Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-154

Brokaw-Pontiac Midpoint

June 7, 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.

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 B-2 of Manual 14G. 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 B-1 of Manual 14G) 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

Queue **AD2-154** project is a proposal to connect a **150** MW Energy, **26.4** MW Capacity, **wind** facility to be located in Woodford and McLean Counties, IL (POI is in McLean County, IL). It is proposed in the Interconnection Request (Attachment N) that the primary point of interconnection to be studied is **a new interconnecting substation on the Brokaw (Ameren) (**PSSe bus nos. **348847) to McLean** (to be built by Z2-087) 345kV **Line** (PSSe bus nos. **917500**), 9.5 miles from Brokaw and 10.5 miles from McLean. A secondary POI has been selected as the McLean 345kV bus (to be built by Z2-087)**.** This project will have a dedicated 12 mile attachment line (not shared with any other facility). **AD2-154** is proposing to connect (60) GE 2.5 WTGs and (6) 2.3 WTGs, (60) 2.5 MVA and (6) 2.3 MVA, 690 V/34.5 kV pad mount transformers, (3) collection feeders of up to 23 WTGs each, and a step up transformer.

Also stated in the Attachment N is the potential for a storage facility, but that will not be part of this queue position's analysis.

The IC has proposed a service date for this project of December 31, 2020.

Impacts on the MISO member transmission systems are not included in this analysis, but will be included 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) AD2-154 proposes to interconnect 150 MW windfarm to ComEd transmission system by tapping into 'Brokaw – McClean TSS 92 (to be built by Z2-087)' 345kV line 9203, approximately 10 miles from Brokaw.

Attachment Facilities

The IC AD2-154 generator lead will interconnect to a new 345kV Interconnection Substation. This interconnection would require one 345kV line MOD, a dead-end structure and revenue metering as shown in the one-line diagram.

The estimated cost for the attachment facilities is given below.

Scope of Work	Cost Estimate
Installation of one 345kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1.0M

Direct Connection Network Upgrades

Prior to AD2-154 queue position, a new 345kV Interconnection Substation would be built under an earlier queue positions AD2-153, by tapping into 'Brokaw – McClean TSS 92 (to be built by Z2-087)' 345kV line 9203, approximately 10 miles from Brokaw. It is proposed to interconnect developer's generator lead to the already built Interconnection Substation.

The scope of work includes installation of one 345kV circuit breakers at the Interconnection Substation (to be built by AD2-153), to create a line position for IC's generator lead, as shown in the one-line diagram below. It should be noted that if AD2-153 project drops out or does not build the Interconnection Substation, then the interconnection scope of work for AD2-154 project would change.

The Interconnection Customer is responsible for constructing all the facilities on the Interconnection Customer side of the point of interconnection outside of the Interconnection.

The estimated cost for Direct Connection Network Upgrade is given below.

Scope of Work	Cost Estimate
Installation of one 345kV circuit breaker at the Interconnection Substation (built by AD2-153) and relay/protection work	$3,000,000
Total Cost Estimate (see notes below on cost estimate)	$3,000,000

Normally, it takes about 24-months to engineer, design, procure material and construct 345kV facilities after ISA/ICSA are signed.

Non-Direct Connection Cost Estimate

None

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 Interconnection Customer.

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 Interconnection Customer and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, Interconnection Customer will be responsible for paying all actual costs of ComEd's work.

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

Network Impacts

The Queue Project AD2-154 was evaluated as a 150.0 MW (Capacity 26.4 MW) injection tapping the AB2-047 TAP to Brokaw 345kV line in the ComEd area. Project AD2-154 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-154 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 AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 134.94% to 136.2% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#3128_05EUGENE 345'. This project contributes approximately 18.38 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#3128_05EUGENE 345'
 OPEN BRANCH FROM BUS 243221 TO BUS 249504 CKT 1          / 243221 05EUGENE 345 249504 08CAYSUB 345 1
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1          / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

Please refer to Appendix 1 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)

None.

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. (CE - CE) The BLUEMOUND; B-PONTIAC ; B 345 kV line (from bus 270668 to bus 270852 ckt 1) loads from 137.52% to 139.17% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.27 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1            / PONTI; R 345 Z2-087 TAP 345
 END
```

2. (CE - CE) The LORETTO ; B-AD1-100 TAP 345 kV line (from bus 270704 to bus 934720 ckt 1) loads from 203.95% to 207.77% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8014_T_-S-B'. This project contributes approximately 61.09 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8014_T_-S-B'
 TRIP BRANCH FROM BUS 935000 TO BUS 270717 CKT 1            / AD1-133 TAP 345 DRESDEN ; R 345
 END
```

3. (CE - CE) The LORETTO ; B-AD1-100 TAP 345 kV line (from bus 270704 to bus 934720 ckt 1) loads from 153.14% to 156.06% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 41.7 MW to the thermal violation.

