018 E*	*18.97*
918972	*AA1-116 E*	*3.21*

918982	*AA1-117 E*	*3.21*
919221	*AA1-146*	*20.55*
919581	*AA2-030*	*20.55*
919591	*AA2-035*	*151.52*
920112	*AA2-107 E*	*2.86*
920272	*AA2-123 E*	*2.85*
930481	*AB1-089*	*76.71*
930491	*AB1-090*	*76.71*
930501	*AB1-091*	*89.49*
930761	*AB1-122 1*	*82.91*
930771	*AB1-122 2*	*86.1*
931221	*AB1-172*	*0.95*
LTF	*AB2-013*	*18.91*
924471	*AB2-096*	*49.4*
925161	*AB2-173*	*3.67*
925301	*AB2-191 C*	*1.47*
925302	*AB2-191 E*	*1.31*
925881	*AC1-067*	*200.82*
926311	*AC1-109 1*	*2.22*
926321	*AC1-109 2*	*2.22*
926331	*AC1-110 1*	*2.21*
926341	*AC1-110 2*	*2.21*
926351	*AC1-111 1*	*0.89*
926361	*AC1-111 2*	*0.89*
926371	*AC1-111 3*	*0.89*
926381	*AC1-111 4*	*0.89*
926391	*AC1-111 5*	*0.89*
926401	*AC1-111 6*	*0.89*
927511	*AC1-113 1*	*1.39*
927522	*AC1-113 2*	*1.39*
926431	*AC1-114*	*2.78*
927451	*AC1-142A 1*	*4.9*
927461	*AC1-142A 2*	*4.9*
926701	*AC1-153 C1*	*90.12*
926711	*AC1-153 C2*	*93.59*
926702	*AC1-153 E1*	*3.61*
926712	*AC1-153 E2*	*3.74*
926821	*AC1-168 C*	*1.35*
926822	*AC1-168 E*	*9.07*
927531	*AC1-185 1*	*0.8*
927541	*AC1-185 2*	*0.8*
927551	*AC1-185 3*	*0.8*
927561	*AC1-185 4*	*0.8*
927571	*AC1-185 5*	*0.8*
927581	*AC1-185 6*	*0.8*

927591	*AC1-185 7*	*0.8*
927601	*AC1-185 8*	*0.8*
927091	*AC1-204 1*	*84.36*
927101	*AC1-204 2*	*84.34*
927201	*AC1-214 C*	*1.34*
927202	*AC1-214 E*	*3.57*

Appendix 2

(CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.91*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.23*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.85*
933512	*AC2-166 E*	*3.15*
933911	*AD1-013 C O1*	*2.25*
933912	*AD1-013 E O1*	*3.6*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.85*
934101	*AD1-039 1*	*9.66*
934111	*AD1-039 2*	*9.84*
934401	*AD1-064 C O1*	*3.92*
934402	*AD1-064 E O1*	*18.38*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
LTF	*AD1-092*	*13.89*
LTF	*AD1-093*	*23.99*
LTF	*AD1-094*	*4.66*
934651	*AD1-096 C*	*1.09*
934652	*AD1-096 E*	*1.78*
934701	*AD1-098 C O1*	*8.42*

934702	*AD1-098 E O1*	*6.15*
934721	*AD1-100 C*	*35.21*
934722	*AD1-100 E*	*164.82*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934941	*AD1-126 C*	*7.16*
934942	*AD1-126 E*	*4.77*
934971	*AD1-129 C*	*1.1*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.67*
935002	*AD1-133 E O1*	*18.45*
936181	*AD2-024 C O1*	*1.14*
936182	*AD2-024 E O1*	*1.85*
936291	*AD2-038 C O1*	*2.89*
936292	*AD2-038 E O1*	*19.36*
936371	*AD2-047 C O1*	*2.87*
936372	*AD2-047 E O1*	*30.89*
936461	*AD2-060*	*3.38*
936511	*AD2-066 C O1*	*10.37*
936512	*AD2-066 E O1*	*6.92*
936781	*AD2-101 C*	*6.09*
936782	*AD2-101 E*	*28.49*
936791	*AD2-102 C*	*14.73*
936792	*AD2-102 E*	*14.15*
936961	*AD2-130 C*	*1.93*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.34*
937002	*AD2-134 E*	*13.82*
937031	*AD2-137 C O1*	*7.27*
937032	*AD2-137 E O1*	*34.02*
937051	*AD2-140 C O1*	*7.63*
937052	*AD2-140 E O1*	*35.73*
937061	*AD2-141 C O1*	*7.59*
937062	*AD2-141 E O1*	*35.77*
937071	*AD2-142 C O1*	*15.26*
937072	*AD2-142 E O1*	*71.46*
937121	*AD2-148 C O1*	*4.77*
937122	*AD2-148 E O1*	*22.34*
937131	*AD2-149 C O1*	*4.77*
937132	*AD2-149 E O1*	*22.34*
937141	*AD2-150 C O1*	*4.77*
937142	*AD2-150 E O1*	*22.34*
937181	*AD2-155 C O1*	*4.77*
937182	*AD2-155 E O1*	*22.34*
937311	*AD2-172 C*	*3.02*

937312	*AD2-172 E*	*4.16*
937321	*AD2-175 C*	*22.23*
937322	*AD2-175 E*	*14.82*
937331	*AD2-176 C O1*	*8.97*
937332	*AD2-176 E O1*	*5.98*
937401	*AD2-194 C1*	*4.8*
937411	*AD2-194 C2*	*4.8*
937402	*AD2-194 E1*	*4.8*
937412	*AD2-194 E2*	*4.8*
LTF	*BLUEG*	*2.6*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.94*
LTF	*CATAWBA*	*0.34*
274890	*CAYUG;1U E*	*20.65*
274891	*CAYUG;2U E*	*20.65*
LTF	*CBM-S1*	*2.*
LTF	*CBM-W1*	*74.76*
LTF	*CBM-W2*	*53.18*
LTF	*CELEVELAND*	*0.94*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*15.69*
LTF	*DEARBORN*	*2.77*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.54*
290051	*GSG-6; E*	*12.79*
LTF	*HAMLET*	*1.31*
275149	*KEMPTON ;1E*	*23.64*
290108	*LEEDK;1U E*	*29.72*
274770	*LINCOLN ;1U*	*4.13*
274771	*LINCOLN ;2U*	*4.13*
274772	*LINCOLN ;3U*	*4.13*
274773	*LINCOLN ;4U*	*4.13*
274774	*LINCOLN ;5U*	*4.13*
274775	*LINCOLN ;6U*	*4.13*
274776	*LINCOLN ;7U*	*4.13*
274777	*LINCOLN ;8U*	*4.13*
LTF	*MEC*	*46.92*
274850	*MENDOTA H;RU*	*6.6*
293061	*N-015 E*	*19.2*
LTF	*O-066*	*16.29*
293644	*O22 E1*	*12.6*
293645	*O22 E2*	*24.46*
290021	*O50 E*	*23.83*

294392	*P-010 E*	*24.38*
294763	*P-046 E*	*11.49*
274888	*PILOT HIL;1E*	*23.64*
274830	*PWR VTREC;1U*	*7.47*
274831	*PWR VTREC;2U*	*7.47*
296308	*R-030 C1*	*5.*
296271	*R-030 C2*	*5.*
296125	*R-030 C3*	*5.06*
296309	*R-030 E1*	*20.01*
296272	*R-030 E2*	*20.01*
296128	*R-030 E3*	*20.26*
LTF	*RENSSELAER*	*0.74*
LTF	*ROSETON*	*5.35*
LTF	*ROWAN*	*0.8*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.33*
LTF	*TRIMBLE*	*0.53*
299993	*U3-031C*	*11.53*
903433	*W3-046*	*17.81*
LTF	*WEC*	*9.78*
295109	*WESTBROOK E*	*6.85*
274687	*WILL CNTY;4U*	*82.07*
910542	*X3-005 E*	*0.9*
914641	*Y2-103*	*55.09*
915011	*Y3-013 1*	*4.59*
915021	*Y3-013 2*	*4.59*
915031	*Y3-013 3*	*4.59*
LTF	*Z1-043*	*35.61*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.17*
916522	*Z1-108 E*	*3.05*
917501	*Z2-087 C*	*3.91*
917502	*Z2-087 E*	*26.18*
918051	*AA1-018 C*	*3.02*
918052	*AA1-018 E*	*20.2*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*160.67*
920112	*AA2-107 E*	*3.*
920272	*AA2-123 E*	*2.99*
930481	*AB1-089*	*80.54*
930491	*AB1-090*	*80.54*
930501	*AB1-091*	*91.2*
930761	*AB1-122 1*	*88.88*

930771	*AB1-122 2*	*90.52*
931221	*AB1-172*	*0.98*
LTF	*AB2-013*	*19.99*
924041	*AB2-047 C O1*	*4.83*
924042	*AB2-047 E O1*	*32.3*
924471	*AB2-096*	*51.86*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.37*
925881	*AC1-067*	*167.77*
926311	*AC1-109 1*	*2.34*
926321	*AC1-109 2*	*2.34*
926331	*AC1-110 1*	*2.33*
926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.14*
927461	*AC1-142A 2*	*5.14*
926701	*AC1-153 C1*	*96.61*
926711	*AC1-153 C2*	*98.39*
926702	*AC1-153 E1*	*3.86*
926712	*AC1-153 E2*	*3.94*
927091	*AC1-204 1*	*89.19*
927101	*AC1-204 2*	*89.19*

Appendix 3

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 152.91% to 153.07% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.95*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.65*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.78*
933361	*AC2-149 C*	*1.16*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933411	*AC2-154 C*	*3.27*
933412	*AC2-154 E*	*5.34*
933431	*AC2-156 C*	*1.19*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.91*
933512	*AC2-166 E*	*3.22*
933911	*AD1-013 C O1*	*2.3*
933912	*AD1-013 E O1*	*3.67*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.89*
934101	*AD1-039 1*	*9.87*
934111	*AD1-039 2*	*10.05*
934401	*AD1-064 C O1*	*4.01*
934402	*AD1-064 E O1*	*18.77*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
LTF	*AD1-092*	*14.18*
LTF	*AD1-093*	*24.5*
LTF	*AD1-094*	*4.75*

934651	*AD1-096 C*	*1.12*
934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.6*
934702	*AD1-098 E O1*	*6.28*
934721	*AD1-100 C*	*35.9*
934722	*AD1-100 E*	*168.07*
934871	*AD1-116 C*	*1.2*
934872	*AD1-116 E*	*1.96*
934881	*AD1-117 C*	*6.72*
934882	*AD1-117 E*	*4.48*
934941	*AD1-126 C*	*7.31*
934942	*AD1-126 E*	*4.87*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.24*
935002	*AD1-133 E O1*	*18.83*
936181	*AD2-024 C O1*	*1.16*
936182	*AD2-024 E O1*	*1.89*
936291	*AD2-038 C O1*	*2.96*
936292	*AD2-038 E O1*	*19.78*
936371	*AD2-047 C O1*	*2.93*
936372	*AD2-047 E O1*	*31.53*
936461	*AD2-060*	*3.45*
936511	*AD2-066 C O1*	*10.59*
936512	*AD2-066 E O1*	*7.06*
936781	*AD2-101 C*	*6.21*
936782	*AD2-101 E*	*29.08*
936791	*AD2-102 C*	*15.05*
936792	*AD2-102 E*	*14.46*
936961	*AD2-130 C*	*1.97*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.42*
937002	*AD2-134 E*	*14.11*
937031	*AD2-137 C O1*	*7.4*
937032	*AD2-137 E O1*	*34.65*
937051	*AD2-140 C O1*	*7.77*
937052	*AD2-140 E O1*	*36.39*
937061	*AD2-141 C O1*	*7.73*
937062	*AD2-141 E O1*	*36.43*
937071	*AD2-142 C O1*	*15.54*
937072	*AD2-142 E O1*	*72.77*
937121	*AD2-148 C O1*	*4.87*
937122	*AD2-148 E O1*	*22.79*
937131	*AD2-149 C O1*	*4.87*
937132	*AD2-149 E O1*	*22.79*

937141	*AD2-150 C O1*	*4.87*
937142	*AD2-150 E O1*	*22.79*
937181	*AD2-155 C O1*	*4.87*
937182	*AD2-155 E O1*	*22.79*
937311	*AD2-172 C*	*3.08*
937312	*AD2-172 E*	*4.25*
937321	*AD2-175 C*	*22.68*
937322	*AD2-175 E*	*15.12*
937331	*AD2-176 C O1*	*9.16*
937332	*AD2-176 E O1*	*6.11*
937401	*AD2-194 C1*	*4.9*
937411	*AD2-194 C2*	*4.9*
937402	*AD2-194 E1*	*4.9*
937412	*AD2-194 E2*	*4.9*
LTF	*BLUEG*	*2.66*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.96*
LTF	*CATAWBA*	*0.35*
274890	*CAYUG;1U E*	*21.06*
274891	*CAYUG;2U E*	*21.06*
LTF	*CBM-S1*	*2.05*
LTF	*CBM-W1*	*76.35*
LTF	*CBM-W2*	*54.29*
LTF	*CELEVELAND*	*0.96*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*16.03*
LTF	*DEARBORN*	*2.83*
274859	*EASYR;U1 E*	*10.78*
274860	*EASYR;U2 E*	*10.78*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.59*
290051	*GSG-6; E*	*13.07*
LTF	*HAMLET*	*1.34*
275149	*KEMPTON ;1E*	*24.13*
290108	*LEEDK;1U E*	*30.35*
274770	*LINCOLN ;1U*	*4.24*
274771	*LINCOLN ;2U*	*4.24*
274772	*LINCOLN ;3U*	*4.24*
274773	*LINCOLN ;4U*	*4.24*
274774	*LINCOLN ;5U*	*4.24*
274775	*LINCOLN ;6U*	*4.24*
274776	*LINCOLN ;7U*	*4.24*
274777	*LINCOLN ;8U*	*4.24*

LTF	*MEC*	*47.91*
274850	*MENDOTA H;RU*	*6.74*
293061	*N-015 E*	*19.6*
LTF	*O-066*	*16.64*
293644	*O22 E1*	*12.86*
293645	*O22 E2*	*24.97*
290021	*O50 E*	*24.34*
294392	*P-010 E*	*24.89*
294763	*P-046 E*	*11.73*
274888	*PILOT HIL;1E*	*24.13*
274830	*PWR VTREC;1U*	*7.63*
274831	*PWR VTREC;2U*	*7.63*
296308	*R-030 C1*	*5.1*
296271	*R-030 C2*	*5.1*
296125	*R-030 C3*	*5.17*
296309	*R-030 E1*	*20.42*
296272	*R-030 E2*	*20.42*
296128	*R-030 E3*	*20.66*
LTF	*RENSSELAER*	*0.76*
LTF	*ROSETON*	*5.46*
LTF	*ROWAN*	*0.81*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.4*
LTF	*TRIMBLE*	*0.55*
299993	*U3-031C*	*11.84*
903433	*W3-046*	*30.11*
LTF	*WEC*	*9.99*
295109	*WESTBROOK E*	*7.*
274687	*WILL CNTY;4U*	*83.82*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.26*
915011	*Y3-013 1*	*4.69*
915021	*Y3-013 2*	*4.69*
915031	*Y3-013 3*	*4.69*
LTF	*Z1-043*	*36.36*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.24*
916522	*Z1-108 E*	*3.11*
917501	*Z2-087 C*	*3.99*
917502	*Z2-087 E*	*26.7*
918051	*AA1-018 C*	*3.08*
918052	*AA1-018 E*	*20.64*
918972	*AA1-116 E*	*3.45*
918982	*AA1-117 E*	*3.45*

919591	*AA2-035*	*164.09*
920112	*AA2-107 E*	*3.07*
920272	*AA2-123 E*	*3.05*
930481	*AB1-089*	*82.25*
930491	*AB1-090*	*82.25*
930501	*AB1-091*	*93.12*
930761	*AB1-122 1*	*90.76*
930771	*AB1-122 2*	*92.45*
931221	*AB1-172*	*1.*
LTF	*AB2-013*	*20.42*
924041	*AB2-047 C O1*	*4.92*
924042	*AB2-047 E O1*	*32.95*
924471	*AB2-096*	*52.97*
925301	*AB2-191 C*	*1.58*
925302	*AB2-191 E*	*1.4*
925881	*AC1-067*	*171.5*
926311	*AC1-109 1*	*2.39*
926321	*AC1-109 2*	*2.39*
926331	*AC1-110 1*	*2.37*
926341	*AC1-110 2*	*2.37*
926351	*AC1-111 1*	*0.95*
926361	*AC1-111 2*	*0.95*
926371	*AC1-111 3*	*0.95*
926381	*AC1-111 4*	*0.95*
926391	*AC1-111 5*	*0.95*
926401	*AC1-111 6*	*0.95*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.25*
927461	*AC1-142A 2*	*5.25*
926701	*AC1-153 C1*	*98.66*
926711	*AC1-153 C2*	*100.49*
926702	*AC1-153 E1*	*3.95*
926712	*AC1-153 E2*	*4.02*
927531	*AC1-185 1*	*0.86*
927541	*AC1-185 2*	*0.86*
927551	*AC1-185 3*	*0.86*
927561	*AC1-185 4*	*0.86*
927571	*AC1-185 5*	*0.86*
927581	*AC1-185 6*	*0.86*
927591	*AC1-185 7*	*0.86*
927601	*AC1-185 8*	*0.86*
927091	*AC1-204 1*	*91.1*
927101	*AC1-204 2*	*91.1*

Appendix 4

(CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 134.89% to 134.97% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 9.99 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*0.69*
932012	*AC2-007 E*	*1.28*
932881	*AC2-115 1*	*1.94*
932891	*AC2-115 2*	*1.94*
932921	*AC2-116*	*0.68*
932931	*AC2-117*	*10.47*
933341	*AC2-147 C*	*0.71*
933342	*AC2-147 E*	*1.16*
933361	*AC2-149 C*	*0.76*
933362	*AC2-149 E*	*1.24*
933381	*AC2-151 C*	*0.81*
933382	*AC2-151 E*	*1.31*
933411	*AC2-154 C*	*2.05*
933412	*AC2-154 E*	*3.34*
933431	*AC2-156 C*	*0.78*
933432	*AC2-156 E*	*1.28*
933511	*AC2-166 C*	*1.9*
933512	*AC2-166 E*	*2.1*
933911	*AD1-013 C O1*	*1.5*
933912	*AD1-013 E O1*	*2.39*
933931	*AD1-016 C*	*0.76*
933932	*AD1-016 E*	*1.24*
934101	*AD1-039 1*	*6.33*
934111	*AD1-039 2*	*6.54*
934401	*AD1-064 C O1*	*2.62*
934402	*AD1-064 E O1*	*12.25*
934431	*AD1-067 C*	*0.11*
934432	*AD1-067 E*	*0.45*
LTF	*AD1-092*	*9.*
LTF	*AD1-093*	*15.6*
LTF	*AD1-094*	*3.03*
934651	*AD1-096 C*	*0.73*

934652	*AD1-096 E*	*1.18*
934701	*AD1-098 C O1*	*5.6*
934702	*AD1-098 E O1*	*4.09*
934721	*AD1-100 C*	*18.07*
934722	*AD1-100 E*	*84.58*
934871	*AD1-116 C*	*0.84*
934872	*AD1-116 E*	*1.38*
934881	*AD1-117 C*	*4.36*
934882	*AD1-117 E*	*2.91*
934941	*AD1-126 C*	*4.77*
934942	*AD1-126 E*	*3.18*
934971	*AD1-129 C*	*0.74*
934972	*AD1-129 E*	*0.49*
935001	*AD1-133 C O1*	*16.79*
935002	*AD1-133 E O1*	*11.19*
936181	*AD2-024 C O1*	*0.76*
936182	*AD2-024 E O1*	*1.24*
936291	*AD2-038 C O1*	*2.*
936292	*AD2-038 E O1*	*13.35*
936371	*AD2-047 C O1*	*1.83*
936372	*AD2-047 E O1*	*19.72*
936461	*AD2-060*	*2.16*
936511	*AD2-066 C O1*	*6.9*
936512	*AD2-066 E O1*	*4.6*
936781	*AD2-101 C*	*3.5*
936782	*AD2-101 E*	*16.39*
936791	*AD2-102 C*	*9.81*
936792	*AD2-102 E*	*9.42*
936961	*AD2-130 C*	*1.3*
936962	*AD2-130 E*	*0.17*
937001	*AD2-134 C*	*2.22*
937002	*AD2-134 E*	*9.19*
937031	*AD2-137 C O1*	*2.7*
937032	*AD2-137 E O1*	*12.62*
937051	*AD2-140 C O1*	*2.7*
937052	*AD2-140 E O1*	*12.66*
937061	*AD2-141 C O1*	*2.69*
937062	*AD2-141 E O1*	*12.67*
937071	*AD2-142 C O1*	*5.41*
937072	*AD2-142 E O1*	*25.31*
937121	*AD2-148 C O1*	*2.73*
937122	*AD2-148 E O1*	*12.77*
937131	*AD2-149 C O1*	*2.73*
937132	*AD2-149 E O1*	*12.77*
937141	*AD2-150 C O1*	*2.73*

937142	*AD2-150 E O1*	*12.77*
937181	*AD2-155 C O1*	*2.73*
937182	*AD2-155 E O1*	*12.77*
937311	*AD2-172 C*	*2.01*
937312	*AD2-172 E*	*2.77*
937321	*AD2-175 C*	*12.7*
937322	*AD2-175 E*	*8.47*
937331	*AD2-176 C O1*	*5.99*
937332	*AD2-176 E O1*	*3.99*
937401	*AD2-194 C1*	*3.21*
937411	*AD2-194 C2*	*3.21*
937402	*AD2-194 E1*	*3.21*
937412	*AD2-194 E2*	*3.21*
937531	*AD2-214 C*	*3.57*
937532	*AD2-214 E*	*1.68*
274832	*ANNAWAN ; 1U*	*5.44*
LTF	*BLUEG*	*1.48*
LTF	*CALDERWOOD*	*0.02*
LTF	*CANNELTON*	*0.07*
LTF	*CARR*	*0.62*
LTF	*CATAWBA*	*0.21*
274890	*CAYUG;1U E*	*10.71*
274891	*CAYUG;2U E*	*10.71*
LTF	*CBM-S1*	*1.28*
LTF	*CBM-W1*	*44.45*
LTF	*CBM-W2*	*32.09*
LTF	*CELEVELAND*	*0.58*
LTF	*CHEOAH*	*0.03*
LTF	*CHILHOWEE*	*< 0.01*
LTF	*CLIFTY*	*9.14*
LTF	*DEARBORN*	*2.57*
274859	*EASYR;U1 E*	*8.93*
274860	*EASYR;U2 E*	*8.93*
LTF	*ELMERSMITH*	*0.13*
LTF	*G-007*	*1.65*
LTF	*GIBSON*	*0.06*
290051	*GSG-6; E*	*8.51*
LTF	*HAMLET*	*0.81*
275149	*KEMPTON ;1E*	*15.08*
290108	*LEEDK;1U E*	*19.79*
LTF	*MEC*	*30.47*
274850	*MENDOTA H;RU*	*4.39*
293061	*N-015 E*	*12.8*
293516	*O-009 E1*	*7.37*
293517	*O-009 E2*	*3.74*

293518	*O-009 E3*	*4.12*
293715	*O-029 E*	*7.88*
293716	*O-029 E*	*4.32*
293717	*O-029 E*	*3.97*
LTF	*O-066*	*10.57*
293644	*O22 E1*	*7.91*
293645	*O22 E2*	*15.35*
290021	*O50 E*	*15.77*
294392	*P-010 E*	*16.26*
294763	*P-046 E*	*7.64*
274888	*PILOT HIL;1E*	*15.08*
274830	*PWR VTREC;1U*	*4.98*
274831	*PWR VTREC;2U*	*4.98*
LTF	*RENSSELAER*	*0.49*
LTF	*ROSETON*	*3.54*
LTF	*ROWAN*	*0.49*
LTF	*SANTEETLA*	*< 0.01*
295111	*SUBLETTE E*	*2.21*
LTF	*TRIMBLE*	*0.3*
299993	*U3-031C*	*4.1*
291984	*U4-033*	*1.52*
274814	*UNIV PK N;0U*	*1.19*
274806	*UNIV PK N;2U*	*1.19*
274807	*UNIV PK N;3U*	*1.19*
274808	*UNIV PK N;4U*	*1.19*
274809	*UNIV PK N;5U*	*1.19*
274810	*UNIV PK N;6U*	*1.19*
274811	*UNIV PK N;7U*	*1.19*
274812	*UNIV PK N;8U*	*1.19*
274813	*UNIV PK N;9U*	*1.19*
274815	*UNIV PK N;XU*	*1.19*
274816	*UNIV PK N;YU*	*1.19*
903433	*W3-046*	*19.41*
905471	*W4-084*	*0.36*
274874	*WALNR;2U*	*1.93*
294502	*WALNR;2U E*	*7.74*
LTF	*WEC*	*6.54*
295109	*WESTBROOK E*	*4.55*
274687	*WILL CNTY;4U*	*53.33*
910542	*X3-005 E*	*0.52*
914641	*Y2-103*	*36.97*
915011	*Y3-013 1*	*3.08*
915021	*Y3-013 2*	*3.08*
915031	*Y3-013 3*	*3.08*
LTF	*Z1-043*	*23.15*