4. (CE - CE) The DRESDEN ; R-COLLINS ; R 345 kV line (from bus 270717 to bus 270697 ckt 1) loads from 102.25% to 103.44% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B'. This project contributes approximately 18.16 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B'
 TRIP BRANCH FROM BUS 934720 TO BUS 270704 CKT 1            / AD1-100 TAP 345 LORET; B 345
 END
```

5. (CE - CE) The DRESDEN ; R-ELWOOD ; R 345 kV line (from bus 270717 to bus 270737 ckt 1) loads from 134.27% to 135.2% (**DC power flow**) of its emergency rating (1479 MVA) for the single line contingency outage of 'COMED_P1-2_345-L1223_TR-S'. This project contributes approximately 15.66 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L1223_TR-S'
 TRIP BRANCH FROM BUS 270717 TO BUS 270731 CKT 1          / DRESD; R 345 ELECT;4R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 270717 CKT 1          / DRESD;3M 138 DRESD; R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 271336 CKT 1          / DRESD;3M 138 DRESD; B 138
 TRIP BRANCH FROM BUS 275180 TO BUS 275280 CKT 1          / DRESD;3M 138 DRESD;3C 34.5
 END
```

6. (CE - MISO AMIL) The KINCAID ; B-7AUSTIN 345 kV line (from bus 270796 to bus 347955 ckt 1) loads from 112.16% to 114.95% (**DC power flow**) of its emergency rating (956 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 28.25 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1          / PONTI; R 345 Z2-087 TAP 345
 END
```

7. (CE - MISO AMIL) The KINCAID ; B-7AUSTIN 345 kV line (from bus 270796 to bus 347955 ckt 1) loads from 110.66% to 112.84% (**DC power flow**) of its normal rating (797 MVA) for non-contingency condition. This project contributes approximately 17.33 MW to the thermal violation.

8. (CE - CE) The LATHAM ; T-W4-005 TAP 345 kV line (from bus 270804 to bus 905080 ckt 1) loads from 126.58% to 128.22% (**DC power flow**) of its emergency rating (1334 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.37 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1          / PONTI; R 345 Z2-087 TAP 345
 END
```

9. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 191.45% to 195.38% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8014_T_-S-B'. This project contributes approximately 61.13 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8014_T_-S-B'
 TRIP BRANCH FROM BUS 935000 TO BUS 270717 CKT 1          / AD1-133 TAP 345 DRESDEN ; R 345
 END
```

10. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 140.98% to 143.76% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 41.74 MW to the thermal violation.

11. (CE - CE) The PONTIAC ; R-AD1-133 TAP 345 kV line (from bus 270853 to bus 935000 ckt 1) loads from 178.46% to 181.83% (**DC power flow**) of its emergency rating (1528 MVA)

for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B'. This project contributes approximately 56.31 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B'
 TRIP BRANCH FROM BUS 934720 TO BUS 270704 CKT 1              / AD1-100 TAP 345 LORET; B 345
 END
```

12. (CE - CE) The PONTIAC ; R-AD1-133 TAP 345 kV line (from bus 270853 to bus 935000 ckt 1) loads from 119.15% to 121.41% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 33.94 MW to the thermal violation.

13. (MISO AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 129.45% to 130.6% (**DC power flow**) of its normal rating (1451 MVA) for the single line contingency outage of 'AEP_P1-2_#286'. This project contributes approximately 18.26 MW to the thermal violation.

```
CONTINGENCY 'AEP_P1-2_#286'
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1              / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

14. (CE - CE) The W4-005 TAP-BLUEMOUND; B 345 kV line (from bus 905080 to bus 270668 ckt 1) loads from 139.5% to 141.24% (**DC power flow**) of its emergency rating (1334 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.33 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1              / PONTI; R 345 Z2-087 TAP 345
 END
```