916502	*Z1-106 E1*	*1.03*
916504	*Z1-106 E2*	*1.04*
916512	*Z1-107 E*	*2.23*
916522	*Z1-108 E*	*2.04*
918051	*AA1-018 C*	*2.17*
918052	*AA1-018 E*	*14.5*
918972	*AA1-116 E*	*2.15*
918982	*AA1-117 E*	*2.15*
919221	*AA1-146*	*14.24*
919581	*AA2-030*	*14.24*
919591	*AA2-035*	*107.19*
920112	*AA2-107 E*	*2.*
920272	*AA2-123 E*	*2.*
930481	*AB1-089*	*53.65*
930491	*AB1-090*	*53.65*
930501	*AB1-091*	*58.45*
930761	*AB1-122 1*	*58.22*
930771	*AB1-122 2*	*60.21*
931221	*AB1-172*	*0.69*
LTF	*AB2-013*	*13.*
924471	*AB2-096*	*34.61*
925161	*AB2-173*	*2.54*
925301	*AB2-191 C*	*1.03*
925302	*AB2-191 E*	*0.91*
925881	*AC1-067*	*98.97*
926311	*AC1-109 1*	*1.57*
926321	*AC1-109 2*	*1.57*
926331	*AC1-110 1*	*1.55*
926341	*AC1-110 2*	*1.55*
926351	*AC1-111 1*	*0.63*
926361	*AC1-111 2*	*0.63*
926371	*AC1-111 3*	*0.63*
926381	*AC1-111 4*	*0.63*
926391	*AC1-111 5*	*0.63*
926401	*AC1-111 6*	*0.63*
927511	*AC1-113 1*	*0.97*
927522	*AC1-113 2*	*0.97*
926431	*AC1-114*	*1.94*
927451	*AC1-142A 1*	*3.49*
927461	*AC1-142A 2*	*3.48*
926701	*AC1-153 C1*	*63.28*
926711	*AC1-153 C2*	*65.45*
926702	*AC1-153 E1*	*2.53*
926712	*AC1-153 E2*	*2.62*
926821	*AC1-168 C*	*0.94*

926822	*AC1-168 E*	*6.31*
927531	*AC1-185 1*	*0.56*
927541	*AC1-185 2*	*0.56*
927551	*AC1-185 3*	*0.56*
927561	*AC1-185 4*	*0.56*
927571	*AC1-185 5*	*0.56*
927581	*AC1-185 6*	*0.56*
927591	*AC1-185 7*	*0.56*
927601	*AC1-185 8*	*0.56*
927091	*AC1-204 1*	*59.71*
927101	*AC1-204 2*	*59.76*

Appendix 5

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 153.2% to 153.37% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.95 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.91*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.23*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.85*
933512	*AC2-166 E*	*3.15*
933911	*AD1-013 C O1*	*2.25*
933912	*AD1-013 E O1*	*3.6*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.85*
934101	*AD1-039 1*	*9.66*
934111	*AD1-039 2*	*9.84*
934401	*AD1-064 C O1*	*3.92*
934402	*AD1-064 E O1*	*18.38*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
LTF	*AD1-092*	*13.89*
LTF	*AD1-093*	*23.99*
LTF	*AD1-094*	*4.66*
934651	*AD1-096 C*	*1.09*
934652	*AD1-096 E*	*1.78*
934701	*AD1-098 C O1*	*8.42*

934702	*AD1-098 E O1*	*6.15*
934721	*AD1-100 C*	*35.21*
934722	*AD1-100 E*	*164.82*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934941	*AD1-126 C*	*7.16*
934942	*AD1-126 E*	*4.77*
934971	*AD1-129 C*	*1.1*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.67*
935002	*AD1-133 E O1*	*18.45*
936181	*AD2-024 C O1*	*1.14*
936182	*AD2-024 E O1*	*1.85*
936291	*AD2-038 C O1*	*2.89*
936292	*AD2-038 E O1*	*19.36*
936371	*AD2-047 C O1*	*2.87*
936372	*AD2-047 E O1*	*30.89*
936461	*AD2-060*	*3.38*
936511	*AD2-066 C O1*	*10.37*
936512	*AD2-066 E O1*	*6.92*
936781	*AD2-101 C*	*6.09*
936782	*AD2-101 E*	*28.49*
936791	*AD2-102 C*	*14.73*
936792	*AD2-102 E*	*14.15*
936961	*AD2-130 C*	*1.93*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.34*
937002	*AD2-134 E*	*13.82*
937031	*AD2-137 C O1*	*7.27*
937032	*AD2-137 E O1*	*34.02*
937051	*AD2-140 C O1*	*7.63*
937052	*AD2-140 E O1*	*35.73*
937061	*AD2-141 C O1*	*7.59*
937062	*AD2-141 E O1*	*35.77*
937071	*AD2-142 C O1*	*15.26*
937072	*AD2-142 E O1*	*71.46*
937121	*AD2-148 C O1*	*4.77*
937122	*AD2-148 E O1*	*22.34*
937131	*AD2-149 C O1*	*4.77*
937132	*AD2-149 E O1*	*22.34*
937141	*AD2-150 C O1*	*4.77*
937142	*AD2-150 E O1*	*22.34*
937181	*AD2-155 C O1*	*4.77*
937182	*AD2-155 E O1*	*22.34*
937311	*AD2-172 C*	*3.02*

937312	*AD2-172 E*	*4.16*
937321	*AD2-175 C*	*22.23*
937322	*AD2-175 E*	*14.82*
937331	*AD2-176 C O1*	*8.97*
937332	*AD2-176 E O1*	*5.98*
937401	*AD2-194 C1*	*4.8*
937411	*AD2-194 C2*	*4.8*
937402	*AD2-194 E1*	*4.8*
937412	*AD2-194 E2*	*4.8*
LTF	*BLUEG*	*2.6*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.94*
LTF	*CATAWBA*	*0.34*
274890	*CAYUG;1U E*	*20.65*
274891	*CAYUG;2U E*	*20.65*
LTF	*CBM-S1*	*2.*
LTF	*CBM-W1*	*74.76*
LTF	*CBM-W2*	*53.18*
LTF	*CELEVELAND*	*0.94*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*15.69*
LTF	*DEARBORN*	*2.77*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.54*
290051	*GSG-6; E*	*12.79*
LTF	*HAMLET*	*1.31*
275149	*KEMPTON ;1E*	*23.64*
290108	*LEEDK;1U E*	*29.72*
274770	*LINCOLN ;1U*	*4.13*
274771	*LINCOLN ;2U*	*4.13*
274772	*LINCOLN ;3U*	*4.13*
274773	*LINCOLN ;4U*	*4.13*
274774	*LINCOLN ;5U*	*4.13*
274775	*LINCOLN ;6U*	*4.13*
274776	*LINCOLN ;7U*	*4.13*
274777	*LINCOLN ;8U*	*4.13*
LTF	*MEC*	*46.92*
274850	*MENDOTA H;RU*	*6.6*
293061	*N-015 E*	*19.2*
LTF	*O-066*	*16.29*
293644	*O22 E1*	*12.6*
293645	*O22 E2*	*24.46*
290021	*O50 E*	*23.83*

294392	*P-010 E*	*24.38*
294763	*P-046 E*	*11.49*
274888	*PILOT HIL;1E*	*23.64*
274830	*PWR VTREC;1U*	*7.47*
274831	*PWR VTREC;2U*	*7.47*
296308	*R-030 C1*	*5.*
296271	*R-030 C2*	*5.*
296125	*R-030 C3*	*5.06*
296309	*R-030 E1*	*20.01*
296272	*R-030 E2*	*20.01*
296128	*R-030 E3*	*20.26*
LTF	*RENSSELAER*	*0.74*
LTF	*ROSETON*	*5.35*
LTF	*ROWAN*	*0.8*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.33*
LTF	*TRIMBLE*	*0.53*
299993	*U3-031C*	*11.53*
903433	*W3-046*	*17.81*
LTF	*WEC*	*9.78*
295109	*WESTBROOK E*	*6.85*
274687	*WILL CNTY;4U*	*82.07*
910542	*X3-005 E*	*0.9*
914641	*Y2-103*	*55.09*
915011	*Y3-013 1*	*4.59*
915021	*Y3-013 2*	*4.59*
915031	*Y3-013 3*	*4.59*
LTF	*Z1-043*	*35.61*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.17*
916522	*Z1-108 E*	*3.05*
917501	*Z2-087 C*	*3.91*
917502	*Z2-087 E*	*26.18*
918051	*AA1-018 C*	*3.02*
918052	*AA1-018 E*	*20.2*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*160.67*
920112	*AA2-107 E*	*3.*
920272	*AA2-123 E*	*2.99*
930481	*AB1-089*	*80.54*
930491	*AB1-090*	*80.54*
930501	*AB1-091*	*91.2*
930761	*AB1-122 1*	*88.88*

930771	*AB1-122 2*	*90.52*
931221	*AB1-172*	*0.98*
LTF	*AB2-013*	*19.99*
924041	*AB2-047 C O1*	*4.83*
924042	*AB2-047 E O1*	*32.3*
924471	*AB2-096*	*51.86*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.37*
925881	*AC1-067*	*167.77*
926311	*AC1-109 1*	*2.34*
926321	*AC1-109 2*	*2.34*
926331	*AC1-110 1*	*2.33*
926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.14*
927461	*AC1-142A 2*	*5.14*
926701	*AC1-153 C1*	*96.61*
926711	*AC1-153 C2*	*98.39*
926702	*AC1-153 E1*	*3.86*
926712	*AC1-153 E2*	*3.94*
927091	*AC1-204 1*	*89.19*
927101	*AC1-204 2*	*89.19*

Appendix 6

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 152.9% to 153.06% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.27 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.95*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.65*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.78*
933361	*AC2-149 C*	*1.16*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933411	*AC2-154 C*	*3.27*
933412	*AC2-154 E*	*5.34*
933431	*AC2-156 C*	*1.19*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.91*
933512	*AC2-166 E*	*3.22*
933911	*AD1-013 C O1*	*2.3*
933912	*AD1-013 E O1*	*3.67*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.89*
934101	*AD1-039 1*	*9.87*
934111	*AD1-039 2*	*10.05*
934401	*AD1-064 C O1*	*4.01*
934402	*AD1-064 E O1*	*18.77*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
LTF	*AD1-092*	*14.18*
LTF	*AD1-093*	*24.5*
LTF	*AD1-094*	*4.75*

934651	*AD1-096 C*	*1.12*
934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.6*
934702	*AD1-098 E O1*	*6.28*
934721	*AD1-100 C*	*35.9*
934722	*AD1-100 E*	*168.07*
934871	*AD1-116 C*	*1.2*
934872	*AD1-116 E*	*1.96*
934881	*AD1-117 C*	*6.72*
934882	*AD1-117 E*	*4.48*
934941	*AD1-126 C*	*7.31*
934942	*AD1-126 E*	*4.87*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.24*
935002	*AD1-133 E O1*	*18.83*
936181	*AD2-024 C O1*	*1.16*
936182	*AD2-024 E O1*	*1.89*
936291	*AD2-038 C O1*	*2.96*
936292	*AD2-038 E O1*	*19.78*
936371	*AD2-047 C O1*	*2.93*
936372	*AD2-047 E O1*	*31.53*
936461	*AD2-060*	*3.45*
936511	*AD2-066 C O1*	*10.59*
936512	*AD2-066 E O1*	*7.06*
936781	*AD2-101 C*	*6.21*
936782	*AD2-101 E*	*29.08*
936791	*AD2-102 C*	*15.05*
936792	*AD2-102 E*	*14.46*
936961	*AD2-130 C*	*1.97*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.42*
937002	*AD2-134 E*	*14.11*
937031	*AD2-137 C O1*	*7.4*
937032	*AD2-137 E O1*	*34.65*
937051	*AD2-140 C O1*	*7.77*
937052	*AD2-140 E O1*	*36.39*
937061	*AD2-141 C O1*	*7.73*
937062	*AD2-141 E O1*	*36.43*
937071	*AD2-142 C O1*	*15.54*
937072	*AD2-142 E O1*	*72.77*
937121	*AD2-148 C O1*	*4.87*
937122	*AD2-148 E O1*	*22.79*
937131	*AD2-149 C O1*	*4.87*
937132	*AD2-149 E O1*	*22.79*

937141	*AD2-150 C O1*	*4.87*
937142	*AD2-150 E O1*	*22.79*
937181	*AD2-155 C O1*	*4.87*
937182	*AD2-155 E O1*	*22.79*
937311	*AD2-172 C*	*3.08*
937312	*AD2-172 E*	*4.25*
937321	*AD2-175 C*	*22.68*
937322	*AD2-175 E*	*15.12*
937331	*AD2-176 C O1*	*9.16*
937332	*AD2-176 E O1*	*6.11*
937401	*AD2-194 C1*	*4.9*
937411	*AD2-194 C2*	*4.9*
937402	*AD2-194 E1*	*4.9*
937412	*AD2-194 E2*	*4.9*
LTF	*BLUEG*	*2.66*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.96*
LTF	*CATAWBA*	*0.35*
274890	*CAYUG;1U E*	*21.06*
274891	*CAYUG;2U E*	*21.06*
LTF	*CBM-S1*	*2.05*
LTF	*CBM-W1*	*76.35*
LTF	*CBM-W2*	*54.29*
LTF	*CELEVELAND*	*0.96*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*16.03*
LTF	*DEARBORN*	*2.83*
274859	*EASYR;U1 E*	*10.78*
274860	*EASYR;U2 E*	*10.78*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.59*
290051	*GSG-6; E*	*13.07*
LTF	*HAMLET*	*1.34*
275149	*KEMPTON ;1E*	*24.13*
290108	*LEEDK;1U E*	*30.35*
274770	*LINCOLN ;1U*	*4.24*
274771	*LINCOLN ;2U*	*4.24*
274772	*LINCOLN ;3U*	*4.24*
274773	*LINCOLN ;4U*	*4.24*
274774	*LINCOLN ;5U*	*4.24*
274775	*LINCOLN ;6U*	*4.24*
274776	*LINCOLN ;7U*	*4.24*
274777	*LINCOLN ;8U*	*4.24*

LTF	*MEC*	*47.91*
274850	*MENDOTA H;RU*	*6.74*
293061	*N-015 E*	*19.6*
LTF	*O-066*	*16.64*
293644	*O22 E1*	*12.86*
293645	*O22 E2*	*24.97*
290021	*O50 E*	*24.34*
294392	*P-010 E*	*24.89*
294763	*P-046 E*	*11.73*
274888	*PILOT HIL;1E*	*24.13*
274830	*PWR VTREC;1U*	*7.63*
274831	*PWR VTREC;2U*	*7.63*
296308	*R-030 C1*	*5.1*
296271	*R-030 C2*	*5.1*
296125	*R-030 C3*	*5.17*
296309	*R-030 E1*	*20.42*
296272	*R-030 E2*	*20.42*
296128	*R-030 E3*	*20.66*
LTF	*RENSSELAER*	*0.76*
LTF	*ROSETON*	*5.46*
LTF	*ROWAN*	*0.81*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.4*
LTF	*TRIMBLE*	*0.55*
299993	*U3-031C*	*11.84*
903433	*W3-046*	*30.11*
LTF	*WEC*	*9.99*
295109	*WESTBROOK E*	*7.*
274687	*WILL CNTY;4U*	*83.82*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.26*
915011	*Y3-013 1*	*4.69*
915021	*Y3-013 2*	*4.69*
915031	*Y3-013 3*	*4.69*
LTF	*Z1-043*	*36.36*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.24*
916522	*Z1-108 E*	*3.11*
917501	*Z2-087 C*	*3.99*
917502	*Z2-087 E*	*26.7*
918051	*AA1-018 C*	*3.08*
918052	*AA1-018 E*	*20.64*
918972	*AA1-116 E*	*3.45*
918982	*AA1-117 E*	*3.45*

919591	*AA2-035*	*164.09*
920112	*AA2-107 E*	*3.07*
920272	*AA2-123 E*	*3.05*
930481	*AB1-089*	*82.25*
930491	*AB1-090*	*82.25*
930501	*AB1-091*	*93.12*
930761	*AB1-122 1*	*90.76*
930771	*AB1-122 2*	*92.45*
931221	*AB1-172*	*1.*
LTF	*AB2-013*	*20.42*
924041	*AB2-047 C O1*	*4.92*
924042	*AB2-047 E O1*	*32.95*
924471	*AB2-096*	*52.97*
925301	*AB2-191 C*	*1.58*
925302	*AB2-191 E*	*1.4*
925881	*AC1-067*	*171.5*
926311	*AC1-109 1*	*2.39*
926321	*AC1-109 2*	*2.39*
926331	*AC1-110 1*	*2.37*
926341	*AC1-110 2*	*2.37*
926351	*AC1-111 1*	*0.95*
926361	*AC1-111 2*	*0.95*
926371	*AC1-111 3*	*0.95*
926381	*AC1-111 4*	*0.95*
926391	*AC1-111 5*	*0.95*
926401	*AC1-111 6*	*0.95*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.25*
927461	*AC1-142A 2*	*5.25*
926701	*AC1-153 C1*	*98.66*
926711	*AC1-153 C2*	*100.49*
926702	*AC1-153 E1*	*3.95*
926712	*AC1-153 E2*	*4.02*
927531	*AC1-185 1*	*0.86*
927541	*AC1-185 2*	*0.86*
927551	*AC1-185 3*	*0.86*
927561	*AC1-185 4*	*0.86*
927571	*AC1-185 5*	*0.86*
927581	*AC1-185 6*	*0.86*
927591	*AC1-185 7*	*0.86*
927601	*AC1-185 8*	*0.86*
927091	*AC1-204 1*	*91.1*
927101	*AC1-204 2*	*91.1*

Secondary Point of Interconnection (Option-2)

Under this option, the IC AD2-176, a 100MW solar facility, proposes to interconnect with the ComEd transmission system by tying into the Belvidere-Marengo-Woodstock 138kV Line 12205.

Attachment Facilities

The IC AD2-176 generator lead would interconnect to a new 138kV Interconnection Substation. This interconnection would require one 138kV line MOD, a dead-end structure and revenue metering as shown in the one-line diagram.

The cost for the attachment facilities is estimated at $1M.

Scope of Work	Cost Estimate
Installation of one 138kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1,000,000

Direct Connection Network Upgrades

In order to accommodate interconnection of AD2-176, a new 138kV Interconnection Substation would need to be built close to the Belvidere-Woodstock 138kV Line 12205, and close to the Marengo Tap.

The scope of work includes the installation of three 138kV circuit breakers in a "breaker-and-a-half" bus configuration and cutting in the Interconnection Substation to Belvidere-Woodstock 138kV Line 12205, as shown in the one-line diagram below.

The IC is responsible for constructing all of the facilities on the IC side of the point of interconnection outside of the substation. It is assumed for the purposes of this report that the IC will obtain the site for the Interconnection Substation and right-of-way between the Interconnection Substation and the 138kV transmission line.

In the event that the IC exercises the option to build the interconnecting substation, the IC will be required to construct all interconnection facilities that will be turned over to ComEd in accordance with ComEd published standards and the PJM Tariff.

ComEd would design, engineer and construct the tie in of the Interconnection Substation to the Belvidere-Woodstock 138kV Line 12205.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following tables.

For Option to Build Direct Connection cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	N/A
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
ComEd oversight and testing	$ 1,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 3,000,000

For ComEd building the interconnecting substation cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	$15,000,000
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 17,000,000

ComEd would take approximately 24-months to construct the substation and transmission line work after the ISA / ICSA are signed.

Non-Direct Connection Network Upgrades

The integration of the new 138kV Interconnection Substation would require relay/communications/SCADA upgrades at the Belvidere TSS 122, Marengo TSS 123 and Woodstock TSS 151. The ComEd cost is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at Belvidere TSS 122 substation	$ 750,000
Relay/communications/SCADA upgrades at Marengo TSS 123 substation	$ 750,000
Relay/communications/SCADA upgrades at Woodstock TSS 151 substation	$ 750,000
Total Cost Estimate (see notes below on cost estimate)	$ 2,250,000

Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the IC.

2) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

3) These estimates are not a guarantee of the maximum amount payable by the IC and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, IC will be responsible for paying all actual costs of ComEd's work.

4) The IC is responsible for all engineering, procurement, testing and construction of all equipment on the IC's side of the Point of Interconnection (POI).

5) These cost estimates do not include cost of acquiring right-of-way for the transmission line and purchasing any additional land, if needed, for the line terminations. The need and cost of acquiring property and associated legal costs will be investigated during Facilities Study for this project.

Network Impacts for Secondary POI

The Queue Project AD2-176 was evaluated as a 100.0 MW (Capacity 60.0 MW) injection tapping the Belvidere; B to Marengo; BT 138kV line in the ComEd area. Project AD2-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-176 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

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)

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 166.03% to 166.12% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 14.12 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 150.46% to 150.61% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.83 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
```

```
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 152.75% to 152.89% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.14 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

4. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 134.84% to 134.92% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 9.9 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

5. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.76% to 133.83% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT4-5__'. This project contributes approximately 9.97 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT4-5__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

6. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.75% to 133.83% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 9.97 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1          / COLLI;2M 345 COLLI; 765
```

```
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1          / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1          / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 END
```

7. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.75% to 133.83% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT3-4__'. This project contributes approximately 9.97 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT3-4__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

8. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.73% to 133.8% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 9.99 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1          / COLLI; 765 PLANO; 765
 END
```

9. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 150.46% to 150.61% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.83 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

10. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 152.75% to 152.89% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.14 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

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

To be determined

Short Circuit
(Summary of impacted circuit breakers)

No issues identified

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

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

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 162.87% to 162.96% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 14.47 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

2. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 133.71% to 133.79% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 9.97 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

Light Load Analysis - 2021

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

Short Circuit

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

None.

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

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

None

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 166.03% to 166.12% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 14.12 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*0.98*
932012	*AC2-007 E*	*1.82*
932881	*AC2-115 1*	*2.78*
932891	*AC2-115 2*	*2.78*
932921	*AC2-116*	*0.97*
932931	*AC2-117*	*5.89*
933341	*AC2-147 C*	*1.02*
933342	*AC2-147 E*	*1.66*
933361	*AC2-149 C*	*1.08*
933362	*AC2-149 E*	*1.77*
933381	*AC2-151 C*	*1.13*
933382	*AC2-151 E*	*1.84*
933411	*AC2-154 C*	*3.05*
933412	*AC2-154 E*	*4.98*
933431	*AC2-156 C*	*1.11*
933432	*AC2-156 E*	*1.81*
933511	*AC2-166 C*	*2.72*
933512	*AC2-166 E*	*3.*
933911	*AD1-013 C O1*	*2.14*
933912	*AD1-013 E O1*	*3.43*
933931	*AD1-016 C*	*1.08*
933932	*AD1-016 E*	*1.77*
934101	*AD1-039 1*	*9.01*
934111	*AD1-039 2*	*9.36*
934401	*AD1-064 C O1*	*3.74*
934402	*AD1-064 E O1*	*17.49*
934431	*AD1-067 C*	*0.15*
934432	*AD1-067 E*	*0.64*
LTF	*AD1-092*	*13.13*
LTF	*AD1-093*	*22.7*
LTF	*AD1-094*	*4.38*
934651	*AD1-096 C*	*1.04*

934652	*AD1-096 E*	*1.7*
934701	*AD1-098 C O1*	*8.02*
934702	*AD1-098 E O1*	*5.85*
934721	*AD1-100 C*	*26.69*
934722	*AD1-100 E*	*124.96*
934871	*AD1-116 C*	*1.1*
934872	*AD1-116 E*	*1.8*
934881	*AD1-117 C*	*6.27*
934882	*AD1-117 E*	*4.18*
934941	*AD1-126 C*	*6.81*
934942	*AD1-126 E*	*4.54*
934971	*AD1-129 C*	*1.05*
934972	*AD1-129 E*	*0.7*
935001	*AD1-133 C O1*	*24.44*
935002	*AD1-133 E O1*	*16.29*
936181	*AD2-024 C O2*	*1.08*
936182	*AD2-024 E O2*	*1.77*
936291	*AD2-038 C O2*	*2.68*
936292	*AD2-038 E O2*	*17.91*
936371	*AD2-047 C O2*	*2.86*
936372	*AD2-047 E O2*	*30.8*
936461	*AD2-060*	*3.21*
936511	*AD2-066 C O2*	*10.34*
936512	*AD2-066 E O2*	*6.89*
936781	*AD2-101 C*	*5.91*
936782	*AD2-101 E*	*27.66*
936791	*AD2-102 C*	*14.04*
936792	*AD2-102 E*	*13.49*
936961	*AD2-130 C*	*1.86*
936962	*AD2-130 E*	*0.25*
937001	*AD2-134 C*	*3.18*
937002	*AD2-134 E*	*13.16*
937031	*AD2-137 C O2*	*4.17*
937032	*AD2-137 E O2*	*19.51*
937051	*AD2-140 C O2*	*4.13*
937052	*AD2-140 E O2*	*19.34*
937061	*AD2-141 C O2*	*4.19*
937062	*AD2-141 E O2*	*19.78*
937071	*AD2-142 C O2*	*8.26*
937072	*AD2-142 E O2*	*38.69*
937121	*AD2-148 C O2*	*3.88*
937122	*AD2-148 E O2*	*18.16*
937131	*AD2-149 C O2*	*3.88*
937132	*AD2-149 E O2*	*18.16*
937141	*AD2-150 C O2*	*3.88*