15. (CE - CE) The Z2-087 TAP-PONTIAC ; R 345 kV line (from bus 917500 to bus 270853 ckt 1) loads from 176.01% to 180.55% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8002___-S'. This project contributes approximately 79.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8002___-S'
 TRIP BRANCH FROM BUS 270852 TO BUS 270668 CKT 1              / PONTI; B 345 BLUEM; B 345
 END
```

16. (CE - CE) The Z2-087 TAP-PONTIAC ; R 345 kV line (from bus 917500 to bus 270853 ckt 1) loads from 146.25% to 151.3% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 84.21 MW to the thermal violation.

17. (CE - CE) The AB2-047 TAP-Z2-087 TAP 345 kV line (from bus 924040 to bus 917500 ckt 1) loads from 167.32% to 171.72% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8002___-S'. This project contributes approximately 79.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8002___-S'
 TRIP BRANCH FROM BUS 270852 TO BUS 270668 CKT 1              / PONTI; B 345 BLUEM; B 345
 END
```

18. (CE - CE) The AB2-047 TAP-Z2-087 TAP 345 kV line (from bus 924040 to bus 917500 ckt 1) loads from 137.82% to 142.54% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 84.21 MW to the thermal violation.

19. (CE - CE) The AD1-100 TAP-AD2-137 TAP 345 kV line (from bus 934720 to bus 937030 ckt 1) loads from 158.77% to 161.05% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of '"934725'. This project contributes approximately 34.83 MW to the thermal violation.

```
CONTINGENCY '934725'                          AD1-100 JNT 345 934730 AD1-100 TAP 345 1
 OPEN BRANCH FROM BUS 934725 TO BUS 934730 CKT 1
 END
```

20. (CE - CE) The AD1-100 TAP-AD2-137 TAP 345 kV line (from bus 934720 to bus 937030 ckt 1) loads from 125.49% to 126.91% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 21.18 MW to the thermal violation.

21. (CE - CE) The AD1-133 TAP-DRESDEN ; R 345 kV line (from bus 935000 to bus 270717 ckt 1) loads from 190.38% to 193.9% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B'. This project contributes approximately 56.31 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B'
 TRIP BRANCH FROM BUS 934720 TO BUS 270704 CKT 1          / AD1-100 TAP 345 LORET; B 345
 END
```

22. (CE - CE) The AD1-133 TAP-DRESDEN ; R 345 kV line (from bus 935000 to bus 270717 ckt 1) loads from 130.98% to 133.39% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 33.94 MW to the thermal violation.

23. (CE - CE) The AD2-137 TAP-WILTON ; B 345 kV line (from bus 937030 to bus 270926 ckt 1) loads from 163.46% to 165.16% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of '"934725'. This project contributes approximately 34.83 MW to the thermal violation.

```
CONTINGENCY '934725'                          AD1-100 JNT 345 934730 AD1-100 TAP 345 1
 OPEN BRANCH FROM BUS 934725 TO BUS 934730 CKT 1
 END
```

24. (CE - CE) The AD2-137 TAP-WILTON ; B 345 kV line (from bus 937030 to bus 270926 ckt 1) loads from 132.25% to 133.66% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 21.18 MW to the thermal violation.

25. (CE - CE) The AD2-153 TAP-AB2-047 TAP 345 kV line (from bus 937160 to bus 924040 ckt 1) loads from 157.86% to 163.04% (**DC power flow**) of its emergency rating (1528 MVA)

for the single line contingency outage of 'COMED_P1-2_345-L8002___-S'. This project contributes approximately 79.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8002___-S'
 TRIP BRANCH FROM BUS 270852 TO BUS 270668 CKT 1              / PONTI; B 345 BLUEM; B 345
 END
```

26. (CE - CE) The AD2-153 TAP-AB2-047 TAP 345 kV line (from bus 937160 to bus 924040 ckt 1) loads from 126.98% to 132.7% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 84.21 MW to the thermal violation.

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 AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 134.94% to 136.2% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#3128_05EUGENE 345'. This project contributes approximately 18.38 MW to the thermal violation.

AEP:

1. **Rebuild 0.82 mile of the ACAR ~ 1024.5 ~ 30/7 ~ RAIL1 conductor section 5. Estimated Cost is $1.64 Million.**
2. **Rebuild 0.82 mile of the ACAR ~ 1024.5 ~ 30/7 ~ RAIL1 conductor section 6. Estimated Cost is $1.64 Million.**
3. **Rebuild 1.0 mile of the ACSR/PE ~ 1414 ~ 62/19 ~ conductor section 2. Estimated Cost is $2 Million.**

An approximate construction time would be 24 to 36 months after signing an interconnection agreement

MISO:
The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact study phase.