937142	*AD2-150 E O2*	*18.16*
937161	*AD2-153 C O2*	*4.47*
937162	*AD2-153 E O2*	*20.91*
937181	*AD2-155 C O2*	*4.13*
937182	*AD2-155 E O2*	*19.34*
937311	*AD2-172 C*	*2.87*
937312	*AD2-172 E*	*3.97*
937321	*AD2-175 C*	*19.66*
937322	*AD2-175 E*	*13.1*
937331	*AD2-176 C O2*	*8.47*
937332	*AD2-176 E O2*	*5.65*
937401	*AD2-194 C1*	*4.54*
937411	*AD2-194 C2*	*4.53*
937402	*AD2-194 E1*	*4.54*
937412	*AD2-194 E2*	*4.53*
937531	*AD2-214 C*	*5.17*
937532	*AD2-214 E*	*2.43*
274832	*ANNAWAN ; 1U*	*8.26*
LTF	*BLUEG*	*0.15*
LTF	*CARR*	*0.91*
LTF	*CATAWBA*	*0.17*
274890	*CAYUG;1U E*	*16.05*
274891	*CAYUG;2U E*	*16.05*
LTF	*CBM-S1*	*4.13*
LTF	*CBM-W1*	*73.22*
LTF	*CBM-W2*	*62.78*
LTF	*CELEVELAND*	*0.46*
LTF	*CIN*	*3.09*
LTF	*CLIFTY*	*8.01*
LTF	*DEARBORN*	*3.83*
274859	*EASYR;U1 E*	*12.84*
274860	*EASYR;U2 E*	*12.84*
LTF	*G-007*	*2.36*
290051	*GSG-6; E*	*12.18*
LTF	*HAMLET*	*0.79*
LTF	*IPL*	*1.33*
940531	*J351*	*434.36*
951131	*J643*	*25.84*
981291	*J740 C*	*5.51*
981292	*J740 E*	*22.06*
938961	*J847*	*13.15*
275149	*KEMPTON ;1E*	*22.48*
290108	*LEEDK;1U E*	*28.29*
LTF	*MEC*	*45.53*
274850	*MENDOTA H;RU*	*6.29*

293061	*N-015 E*	*17.78*
293516	*O-009 E1*	*10.65*
293517	*O-009 E2*	*5.41*
293518	*O-009 E3*	*5.96*
293715	*O-029 E*	*11.38*
293716	*O-029 E*	*6.24*
293717	*O-029 E*	*5.74*
LTF	*O-066*	*15.17*
293644	*O22 E1*	*12.12*
293645	*O22 E2*	*23.53*
290021	*O50 E*	*22.63*
294392	*P-010 E*	*22.58*
294763	*P-046 E*	*10.95*
274888	*PILOT HIL;1E*	*22.48*
274830	*PWR VTREC;1U*	*7.11*
274831	*PWR VTREC;2U*	*7.11*
LTF	*RENSSELAER*	*0.71*
LTF	*ROSETON*	*5.17*
LTF	*ROWAN*	*0.47*
274789	*SE CHICAG;6U*	*1.39*
274790	*SE CHICAG;7U*	*1.39*
274791	*SE CHICAG;8U*	*1.39*
295111	*SUBLETTE E*	*3.17*
LTF	*TRIMBLE*	*0.06*
299993	*U3-031C*	*6.32*
903433	*W3-046*	*27.95*
905471	*W4-084*	*0.52*
274874	*WALNR;2U*	*2.79*
294502	*WALNR;2U E*	*11.15*
LTF	*WEC*	*9.34*
295109	*WESTBROOK E*	*6.52*
274687	*WILL CNTY;4U*	*79.77*
910542	*X3-005 E*	*1.01*
914641	*Y2-103*	*52.52*
915011	*Y3-013 1*	*4.38*
915021	*Y3-013 2*	*4.38*
915031	*Y3-013 3*	*4.38*
LTF	*Z1-043*	*33.46*
916502	*Z1-106 E1*	*1.47*
916504	*Z1-106 E2*	*1.47*
916512	*Z1-107 E*	*3.06*
916522	*Z1-108 E*	*2.9*
918051	*AA1-018 C*	*2.83*
918052	*AA1-018 E*	*18.97*
918972	*AA1-116 E*	*3.21*

918982	*AA1-117 E*	*3.21*
919221	*AA1-146*	*20.55*
919581	*AA2-030*	*20.55*
919591	*AA2-035*	*151.52*
920112	*AA2-107 E*	*2.86*
920272	*AA2-123 E*	*2.85*
930481	*AB1-089*	*76.71*
930491	*AB1-090*	*76.71*
930501	*AB1-091*	*89.49*
930761	*AB1-122 1*	*82.91*
930771	*AB1-122 2*	*86.1*
931221	*AB1-172*	*0.95*
LTF	*AB2-013*	*18.91*
924471	*AB2-096*	*49.4*
925161	*AB2-173*	*3.67*
925301	*AB2-191 C*	*1.47*
925302	*AB2-191 E*	*1.31*
925881	*AC1-067*	*200.82*
926311	*AC1-109 1*	*2.22*
926321	*AC1-109 2*	*2.22*
926331	*AC1-110 1*	*2.21*
926341	*AC1-110 2*	*2.21*
926351	*AC1-111 1*	*0.89*
926361	*AC1-111 2*	*0.89*
926371	*AC1-111 3*	*0.89*
926381	*AC1-111 4*	*0.89*
926391	*AC1-111 5*	*0.89*
926401	*AC1-111 6*	*0.89*
927511	*AC1-113 1*	*1.39*
927522	*AC1-113 2*	*1.39*
926431	*AC1-114*	*2.78*
927451	*AC1-142A 1*	*4.9*
927461	*AC1-142A 2*	*4.9*
926701	*AC1-153 C1*	*90.12*
926711	*AC1-153 C2*	*93.59*
926702	*AC1-153 E1*	*3.61*
926712	*AC1-153 E2*	*3.74*
926821	*AC1-168 C*	*1.35*
926822	*AC1-168 E*	*9.07*
927531	*AC1-185 1*	*0.8*
927541	*AC1-185 2*	*0.8*
927551	*AC1-185 3*	*0.8*
927561	*AC1-185 4*	*0.8*
927571	*AC1-185 5*	*0.8*
927581	*AC1-185 6*	*0.8*

927591	*AC1-185 7*	*0.8*
927601	*AC1-185 8*	*0.8*
927091	*AC1-204 1*	*84.36*
927101	*AC1-204 2*	*84.34*

Appendix 2

(CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 150.46% to 150.61% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.83 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.91*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
932931	*AC2-117*	*6.51*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.23*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.85*
933512	*AC2-166 E*	*3.15*
933911	*AD1-013 C O1*	*2.25*
933912	*AD1-013 E O1*	*3.6*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.85*
934101	*AD1-039 1*	*9.66*
934111	*AD1-039 2*	*9.84*
934401	*AD1-064 C O1*	*3.92*
934402	*AD1-064 E O1*	*18.37*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
LTF	*AD1-092*	*13.89*
LTF	*AD1-093*	*23.99*
LTF	*AD1-094*	*4.66*
934651	*AD1-096 C*	*1.09*
934652	*AD1-096 E*	*1.78*
934701	*AD1-098 C O1*	*8.42*

934702	*AD1-098 E O1*	*6.15*
934721	*AD1-100 C*	*35.21*
934722	*AD1-100 E*	*164.82*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934881	*AD1-117 C*	*0.61*
934882	*AD1-117 E*	*0.4*
934941	*AD1-126 C*	*7.16*
934942	*AD1-126 E*	*4.77*
934971	*AD1-129 C*	*1.1*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.67*
935002	*AD1-133 E O1*	*18.45*
936181	*AD2-024 C O2*	*1.14*
936182	*AD2-024 E O2*	*1.85*
936291	*AD2-038 C O2*	*2.85*
936292	*AD2-038 E O2*	*19.06*
936371	*AD2-047 C O2*	*2.93*
936372	*AD2-047 E O2*	*31.55*
936461	*AD2-060*	*3.38*
936511	*AD2-066 C O2*	*11.11*
936512	*AD2-066 E O2*	*7.41*
936781	*AD2-101 C*	*6.09*
936782	*AD2-101 E*	*28.49*
936791	*AD2-102 C*	*14.73*
936792	*AD2-102 E*	*14.15*
936961	*AD2-130 C*	*1.93*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.34*
937002	*AD2-134 E*	*13.82*
937031	*AD2-137 C O2*	*7.63*
937032	*AD2-137 E O2*	*35.73*
937051	*AD2-140 C O2*	*7.27*
937052	*AD2-140 E O2*	*34.02*
937061	*AD2-141 C O2*	*4.74*
937062	*AD2-141 E O2*	*22.37*
937071	*AD2-142 C O2*	*14.53*
937072	*AD2-142 E O2*	*68.03*
937121	*AD2-148 C O2*	*5.34*
937122	*AD2-148 E O2*	*24.98*
937131	*AD2-149 C O2*	*5.34*
937132	*AD2-149 E O2*	*24.98*
937141	*AD2-150 C O2*	*5.34*
937142	*AD2-150 E O2*	*24.98*
937161	*AD2-153 C O2*	*4.53*

937162	*AD2-153 E O2*	*21.21*
937171	*AD2-154 C O2*	*3.97*
937172	*AD2-154 E O2*	*18.59*
937181	*AD2-155 C O2*	*4.34*
937182	*AD2-155 E O2*	*20.33*
937311	*AD2-172 C*	*3.02*
937312	*AD2-172 E*	*4.16*
937321	*AD2-175 C*	*22.23*
937322	*AD2-175 E*	*14.82*
937331	*AD2-176 C O2*	*8.9*
937332	*AD2-176 E O2*	*5.93*
937401	*AD2-194 C1*	*4.8*
937411	*AD2-194 C2*	*4.8*
937402	*AD2-194 E1*	*4.8*
937412	*AD2-194 E2*	*4.8*
LTF	*BLUEG*	*2.6*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.94*
LTF	*CATAWBA*	*0.34*
274890	*CAYUG;1U E*	*20.65*
274891	*CAYUG;2U E*	*20.65*
LTF	*CBM-S1*	*2.*
LTF	*CBM-W1*	*74.76*
LTF	*CBM-W2*	*53.18*
LTF	*CELEVELAND*	*0.94*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*15.69*
LTF	*DEARBORN*	*2.77*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.54*
290051	*GSG-6; E*	*12.79*
LTF	*HAMLET*	*1.31*
275149	*KEMPTON ;1E*	*23.64*
290108	*LEEDK;1U E*	*29.72*
274770	*LINCOLN ;1U*	*4.13*
274771	*LINCOLN ;2U*	*4.13*
274772	*LINCOLN ;3U*	*4.13*
274773	*LINCOLN ;4U*	*4.13*
274774	*LINCOLN ;5U*	*4.13*
274775	*LINCOLN ;6U*	*4.13*
274776	*LINCOLN ;7U*	*4.13*
274777	*LINCOLN ;8U*	*4.13*
LTF	*MEC*	*46.92*

274850	*MENDOTA H;RU*	*6.6*
293061	*N-015 E*	*19.2*
LTF	*O-066*	*16.29*
293644	*O22 E1*	*12.6*
293645	*O22 E2*	*24.46*
290021	*O50 E*	*23.83*
294392	*P-010 E*	*24.38*
294763	*P-046 E*	*11.49*
274888	*PILOT HIL;1E*	*23.64*
274830	*PWR VTREC;1U*	*7.47*
274831	*PWR VTREC;2U*	*7.47*
296308	*R-030 C1*	*5.*
296271	*R-030 C2*	*5.*
296125	*R-030 C3*	*5.06*
296309	*R-030 E1*	*20.01*
296272	*R-030 E2*	*20.01*
296128	*R-030 E3*	*20.26*
LTF	*RENSSELAER*	*0.74*
LTF	*ROSETON*	*5.35*
LTF	*ROWAN*	*0.8*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.33*
LTF	*TRIMBLE*	*0.53*
299993	*U3-031C*	*11.53*
903433	*W3-046*	*29.48*
LTF	*WEC*	*9.78*
295109	*WESTBROOK E*	*6.85*
274687	*WILL CNTY;4U*	*82.07*
910542	*X3-005 E*	*0.9*
914641	*Y2-103*	*55.09*
915011	*Y3-013 1*	*4.59*
915021	*Y3-013 2*	*4.59*
915031	*Y3-013 3*	*4.59*
LTF	*Z1-043*	*35.61*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.17*
916522	*Z1-108 E*	*3.05*
917501	*Z2-087 C*	*3.91*
917502	*Z2-087 E*	*26.18*
918051	*AA1-018 C*	*3.02*
918052	*AA1-018 E*	*20.2*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*160.67*

920112	*AA2-107 E*	*3.*
920272	*AA2-123 E*	*2.99*
930481	*AB1-089*	*80.54*
930491	*AB1-090*	*80.54*
930501	*AB1-091*	*91.2*
930761	*AB1-122 1*	*88.88*
930771	*AB1-122 2*	*90.52*
931221	*AB1-172*	*0.98*
LTF	*AB2-013*	*19.99*
924041	*AB2-047 C O1*	*4.83*
924042	*AB2-047 E O1*	*32.3*
924471	*AB2-096*	*51.86*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.37*
925881	*AC1-067*	*167.77*
926311	*AC1-109 1*	*2.34*
926321	*AC1-109 2*	*2.34*
926331	*AC1-110 1*	*2.33*
926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.14*
927461	*AC1-142A 2*	*5.14*
926701	*AC1-153 C1*	*96.61*
926711	*AC1-153 C2*	*98.39*
926702	*AC1-153 E1*	*3.86*
926712	*AC1-153 E2*	*3.94*
927091	*AC1-204 1*	*89.19*
927101	*AC1-204 2*	*89.19*

Appendix 3

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 152.75% to 152.89% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.14 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.95*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.65*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.78*
933361	*AC2-149 C*	*1.16*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933411	*AC2-154 C*	*3.27*
933412	*AC2-154 E*	*5.34*
933431	*AC2-156 C*	*1.19*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.91*
933512	*AC2-166 E*	*3.22*
933911	*AD1-013 C O1*	*2.3*
933912	*AD1-013 E O1*	*3.67*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.89*
934101	*AD1-039 1*	*9.87*
934111	*AD1-039 2*	*10.05*
934401	*AD1-064 C O1*	*4.01*
934402	*AD1-064 E O1*	*18.77*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
LTF	*AD1-092*	*14.18*
LTF	*AD1-093*	*24.5*
LTF	*AD1-094*	*4.75*
934651	*AD1-096 C*	*1.12*

934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.6*
934702	*AD1-098 E O1*	*6.28*
934721	*AD1-100 C*	*35.9*
934722	*AD1-100 E*	*168.07*
934871	*AD1-116 C*	*1.2*
934872	*AD1-116 E*	*1.96*
934881	*AD1-117 C*	*6.72*
934882	*AD1-117 E*	*4.48*
934941	*AD1-126 C*	*7.31*
934942	*AD1-126 E*	*4.87*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.24*
935002	*AD1-133 E O1*	*18.83*
936181	*AD2-024 C O2*	*1.16*
936182	*AD2-024 E O2*	*1.89*
936291	*AD2-038 C O2*	*2.91*
936292	*AD2-038 E O2*	*19.46*
936371	*AD2-047 C O2*	*2.99*
936372	*AD2-047 E O2*	*32.2*
936461	*AD2-060*	*3.45*
936511	*AD2-066 C O2*	*11.34*
936512	*AD2-066 E O2*	*7.56*
936781	*AD2-101 C*	*6.21*
936782	*AD2-101 E*	*29.08*
936791	*AD2-102 C*	*15.05*
936792	*AD2-102 E*	*14.46*
936961	*AD2-130 C*	*1.97*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.42*
937002	*AD2-134 E*	*14.11*
937031	*AD2-137 C O2*	*7.77*
937032	*AD2-137 E O2*	*36.39*
937051	*AD2-140 C O2*	*7.4*
937052	*AD2-140 E O2*	*34.65*
937061	*AD2-141 C O2*	*4.84*
937062	*AD2-141 E O2*	*22.82*
937071	*AD2-142 C O2*	*14.8*
937072	*AD2-142 E O2*	*69.29*
937121	*AD2-148 C O2*	*5.44*
937122	*AD2-148 E O2*	*25.47*
937131	*AD2-149 C O2*	*5.44*
937132	*AD2-149 E O2*	*25.47*
937141	*AD2-150 C O2*	*5.44*

937142	*AD2-150 E O2*	*25.47*
937161	*AD2-153 C O2*	*4.62*
937162	*AD2-153 E O2*	*21.64*
937171	*AD2-154 C O2*	*4.05*
937172	*AD2-154 E O2*	*18.97*
937181	*AD2-155 C O2*	*4.43*
937182	*AD2-155 E O2*	*20.75*
937311	*AD2-172 C*	*3.08*
937312	*AD2-172 E*	*4.25*
937321	*AD2-175 C*	*22.68*
937322	*AD2-175 E*	*15.12*
937331	*AD2-176 C O2*	*9.09*
937332	*AD2-176 E O2*	*6.06*
937401	*AD2-194 C1*	*4.9*
937411	*AD2-194 C2*	*4.9*
937402	*AD2-194 E1*	*4.9*
937412	*AD2-194 E2*	*4.9*
LTF	*BLUEG*	*2.66*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.96*
LTF	*CATAWBA*	*0.35*
274890	*CAYUG;1U E*	*21.06*
274891	*CAYUG;2U E*	*21.06*
LTF	*CBM-S1*	*2.05*
LTF	*CBM-W1*	*76.35*
LTF	*CBM-W2*	*54.29*
LTF	*CELEVELAND*	*0.96*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*16.03*
LTF	*DEARBORN*	*2.83*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.59*
290051	*GSG-6; E*	*13.07*
LTF	*HAMLET*	*1.34*
275149	*KEMPTON ;1E*	*24.13*
290108	*LEEDK;1U E*	*30.35*
274770	*LINCOLN ;1U*	*4.24*
274771	*LINCOLN ;2U*	*4.24*
274772	*LINCOLN ;3U*	*4.24*
274773	*LINCOLN ;4U*	*4.24*
274774	*LINCOLN ;5U*	*4.24*
274775	*LINCOLN ;6U*	*4.24*
274776	*LINCOLN ;7U*	*4.24*

274777	*LINCOLN ;8U*	*4.24*
LTF	*MEC*	*47.91*
274850	*MENDOTA H;RU*	*6.74*
293061	*N-015 E*	*19.6*
LTF	*O-066*	*16.64*
293644	*O22 E1*	*12.86*
293645	*O22 E2*	*24.97*
290021	*O50 E*	*24.34*
294392	*P-010 E*	*24.89*
294763	*P-046 E*	*11.73*
274888	*PILOT HIL;1E*	*24.13*
274830	*PWR VTREC;1U*	*7.63*
274831	*PWR VTREC;2U*	*7.63*
296308	*R-030 C1*	*5.1*
296271	*R-030 C2*	*5.1*
296125	*R-030 C3*	*5.17*
296309	*R-030 E1*	*20.42*
296272	*R-030 E2*	*20.42*
296128	*R-030 E3*	*20.66*
LTF	*RENSSELAER*	*0.76*
LTF	*ROSETON*	*5.46*
LTF	*ROWAN*	*0.81*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.4*
LTF	*TRIMBLE*	*0.55*
299993	*U3-031C*	*11.84*
903433	*W3-046*	*30.11*
LTF	*WEC*	*9.99*
295109	*WESTBROOK E*	*7.*
274687	*WILL CNTY;4U*	*83.82*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.26*
915011	*Y3-013 1*	*4.69*
915021	*Y3-013 2*	*4.69*
915031	*Y3-013 3*	*4.69*
LTF	*Z1-043*	*36.36*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.24*
916522	*Z1-108 E*	*3.11*
917501	*Z2-087 C*	*3.99*
917502	*Z2-087 E*	*26.7*
918051	*AA1-018 C*	*3.08*
918052	*AA1-018 E*	*20.64*
918972	*AA1-116 E*	*3.45*

918982	*AA1-117 E*	*3.45*
919591	*AA2-035*	*164.09*
920112	*AA2-107 E*	*3.07*
920272	*AA2-123 E*	*3.05*
930481	*AB1-089*	*82.25*
930491	*AB1-090*	*82.25*
930501	*AB1-091*	*93.12*
930761	*AB1-122 1*	*90.76*
930771	*AB1-122 2*	*92.45*
931221	*AB1-172*	*1.*
LTF	*AB2-013*	*20.42*
924041	*AB2-047 C O1*	*4.92*
924042	*AB2-047 E O1*	*32.95*
924471	*AB2-096*	*52.97*
925301	*AB2-191 C*	*1.58*
925302	*AB2-191 E*	*1.4*
925881	*AC1-067*	*171.5*
926311	*AC1-109 1*	*2.39*
926321	*AC1-109 2*	*2.39*
926331	*AC1-110 1*	*2.37*
926341	*AC1-110 2*	*2.37*
926351	*AC1-111 1*	*0.95*
926361	*AC1-111 2*	*0.95*
926371	*AC1-111 3*	*0.95*
926381	*AC1-111 4*	*0.95*
926391	*AC1-111 5*	*0.95*
926401	*AC1-111 6*	*0.95*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.25*
927461	*AC1-142A 2*	*5.25*
926701	*AC1-153 C1*	*98.66*
926711	*AC1-153 C2*	*100.49*
926702	*AC1-153 E1*	*3.95*
926712	*AC1-153 E2*	*4.02*
927531	*AC1-185 1*	*0.71*
927541	*AC1-185 2*	*0.71*
927551	*AC1-185 3*	*0.71*
927561	*AC1-185 4*	*0.71*
927571	*AC1-185 5*	*0.71*
927581	*AC1-185 6*	*0.71*
927591	*AC1-185 7*	*0.71*
927601	*AC1-185 8*	*0.71*
927091	*AC1-204 1*	*91.1*

927101	*AC1-204 2*	*91.1*

Appendix 4

(CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 134.84% to 134.92% (**DC power flow**) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765'. This project contributes approximately 9.9 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#2978_05DUMONT 765'
 OPEN BRANCH FROM BUS 243206 TO BUS 907040 CKT 1          / 243206 05DUMONT 765 X1-020
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTON ; 765 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*0.69*
932012	*AC2-007 E*	*1.28*
932881	*AC2-115 1*	*1.94*
932891	*AC2-115 2*	*1.94*
932921	*AC2-116*	*0.68*
932931	*AC2-117*	*10.47*
933341	*AC2-147 C*	*0.71*
933342	*AC2-147 E*	*1.16*
933361	*AC2-149 C*	*0.76*
933362	*AC2-149 E*	*1.24*
933381	*AC2-151 C*	*0.81*
933382	*AC2-151 E*	*1.31*
933411	*AC2-154 C*	*2.05*
933412	*AC2-154 E*	*3.34*
933431	*AC2-156 C*	*0.78*
933432	*AC2-156 E*	*1.28*
933511	*AC2-166 C*	*1.9*
933512	*AC2-166 E*	*2.1*
933911	*AD1-013 C O1*	*1.5*
933912	*AD1-013 E O1*	*2.39*
933931	*AD1-016 C*	*0.76*
933932	*AD1-016 E*	*1.24*
934101	*AD1-039 1*	*6.33*
934111	*AD1-039 2*	*6.54*
934401	*AD1-064 C O1*	*2.62*
934402	*AD1-064 E O1*	*12.25*
934431	*AD1-067 C*	*0.11*
934432	*AD1-067 E*	*0.45*
LTF	*AD1-092*	*9.*
LTF	*AD1-093*	*15.6*
LTF	*AD1-094*	*3.03*
934651	*AD1-096 C*	*0.73*
934652	*AD1-096 E*	*1.18*