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 AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 134.94% to 136.2% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#3128_05EUGENE 345'. This project contributes approximately 18.38 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#3128_05EUGENE 345'
 OPEN BRANCH FROM BUS 243221 TO BUS 249504 CKT 1          / 243221 05EUGENE 345 249504 08CAYSUB 345 1
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1          / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
933341	*AC2-147 C*	*0.54*
933342	*AC2-147 E*	*0.89*
934051	*AD1-031 C O1*	*2.37*
934052	*AD1-031 E O1*	*3.87*
934421	*AD1-066*	*0.87*
LTF	*AD1-092*	*9.6*
LTF	*AD1-093*	*16.1*
LTF	*AD1-094*	*2.91*
934881	*AD1-117 C*	*3.34*
934882	*AD1-117 E*	*2.23*
935001	*AD1-133 C O1*	*14.35*
935002	*AD1-133 E O1*	*9.57*
935141	*AD1-148*	*7.48*
936771	*AD2-100 C*	*21.17*
936772	*AD2-100 E*	*14.11*
936972	*AD2-131 E*	*8.4*
937161	*AD2-153 C O1*	*3.24*
937162	*AD2-153 E O1*	*15.15*
937171	*AD2-154 C O1*	*3.24*
937172	*AD2-154 E O1*	*15.15*
937211	*AD2-159 C*	*4.63*
937212	*AD2-159 E*	*21.69*
937531	*AD2-214 C*	*3.23*
937532	*AD2-214 E*	*1.52*
274832	*ANNAWAN ; 1U*	*8.72*
LTF	*BLUEG*	*5.63*
294401	*BSHIL;1U E*	*7.13*
294410	*BSHIL;2U E*	*7.13*
LTF	*CANNELTON*	*1.2*
LTF	*CARR*	*0.33*
274890	*CAYUG;1U E*	*10.29*
274891	*CAYUG;2U E*	*10.29*
LTF	*CBM-S1*	*9.31*

LTF	*CBM-S2*	*2.76*
LTF	*CBM-W1*	*56.04*
LTF	*CBM-W2*	*138.78*
LTF	*CLIFTY*	*18.96*
LTF	*CPLE*	*0.38*
274849	*CRESCENT ;1U*	*3.95*
LTF	*DEARBORN*	*0.59*
274859	*EASYR;U1 E*	*6.86*
274860	*EASYR;U2 E*	*6.86*
LTF	*ELMERSMITH*	*3.21*
LTF	*G-007*	*0.83*
960018	*G997 E*	*-2.86*
LTF	*GIBSON*	*1.43*
960026	*J196 E*	*5.39*
940291	*J291*	*3.23*
983101	*J339*	*6.2*
938571	*J467 C*	*3.57*
938572	*J467 E*	*14.26*
940541	*J468 C*	*7.15*
940542	*J468 E*	*28.62*
951151	*J474 C*	*2.63*
951152	*J474 E*	*10.54*
951641	*J641 C*	*8.28*
951642	*J641 E*	*2.16*
951661	*J644*	*9.66*
981031	*J734*	*5.2*
939811	*J750 C*	*2.74*
939812	*J750 E*	*10.97*
981361	*J756 C*	*3.21*
981362	*J756 E*	*12.84*
981581	*J757 C*	*5.26*
981582	*J757 E*	*21.02*
938331	*J797*	*18.82*
938391	*J808*	*8.79*
938411	*J811*	*17.92*
939761	*J813*	*43.43*
938791	*J815*	*32.44*
938811	*J817*	*10.29*
938841	*J826*	*10.81*
938891	*J835 C*	*3.46*
938892	*J835 E*	*13.85*
938941	*J845 C*	*2.27*
938942	*J845 E*	*9.07*
938971	*J848 C*	*6.82*
938972	*J848 E*	*27.27*