934701	*AD1-098 C O1*	*5.6*
934702	*AD1-098 E O1*	*4.09*
934721	*AD1-100 C*	*18.07*
934722	*AD1-100 E*	*84.58*
934871	*AD1-116 C*	*0.84*
934872	*AD1-116 E*	*1.38*
934881	*AD1-117 C*	*4.36*
934882	*AD1-117 E*	*2.91*
934941	*AD1-126 C*	*4.77*
934942	*AD1-126 E*	*3.18*
934971	*AD1-129 C*	*0.74*
934972	*AD1-129 E*	*0.49*
935001	*AD1-133 C O1*	*16.79*
935002	*AD1-133 E O1*	*11.19*
936181	*AD2-024 C O2*	*0.76*
936182	*AD2-024 E O2*	*1.24*
936291	*AD2-038 C O2*	*1.86*
936292	*AD2-038 E O2*	*12.48*
936371	*AD2-047 C O2*	*1.69*
936372	*AD2-047 E O2*	*18.15*
936461	*AD2-060*	*2.16*
936511	*AD2-066 C O2*	*7.42*
936512	*AD2-066 E O2*	*4.95*
936781	*AD2-101 C*	*3.5*
936782	*AD2-101 E*	*16.39*
936791	*AD2-102 C*	*9.81*
936792	*AD2-102 E*	*9.42*
936961	*AD2-130 C*	*1.3*
936962	*AD2-130 E*	*0.17*
937001	*AD2-134 C*	*2.22*
937002	*AD2-134 E*	*9.19*
937031	*AD2-137 C O2*	*2.7*
937032	*AD2-137 E O2*	*12.66*
937051	*AD2-140 C O2*	*2.7*
937052	*AD2-140 E O2*	*12.62*
937061	*AD2-141 C O2*	*2.71*
937062	*AD2-141 E O2*	*12.78*
937071	*AD2-142 C O2*	*5.39*
937072	*AD2-142 E O2*	*25.24*
937121	*AD2-148 C O2*	*2.6*
937122	*AD2-148 E O2*	*12.18*
937131	*AD2-149 C O2*	*2.6*
937132	*AD2-149 E O2*	*12.18*
937141	*AD2-150 C O2*	*2.6*
937142	*AD2-150 E O2*	*12.18*

937161	*AD2-153 C O2*	*2.61*
937162	*AD2-153 E O2*	*12.21*
937181	*AD2-155 C O2*	*2.83*
937182	*AD2-155 E O2*	*13.26*
937311	*AD2-172 C*	*2.01*
937312	*AD2-172 E*	*2.77*
937321	*AD2-175 C*	*12.7*
937322	*AD2-175 E*	*8.47*
937331	*AD2-176 C O2*	*5.94*
937332	*AD2-176 E O2*	*3.96*
937401	*AD2-194 C1*	*3.21*
937411	*AD2-194 C2*	*3.21*
937402	*AD2-194 E1*	*3.21*
937412	*AD2-194 E2*	*3.21*
937531	*AD2-214 C*	*1.66*
937532	*AD2-214 E*	*0.78*
LTF	*BLUEG*	*1.48*
LTF	*CALDERWOOD*	*0.02*
LTF	*CANNELTON*	*0.07*
LTF	*CARR*	*0.62*
LTF	*CATAWBA*	*0.21*
274890	*CAYUG;1U E*	*10.71*
274891	*CAYUG;2U E*	*10.71*
LTF	*CBM-S1*	*1.28*
LTF	*CBM-W1*	*44.45*
LTF	*CBM-W2*	*32.09*
LTF	*CELEVELAND*	*0.58*
LTF	*CHEOAH*	*0.03*
LTF	*CHILHOWEE*	*< 0.01*
LTF	*CLIFTY*	*9.14*
LTF	*DEARBORN*	*2.57*
274859	*EASYR;U1 E*	*8.93*
274860	*EASYR;U2 E*	*8.93*
LTF	*ELMERSMITH*	*0.13*
LTF	*G-007*	*1.65*
LTF	*GIBSON*	*0.06*
290051	*GSG-6; E*	*8.51*
LTF	*HAMLET*	*0.81*
275149	*KEMPTON ;1E*	*15.08*
290108	*LEEDK;1U E*	*19.79*
LTF	*MEC*	*30.47*
274850	*MENDOTA H;RU*	*4.39*
293061	*N-015 E*	*12.8*
293516	*O-009 E1*	*7.37*
293517	*O-009 E2*	*3.74*

293518	*O-009 E3*	*4.12*
293715	*O-029 E*	*7.88*
293716	*O-029 E*	*4.32*
293717	*O-029 E*	*3.97*
LTF	*O-066*	*10.57*
293644	*O22 E1*	*7.91*
293645	*O22 E2*	*15.35*
290021	*O50 E*	*15.77*
294392	*P-010 E*	*16.26*
294763	*P-046 E*	*7.64*
274888	*PILOT HIL;1E*	*15.08*
274830	*PWR VTREC;1U*	*4.98*
274831	*PWR VTREC;2U*	*4.98*
LTF	*RENSSELAER*	*0.49*
LTF	*ROSETON*	*3.54*
LTF	*ROWAN*	*0.49*
LTF	*SANTEETLA*	*< 0.01*
295111	*SUBLETTE E*	*2.21*
LTF	*TRIMBLE*	*0.3*
299993	*U3-031C*	*4.1*
291984	*U4-033*	*1.52*
274814	*UNIV PK N;0U*	*1.19*
274806	*UNIV PK N;2U*	*1.19*
274807	*UNIV PK N;3U*	*1.19*
274808	*UNIV PK N;4U*	*1.19*
274809	*UNIV PK N;5U*	*1.19*
274810	*UNIV PK N;6U*	*1.19*
274811	*UNIV PK N;7U*	*1.19*
274812	*UNIV PK N;8U*	*1.19*
274813	*UNIV PK N;9U*	*1.19*
274815	*UNIV PK N;XU*	*1.19*
274816	*UNIV PK N;YU*	*1.19*
903433	*W3-046*	*19.41*
905471	*W4-084*	*0.36*
274874	*WALNR;2U*	*1.93*
294502	*WALNR;2U E*	*7.74*
LTF	*WEC*	*6.54*
295109	*WESTBROOK E*	*4.55*
274687	*WILL CNTY;4U*	*53.33*
910542	*X3-005 E*	*0.52*
914641	*Y2-103*	*36.97*
915011	*Y3-013 1*	*3.08*
915021	*Y3-013 2*	*3.08*
915031	*Y3-013 3*	*3.08*
LTF	*Z1-043*	*23.15*

916502	*Z1-106 E1*	*1.03*
916504	*Z1-106 E2*	*1.04*
916512	*Z1-107 E*	*2.23*
916522	*Z1-108 E*	*2.04*
918051	*AA1-018 C*	*2.17*
918052	*AA1-018 E*	*14.5*
918972	*AA1-116 E*	*2.15*
918982	*AA1-117 E*	*2.15*
919221	*AA1-146*	*14.24*
919581	*AA2-030*	*14.24*
919591	*AA2-035*	*107.19*
920112	*AA2-107 E*	*2.*
920272	*AA2-123 E*	*2.*
930481	*AB1-089*	*53.65*
930491	*AB1-090*	*53.65*
930501	*AB1-091*	*58.45*
930761	*AB1-122 1*	*58.22*
930771	*AB1-122 2*	*60.21*
931221	*AB1-172*	*0.69*
LTF	*AB2-013*	*13.*
924471	*AB2-096*	*34.61*
925161	*AB2-173*	*2.54*
925301	*AB2-191 C*	*1.03*
925302	*AB2-191 E*	*0.91*
925881	*AC1-067*	*98.97*
926311	*AC1-109 1*	*1.57*
926321	*AC1-109 2*	*1.57*
926331	*AC1-110 1*	*1.55*
926341	*AC1-110 2*	*1.55*
926351	*AC1-111 1*	*0.63*
926361	*AC1-111 2*	*0.63*
926371	*AC1-111 3*	*0.63*
926381	*AC1-111 4*	*0.63*
926391	*AC1-111 5*	*0.63*
926401	*AC1-111 6*	*0.63*
927511	*AC1-113 1*	*0.97*
927522	*AC1-113 2*	*0.97*
926431	*AC1-114*	*1.94*
927451	*AC1-142A 1*	*3.49*
927461	*AC1-142A 2*	*3.48*
926701	*AC1-153 C1*	*63.28*
926711	*AC1-153 C2*	*65.45*
926702	*AC1-153 E1*	*2.53*
926712	*AC1-153 E2*	*2.62*
926821	*AC1-168 C*	*0.94*

926822	*AC1-168 E*	*6.31*
927531	*AC1-185 1*	*0.56*
927541	*AC1-185 2*	*0.56*
927551	*AC1-185 3*	*0.56*
927561	*AC1-185 4*	*0.56*
927571	*AC1-185 5*	*0.56*
927581	*AC1-185 6*	*0.56*
927591	*AC1-185 7*	*0.56*
927601	*AC1-185 8*	*0.56*
927091	*AC1-204 1*	*59.71*
927101	*AC1-204 2*	*59.76*

Appendix 5

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 150.46% to 150.61% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.83 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.91*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
932931	*AC2-117*	*6.51*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.23*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.85*
933512	*AC2-166 E*	*3.15*
933911	*AD1-013 C O1*	*2.25*
933912	*AD1-013 E O1*	*3.6*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.85*
934101	*AD1-039 1*	*9.66*
934111	*AD1-039 2*	*9.84*
934401	*AD1-064 C O1*	*3.92*
934402	*AD1-064 E O1*	*18.37*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
LTF	*AD1-092*	*13.89*
LTF	*AD1-093*	*23.99*
LTF	*AD1-094*	*4.66*
934651	*AD1-096 C*	*1.09*
934652	*AD1-096 E*	*1.78*
934701	*AD1-098 C O1*	*8.42*

934702	*AD1-098 E O1*	*6.15*
934721	*AD1-100 C*	*35.21*
934722	*AD1-100 E*	*164.82*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934881	*AD1-117 C*	*0.61*
934882	*AD1-117 E*	*0.4*
934941	*AD1-126 C*	*7.16*
934942	*AD1-126 E*	*4.77*
934971	*AD1-129 C*	*1.1*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.67*
935002	*AD1-133 E O1*	*18.45*
936181	*AD2-024 C O2*	*1.14*
936182	*AD2-024 E O2*	*1.85*
936291	*AD2-038 C O2*	*2.85*
936292	*AD2-038 E O2*	*19.06*
936371	*AD2-047 C O2*	*2.93*
936372	*AD2-047 E O2*	*31.55*
936461	*AD2-060*	*3.38*
936511	*AD2-066 C O2*	*11.11*
936512	*AD2-066 E O2*	*7.41*
936781	*AD2-101 C*	*6.09*
936782	*AD2-101 E*	*28.49*
936791	*AD2-102 C*	*14.73*
936792	*AD2-102 E*	*14.15*
936961	*AD2-130 C*	*1.93*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.34*
937002	*AD2-134 E*	*13.82*
937031	*AD2-137 C O2*	*7.63*
937032	*AD2-137 E O2*	*35.73*
937051	*AD2-140 C O2*	*7.27*
937052	*AD2-140 E O2*	*34.02*
937061	*AD2-141 C O2*	*4.74*
937062	*AD2-141 E O2*	*22.37*
937071	*AD2-142 C O2*	*14.53*
937072	*AD2-142 E O2*	*68.03*
937121	*AD2-148 C O2*	*5.34*
937122	*AD2-148 E O2*	*24.98*
937131	*AD2-149 C O2*	*5.34*
937132	*AD2-149 E O2*	*24.98*
937141	*AD2-150 C O2*	*5.34*
937142	*AD2-150 E O2*	*24.98*
937161	*AD2-153 C O2*	*4.53*

937162	*AD2-153 E O2*	*21.21*
937171	*AD2-154 C O2*	*3.97*
937172	*AD2-154 E O2*	*18.59*
937181	*AD2-155 C O2*	*4.34*
937182	*AD2-155 E O2*	*20.33*
937311	*AD2-172 C*	*3.02*
937312	*AD2-172 E*	*4.16*
937321	*AD2-175 C*	*22.23*
937322	*AD2-175 E*	*14.82*
937331	*AD2-176 C O2*	*8.9*
937332	*AD2-176 E O2*	*5.93*
937401	*AD2-194 C1*	*4.8*
937411	*AD2-194 C2*	*4.8*
937402	*AD2-194 E1*	*4.8*
937412	*AD2-194 E2*	*4.8*
LTF	*BLUEG*	*2.6*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.94*
LTF	*CATAWBA*	*0.34*
274890	*CAYUG;1U E*	*20.65*
274891	*CAYUG;2U E*	*20.65*
LTF	*CBM-S1*	*2.*
LTF	*CBM-W1*	*74.76*
LTF	*CBM-W2*	*53.18*
LTF	*CELEVELAND*	*0.94*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*15.69*
LTF	*DEARBORN*	*2.77*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.54*
290051	*GSG-6; E*	*12.79*
LTF	*HAMLET*	*1.31*
275149	*KEMPTON ;1E*	*23.64*
290108	*LEEDK;1U E*	*29.72*
274770	*LINCOLN ;1U*	*4.13*
274771	*LINCOLN ;2U*	*4.13*
274772	*LINCOLN ;3U*	*4.13*
274773	*LINCOLN ;4U*	*4.13*
274774	*LINCOLN ;5U*	*4.13*
274775	*LINCOLN ;6U*	*4.13*
274776	*LINCOLN ;7U*	*4.13*
274777	*LINCOLN ;8U*	*4.13*
LTF	*MEC*	*46.92*

274850	*MENDOTA H;RU*	*6.6*
293061	*N-015 E*	*19.2*
LTF	*O-066*	*16.29*
293644	*O22 E1*	*12.6*
293645	*O22 E2*	*24.46*
290021	*O50 E*	*23.83*
294392	*P-010 E*	*24.38*
294763	*P-046 E*	*11.49*
274888	*PILOT HIL;1E*	*23.64*
274830	*PWR VTREC;1U*	*7.47*
274831	*PWR VTREC;2U*	*7.47*
296308	*R-030 C1*	*5.*
296271	*R-030 C2*	*5.*
296125	*R-030 C3*	*5.06*
296309	*R-030 E1*	*20.01*
296272	*R-030 E2*	*20.01*
296128	*R-030 E3*	*20.26*
LTF	*RENSSELAER*	*0.74*
LTF	*ROSETON*	*5.35*
LTF	*ROWAN*	*0.8*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.33*
LTF	*TRIMBLE*	*0.53*
299993	*U3-031C*	*11.53*
903433	*W3-046*	*29.48*
LTF	*WEC*	*9.78*
295109	*WESTBROOK E*	*6.85*
274687	*WILL CNTY;4U*	*82.07*
910542	*X3-005 E*	*0.9*
914641	*Y2-103*	*55.09*
915011	*Y3-013 1*	*4.59*
915021	*Y3-013 2*	*4.59*
915031	*Y3-013 3*	*4.59*
LTF	*Z1-043*	*35.61*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.17*
916522	*Z1-108 E*	*3.05*
917501	*Z2-087 C*	*3.91*
917502	*Z2-087 E*	*26.18*
918051	*AA1-018 C*	*3.02*
918052	*AA1-018 E*	*20.2*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*160.67*

920112	*AA2-107 E*	*3.*
920272	*AA2-123 E*	*2.99*
930481	*AB1-089*	*80.54*
930491	*AB1-090*	*80.54*
930501	*AB1-091*	*91.2*
930761	*AB1-122 1*	*88.88*
930771	*AB1-122 2*	*90.52*
931221	*AB1-172*	*0.98*
LTF	*AB2-013*	*19.99*
924041	*AB2-047 C O1*	*4.83*
924042	*AB2-047 E O1*	*32.3*
924471	*AB2-096*	*51.86*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.37*
925881	*AC1-067*	*167.77*
926311	*AC1-109 1*	*2.34*
926321	*AC1-109 2*	*2.34*
926331	*AC1-110 1*	*2.33*
926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.14*
927461	*AC1-142A 2*	*5.14*
926701	*AC1-153 C1*	*96.61*
926711	*AC1-153 C2*	*98.39*
926702	*AC1-153 E1*	*3.86*
926712	*AC1-153 E2*	*3.94*
927091	*AC1-204 1*	*89.19*
927101	*AC1-204 2*	*89.19*

Appendix 6

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 152.75% to 152.89% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 15.14 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.95*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.65*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.78*
933361	*AC2-149 C*	*1.16*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933411	*AC2-154 C*	*3.27*
933412	*AC2-154 E*	*5.34*
933431	*AC2-156 C*	*1.19*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.91*
933512	*AC2-166 E*	*3.22*
933911	*AD1-013 C O1*	*2.3*
933912	*AD1-013 E O1*	*3.67*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.89*
934101	*AD1-039 1*	*9.87*
934111	*AD1-039 2*	*10.05*
934401	*AD1-064 C O1*	*4.01*
934402	*AD1-064 E O1*	*18.77*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
LTF	*AD1-092*	*14.18*
LTF	*AD1-093*	*24.5*
LTF	*AD1-094*	*4.75*
934651	*AD1-096 C*	*1.12*

934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.6*
934702	*AD1-098 E O1*	*6.28*
934721	*AD1-100 C*	*35.9*
934722	*AD1-100 E*	*168.07*
934871	*AD1-116 C*	*1.2*
934872	*AD1-116 E*	*1.96*
934881	*AD1-117 C*	*6.72*
934882	*AD1-117 E*	*4.48*
934941	*AD1-126 C*	*7.31*
934942	*AD1-126 E*	*4.87*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.24*
935002	*AD1-133 E O1*	*18.83*
936181	*AD2-024 C O2*	*1.16*
936182	*AD2-024 E O2*	*1.89*
936291	*AD2-038 C O2*	*2.91*
936292	*AD2-038 E O2*	*19.46*
936371	*AD2-047 C O2*	*2.99*
936372	*AD2-047 E O2*	*32.2*
936461	*AD2-060*	*3.45*
936511	*AD2-066 C O2*	*11.34*
936512	*AD2-066 E O2*	*7.56*
936781	*AD2-101 C*	*6.21*
936782	*AD2-101 E*	*29.08*
936791	*AD2-102 C*	*15.05*
936792	*AD2-102 E*	*14.46*
936961	*AD2-130 C*	*1.97*
936962	*AD2-130 E*	*0.26*
937001	*AD2-134 C*	*3.42*
937002	*AD2-134 E*	*14.11*
937031	*AD2-137 C O2*	*7.77*
937032	*AD2-137 E O2*	*36.39*
937051	*AD2-140 C O2*	*7.4*
937052	*AD2-140 E O2*	*34.65*
937061	*AD2-141 C O2*	*4.84*
937062	*AD2-141 E O2*	*22.82*
937071	*AD2-142 C O2*	*14.8*
937072	*AD2-142 E O2*	*69.29*
937121	*AD2-148 C O2*	*5.44*
937122	*AD2-148 E O2*	*25.47*
937131	*AD2-149 C O2*	*5.44*
937132	*AD2-149 E O2*	*25.47*
937141	*AD2-150 C O2*	*5.44*

937142	*AD2-150 E O2*	*25.47*
937161	*AD2-153 C O2*	*4.62*
937162	*AD2-153 E O2*	*21.64*
937171	*AD2-154 C O2*	*4.05*
937172	*AD2-154 E O2*	*18.97*
937181	*AD2-155 C O2*	*4.43*
937182	*AD2-155 E O2*	*20.75*
937311	*AD2-172 C*	*3.08*
937312	*AD2-172 E*	*4.25*
937321	*AD2-175 C*	*22.68*
937322	*AD2-175 E*	*15.12*
937331	*AD2-176 C O2*	*9.09*
937332	*AD2-176 E O2*	*6.06*
937401	*AD2-194 C1*	*4.9*
937411	*AD2-194 C2*	*4.9*
937402	*AD2-194 E1*	*4.9*
937412	*AD2-194 E2*	*4.9*
LTF	*BLUEG*	*2.66*
LTF	*CALDERWOOD*	*0.04*
LTF	*CANNELTON*	*0.12*
LTF	*CARR*	*0.96*
LTF	*CATAWBA*	*0.35*
274890	*CAYUG;1U E*	*21.06*
274891	*CAYUG;2U E*	*21.06*
LTF	*CBM-S1*	*2.05*
LTF	*CBM-W1*	*76.35*
LTF	*CBM-W2*	*54.29*
LTF	*CELEVELAND*	*0.96*
LTF	*CHEOAH*	*0.05*
LTF	*CHILHOWEE*	*0.01*
LTF	*CLIFTY*	*16.03*
LTF	*DEARBORN*	*2.83*
LTF	*ELMERSMITH*	*0.22*
LTF	*G-007*	*2.59*
290051	*GSG-6; E*	*13.07*
LTF	*HAMLET*	*1.34*
275149	*KEMPTON ;1E*	*24.13*
290108	*LEEDK;1U E*	*30.35*
274770	*LINCOLN ;1U*	*4.24*
274771	*LINCOLN ;2U*	*4.24*
274772	*LINCOLN ;3U*	*4.24*
274773	*LINCOLN ;4U*	*4.24*
274774	*LINCOLN ;5U*	*4.24*
274775	*LINCOLN ;6U*	*4.24*
274776	*LINCOLN ;7U*	*4.24*

274777	*LINCOLN ;8U*	*4.24*
LTF	*MEC*	*47.91*
274850	*MENDOTA H;RU*	*6.74*
293061	*N-015 E*	*19.6*
LTF	*O-066*	*16.64*
293644	*O22 E1*	*12.86*
293645	*O22 E2*	*24.97*
290021	*O50 E*	*24.34*
294392	*P-010 E*	*24.89*
294763	*P-046 E*	*11.73*
274888	*PILOT HIL;1E*	*24.13*
274830	*PWR VTREC;1U*	*7.63*
274831	*PWR VTREC;2U*	*7.63*
296308	*R-030 C1*	*5.1*
296271	*R-030 C2*	*5.1*
296125	*R-030 C3*	*5.17*
296309	*R-030 E1*	*20.42*
296272	*R-030 E2*	*20.42*
296128	*R-030 E3*	*20.66*
LTF	*RENSSELAER*	*0.76*
LTF	*ROSETON*	*5.46*
LTF	*ROWAN*	*0.81*
LTF	*SANTEETLA*	*0.02*
295111	*SUBLETTE E*	*3.4*
LTF	*TRIMBLE*	*0.55*
299993	*U3-031C*	*11.84*
903433	*W3-046*	*30.11*
LTF	*WEC*	*9.99*
295109	*WESTBROOK E*	*7.*
274687	*WILL CNTY;4U*	*83.82*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.26*
915011	*Y3-013 1*	*4.69*
915021	*Y3-013 2*	*4.69*
915031	*Y3-013 3*	*4.69*
LTF	*Z1-043*	*36.36*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.24*
916522	*Z1-108 E*	*3.11*
917501	*Z2-087 C*	*3.99*
917502	*Z2-087 E*	*26.7*
918051	*AA1-018 C*	*3.08*
918052	*AA1-018 E*	*20.64*
918972	*AA1-116 E*	*3.45*

918982	*AA1-117 E*	*3.45*
919591	*AA2-035*	*164.09*
920112	*AA2-107 E*	*3.07*
920272	*AA2-123 E*	*3.05*
930481	*AB1-089*	*82.25*
930491	*AB1-090*	*82.25*
930501	*AB1-091*	*93.12*
930761	*AB1-122 1*	*90.76*
930771	*AB1-122 2*	*92.45*
931221	*AB1-172*	*1.*
LTF	*AB2-013*	*20.42*
924041	*AB2-047 C O1*	*4.92*
924042	*AB2-047 E O1*	*32.95*
924471	*AB2-096*	*52.97*
925301	*AB2-191 C*	*1.58*
925302	*AB2-191 E*	*1.4*
925881	*AC1-067*	*171.5*
926311	*AC1-109 1*	*2.39*
926321	*AC1-109 2*	*2.39*
926331	*AC1-110 1*	*2.37*
926341	*AC1-110 2*	*2.37*
926351	*AC1-111 1*	*0.95*
926361	*AC1-111 2*	*0.95*
926371	*AC1-111 3*	*0.95*
926381	*AC1-111 4*	*0.95*
926391	*AC1-111 5*	*0.95*
926401	*AC1-111 6*	*0.95*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.25*
927461	*AC1-142A 2*	*5.25*
926701	*AC1-153 C1*	*98.66*
926711	*AC1-153 C2*	*100.49*
926702	*AC1-153 E1*	*3.95*
926712	*AC1-153 E2*	*4.02*
927531	*AC1-185 1*	*0.71*
927541	*AC1-185 2*	*0.71*
927551	*AC1-185 3*	*0.71*
927561	*AC1-185 4*	*0.71*
927571	*AC1-185 5*	*0.71*
927581	*AC1-185 6*	*0.71*
927591	*AC1-185 7*	*0.71*
927601	*AC1-185 8*	*0.71*
927091	*AC1-204 1*	*91.1*

927101	*AC1-204 2*	*91.1*