939171	*J872 C*	*5.75*
939172	*J872 E*	*22.99*
939261	*J884*	*7.9*
939481	*J912*	*14.37*
939741	*J949*	*39.25*
274650	*KINCAID ;1U*	*17.96*
274651	*KINCAID ;2U*	*17.89*
990901	*L-005 E*	*11.23*
LTF	*MEC*	*44.96*
293516	*O-009 E1*	*6.44*
293517	*O-009 E2*	*3.27*
293518	*O-009 E3*	*3.6*
293715	*O-029 E*	*6.89*
293716	*O-029 E*	*3.78*
293717	*O-029 E*	*3.47*
293771	*O-035 E*	*5.23*
LTF	*O-066*	*5.35*
296308	*R-030 C1*	*3.34*
296271	*R-030 C2*	*3.34*
296125	*R-030 C3*	*3.38*
296309	*R-030 E1*	*13.35*
296272	*R-030 E2*	*13.35*
296128	*R-030 E3*	*13.51*
LTF	*RENSSELAER*	*0.26*
LTF	*ROSETON*	*1.86*
290261	*S-027 C*	*0.91*
290265	*S-028 C*	*0.91*
LTF	*TRIMBLE*	*1.09*
274853	*TWINGROVE;U1*	*19.52*
274854	*TWINGROVE;U2*	*19.52*
276150	*W2-048 E*	*2.06*
903433	*W3-046*	*16.12*
905081	*W4-005 C*	*1.19*
905082	*W4-005 E*	*42.87*
905471	*W4-084*	*0.29*
274874	*WALNR;2U*	*1.53*
294502	*WALNR;2U E*	*6.11*
LTF	*WEC*	*4.2*
909052	*X2-022 E*	*28.64*
LTF	*Z1-043*	*22.26*
917501	*Z2-087 C*	*2.62*
917502	*Z2-087 E*	*17.54*
919221	*AA1-146*	*11.73*
919581	*AA2-030*	*11.73*
919621	*AA2-039 C*	*1.74*

919622	*AA2-039 E*	*11.64*
LTF	*AB2-013*	*13.42*
924041	*AB2-047 C O1*	*3.34*
924042	*AB2-047 E O1*	*22.37*
924261	*AB2-070 C O1*	*3.86*
924262	*AB2-070 E O1*	*25.84*
925161	*AB2-173*	*2.09*
925581	*AC1-033 C*	*1.17*
925582	*AC1-033 E*	*7.82*
925771	*AC1-053 C*	*3.9*
925772	*AC1-053 E*	*26.07*
926821	*AC1-168 C*	*0.84*
926822	*AC1-168 E*	*5.65*
926841	*AC1-171 C*	*1.14*
926842	*AC1-171 E*	*7.61*
927531	*AC1-185 1*	*0.43*
927541	*AC1-185 2*	*0.43*
927551	*AC1-185 3*	*0.43*
927561	*AC1-185 4*	*0.43*
927571	*AC1-185 5*	*0.43*
927581	*AC1-185 6*	*0.43*
927591	*AC1-185 7*	*0.43*
927601	*AC1-185 8*	*0.43*
927201	*AC1-214 C*	*1.68*
927202	*AC1-214 E*	*4.46*

Secondary Point of Interconnection (Option-2)

The Interconnection Customer (IC) AD2-154 proposes to interconnect 150 MW windfarm to ComEd transmission system by connecting to McClean TSS 92 (to be built by Z2-087).

Attachment Facilities

The IC AD2-154 generator lead will interconnect to a new 345kV Interconnection Substation. This interconnection would require one 345kV line MOD, a dead-end structure and revenue metering as shown in the one-line diagram.

The estimated cost for the attachment facilities is given below:

Scope of Work	Cost Estimate
Installation of one 345kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1.0M

Direct Connection Network Upgrades

Prior to AD2-154 queue position, a new 345kV Interconnection Substation would be built under two earlier queue positions Z2-087 and AD2-047, by tapping into 'Brokaw – Pontiac' 345kV line 8001. It is proposed to interconnect developer's generator lead to the already built Interconnection Substation.

The scope of work includes installation of four 345kV circuit breakers at the Interconnection Substation (to be built by Z2-087 and AD2-047), to create a line position for IC's generator lead, as shown in the one-line diagram below. It should be noted that if anyone of Z2-087 and AD2-047 projects drops out or does not build the Interconnection Substation, then the interconnection scope of work for AD2-154 project would change.

The Interconnection Customer is responsible for constructing all the facilities on the Interconnection Customer side of the point of interconnection outside of the Interconnection.

The preliminary cost estimate for Direct Connection Network Upgrade is given below.

Scope of Work	Cost Estimate
Installation of four 345kV circuit breakers at the Interconnection Substation (built by Z2-087 and AD2-047) and relay/protection work	$10,000,000
Total Cost Estimate (see notes below on cost estimate)	$10,000,000

Normally, it takes about 24-months to engineer, design, procure material and construct 345kV facilities after ISA/ICSA are signed.

Non-Direct Connection Cost Estimate

None

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 Interconnection Customer.

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 Interconnection Customer and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, Interconnection Customer will be responsible for paying all actual costs of ComEd's work.

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

Network Impacts for Secondary POI

The Queue Project AD2-154 was evaluated as a 150.0 MW (Capacity 26.4 MW) injection at the Z2-087 Tap which is tapping the AB2-047 Tap to Pontiac; R 345kV line in the ComEd area. Project AD2-154 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-154 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. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 149.56% to 149.78% (**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 22.57 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 1 for a table containing the generators having contribution to this flowgate.

2. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 151.89% to 152.11% (**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 23.02 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 2 for a table containing the generators having contribution to this flowgate.

3. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 149.56% to 149.78% (**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 22.57 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 3 for a table containing the generators having contribution to this flowgate.

4. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 151.89% to 152.11% (**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 23.02 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 4 for a table containing the generators having contribution to this flowgate.

5. (MISO AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 134.03% to 135.06% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#3128_05EUGENE 345'. This project contributes approximately 15.12 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#3128_05EUGENE 345'
 OPEN BRANCH FROM BUS 243221 TO BUS 249504 CKT 1          / 243221 05EUGENE 345 249504 08CAYSUB 345 1
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1          / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

Please refer to Appendix 5 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)

None

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. (CE - CE) The BLUEMOUND; B-PONTIAC ; B 345 kV line (from bus 270668 to bus 270852 ckt 1) loads from 135.87% to 137.52% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.26 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1            / PONTI; R 345 Z2-087 TAP 345
 END
```

2. (CE - CE) The COLLINS ; R-COLLINS ;2M 345 kV line (from bus 270697 to bus 275168 ckt 1) loads from 105.03% to 105.45% (**DC power flow**) of its emergency rating (1379 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B_A'. This project contributes approximately 14.58 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B_A'
 TRIP BRANCH FROM BUS 934720 TO BUS 937120 CKT 1            / AD1-100 TAP 345 AD2-148 TAP 345
 END
```

3. (CE - CE) The LORETTO ; B-AD2-148 TAP 345 kV line (from bus 270704 to bus 937120 ckt 1) loads from 200.09% to 204.76% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8014_T_-S-B'. This project contributes approximately 75.39 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8014_T_-S-B'
```

```
 TRIP BRANCH FROM BUS 935000 TO BUS 270717 CKT 1          / AD1-133 TAP 345 DRESDEN ; R 345
 END
```

4. (CE - CE) The LORETTO ; B-AD2-148 TAP 345 kV line (from bus 270704 to bus 937120 ckt 1) loads from 150.19% to 153.74% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 51.23 MW to the thermal violation.

5. (CE - CE) The DRESDEN ; R-COLLINS ; R 345 kV line (from bus 270717 to bus 270697 ckt 1) loads from 111.05% to 111.55% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L1223_TR-S'. This project contributes approximately 16.98 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L1223_TR-S'
 TRIP BRANCH FROM BUS 270717 TO BUS 270731 CKT 1          / DRESD; R 345 ELECT;4R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 270717 CKT 1          / DRESD;3M 138 DRESD; R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 271336 CKT 1          / DRESD;3M 138 DRESD; B 138
 TRIP BRANCH FROM BUS 275180 TO BUS 275280 CKT 1          / DRESD;3M 138 DRESD;3C 34.5
 END
```

6. (CE - CE) The DRESDEN ; R-ELWOOD ; R 345 kV line (from bus 270717 to bus 270737 ckt 1) loads from 135.22% to 136.4% (**DC power flow**) of its emergency rating (1479 MVA) for the single line contingency outage of 'COMED_P1-2_345-L1223_TR-S'. This project contributes approximately 19.13 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L1223_TR-S'
 TRIP BRANCH FROM BUS 270717 TO BUS 270731 CKT 1          / DRESD; R 345 ELECT;4R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 270717 CKT 1          / DRESD;3M 138 DRESD; R 345
 TRIP BRANCH FROM BUS 275180 TO BUS 271336 CKT 1          / DRESD;3M 138 DRESD; B 138
 TRIP BRANCH FROM BUS 275180 TO BUS 275280 CKT 1          / DRESD;3M 138 DRESD;3C 34.5
 END
```

7. (CE - CE) The DRESDEN ; R-ELWOOD ; R 345 kV line (from bus 270717 to bus 270737 ckt 1) loads from 103.18% to 103.64% (**DC power flow**) of its normal rating (1201 MVA) for non-contingency condition. This project contributes approximately 14.34 MW to the thermal violation.

8. (CE - MISO AMIL) The KINCAID ; B-7AUSTIN 345 kV line (from bus 270796 to bus 347955 ckt 1) loads from 109.93% to 112.03% (**DC power flow**) of its emergency rating (956 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B_B'. This project contributes approximately 20.07 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B_B'
 TRIP BRANCH FROM BUS 937120 TO BUS 270704 CKT 1          / AD2-148 TAP 345 LORET; B 345
 END
```

9. (CE - MISO AMIL) The KINCAID ; B-7AUSTIN 345 kV line (from bus 270796 to bus 347955 ckt 1) loads from 108.5% to 109.26% (**DC power flow**) of its normal rating (797 MVA) for non-contingency condition. This project contributes approximately 13.46 MW to the thermal violation.

10. (CE - CE) The LATHAM ; T-W4-005 TAP 345 kV line (from bus 270804 to bus 905080 ckt 1) loads from 124.76% to 126.32% (**DC power flow**) of its emergency rating (1334 MVA) for

the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.36 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1             / PONTI; R 345 Z2-087 TAP 345
 END
```

11. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 187.5% to 192.33% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8014_T_-S-B'. This project contributes approximately 75.43 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8014_T_-S-B'
 TRIP BRANCH FROM BUS 935000 TO BUS 270717 CKT 1             / AD1-133 TAP 345 DRESDEN ; R 345
 END
```

12. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 138.14% to 141.47% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 51.27 MW to the thermal violation.

13. (CE - CE) The PONTIAC ; R-AD1-133 TAP 345 kV line (from bus 270853 to bus 935000 ckt 1) loads from 187.68% to 191.9% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B_A'. This project contributes approximately 69.77 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B_A'
 TRIP BRANCH FROM BUS 934720 TO BUS 937120 CKT 1             / AD1-100 TAP 345 AD2-148 TAP 345
 END
```

14. (CE - CE) The PONTIAC ; R-AD1-133 TAP 345 kV line (from bus 270853 to bus 935000 ckt 1) loads from 117.97% to 120.77% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 42.29 MW to the thermal violation.

15. (MISO AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 128.0% to 128.93% (**DC power flow**) of its normal rating (1451 MVA) for the single line contingency outage of 'AEP_P1-2_#286'. This project contributes approximately 15.14 MW to the thermal violation.

```
CONTINGENCY 'AEP_P1-2_#286'
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1             / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

16. (CE - CE) The W4-005 TAP-BLUEMOUND; B 345 kV line (from bus 905080 to bus 270668 ckt 1) loads from 137.71% to 139.42% (**DC power flow**) of its emergency rating (1334 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8001___-S-A'. This project contributes approximately 25.33 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8001___-S-A'
 TRIP BRANCH FROM BUS 270853 TO BUS 917500 CKT 1             / PONTI; R 345 Z2-087 TAP 345
 END
```

17. (CE - CE) The Z2-087 TAP-PONTIAC ; R 345 kV line (from bus 917500 to bus 270853 ckt 1) loads from 171.42% to 177.17% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8002___-S'. This project contributes approximately 103.07 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8002___-S'
 TRIP BRANCH FROM BUS 270852 TO BUS 270668 CKT 1              / PONTI; B 345 BLUEM; B 345
 END
```

18. (CE - CE) The Z2-087 TAP-PONTIAC ; R 345 kV line (from bus 917500 to bus 270853 ckt 1) loads from 141.02% to 147.22% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 114.09 MW to the thermal violation.

19. (CE - CE) The AD1-100 TAP-AD2-140 TAP 345 kV line (from bus 934720 to bus 937050 ckt 1) loads from 168.23% to 170.23% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of '"934725'. This project contributes approximately 42.73 MW to the thermal violation.

```
CONTINGENCY '934725'                          AD1-100 JNT 345 934730 AD1-100 TAP 345 1
 OPEN BRANCH FROM BUS 934725 TO BUS 934730 CKT 1
 END
```

20. (CE - CE) The AD1-100 TAP-AD2-140 TAP 345 kV line (from bus 934720 to bus 937050 ckt 1) loads from 132.08% to 133.81% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 25.8 MW to the thermal violation.

21. (CE - CE) The AD1-100 TAP-BRAIDWOOD; B 345 kV line (from bus 934730 to bus 270670 ckt 1) loads from 103.05% to 104.86% (**DC power flow**) of its emergency rating (1341 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-A_A'. This project contributes approximately 28.71 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-A_A'
 TRIP BRANCH FROM BUS 270926 TO BUS 937050 CKT 1              / WILTO; B 345 AD2-140 TAP 345
 END
```

22. (CE - CE) The AD1-100 TAP-DAVIS CRK; B 345 kV line (from bus 934730 to bus 270710 ckt 1) loads from 106.25% to 106.64% (**DC power flow**) of its emergency rating (1341 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-A_A'. This project contributes approximately 14.56 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-A_A'
 TRIP BRANCH FROM BUS 270926 TO BUS 937050 CKT 1              / WILTO; B 345 AD2-140 TAP 345
 END
```

23. (CE - CE) The AD1-133 TAP-DRESDEN ; R 345 kV line (from bus 935000 to bus 270717 ckt 1) loads from 197.07% to 200.7% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L11212_B-S-B_A'. This project contributes approximately 69.77 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L11212_B-S-B_A'
 TRIP BRANCH FROM BUS 934720 TO BUS 937120 CKT 1              / AD1-100 TAP 345 AD2-148 TAP 345
 END
```

24. (CE - CE) The AD1-133 TAP-DRESDEN ; R 345 kV line (from bus 935000 to bus 270717 ckt 1) loads from 129.73% to 132.73% (**DC power flow**) of its normal rating (1334 MVA) for non-contingency condition. This project contributes approximately 42.29 MW to the thermal violation.

25. (CE - CE) The AD2-140 TAP-WILTON ; B 345 kV line (from bus 937050 to bus 270926 ckt 1) loads from 188.99% to 191.23% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of '"934725'. This project contributes approximately 42.73 MW to the thermal violation.

```
CONTINGENCY '934725'                              AD1-100 JNT 345 934730 AD1-100 TAP 345 1
 OPEN BRANCH FROM BUS 934725 TO BUS 934730 CKT 1
 END
```

26. (CE - CE) The AD2-140 TAP-WILTON ; B 345 kV line (from bus 937050 to bus 270926 ckt 1) loads from 153.0% to 154.71% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 25.8 MW to the thermal violation.

27. (CE - CE) The AD2-148 TAP-AD1-100 TAP 345 kV line (from bus 937120 to bus 934720 ckt 1) loads from 217.58% to 221.59% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L8014_T_-S-B'. This project contributes approximately 75.39 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L8014_T_-S-B'
 TRIP BRANCH FROM BUS 935000 TO BUS 270717 CKT 1              / AD1-133 TAP 345 DRESDEN ; R 345
 END
```

28. (CE - CE) The AD2-148 TAP-AD1-100 TAP 345 kV line (from bus 937120 to bus 934720 ckt 1) loads from 168.56% to 171.59% (**DC power flow**) of its normal rating (1364 MVA) for non-contingency condition. This project contributes approximately 51.23 MW to the thermal violation.

Light Load Analysis - 2021

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

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

(CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 149.56% to 149.78% (**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 22.57 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 2

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 151.89% to 152.11% (**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 23.02 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 3

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 149.56% to 149.78% (**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 22.57 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 4

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 151.89% to 152.11% (**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 23.02 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 5

(MISO AMIL - AEP) The 7CASEY-05SULLIVAN 345 kV line (from bus 346809 to bus 247712 ckt 1) loads from 134.03% to 135.06% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#3128_05EUGENE 345'. This project contributes approximately 15.12 MW to the thermal violation.

```
CONTINGENCY 'AEP_P4_#3128_05EUGENE 345'
 OPEN BRANCH FROM BUS 243221 TO BUS 249504 CKT 1          / 243221 05EUGENE 345 249504 08CAYSUB 345 1
 OPEN BRANCH FROM BUS 243221 TO BUS 348885 CKT 1          / 243221 05EUGENE 345 348885 7BUNSONVILLE 345 1
 END
```

Bus Number	*Bus Name*	*Full Contribution*
933341	*AC2-147 C*	*0.54*
933342	*AC2-147 E*	*0.89*
934051	*AD1-031 C O1*	*2.37*
934052	*AD1-031 E O1*	*3.87*
934421	*AD1-066*	*0.87*
LTF	*AD1-092*	*9.6*
LTF	*AD1-093*	*16.1*
LTF	*AD1-094*	*2.91*
934881	*AD1-117 C*	*3.34*
934882	*AD1-117 E*	*2.23*
935001	*AD1-133 C O1*	*14.35*
935002	*AD1-133 E O1*	*9.57*
935141	*AD1-148*	*7.48*
936291	*AD2-038 C O2*	*1.44*
936292	*AD2-038 E O2*	*9.62*
936771	*AD2-100 C*	*21.17*
936772	*AD2-100 E*	*14.11*
936972	*AD2-131 E*	*8.4*
937171	*AD2-154 C O2*	*2.66*
937172	*AD2-154 E O2*	*12.46*
937211	*AD2-159 C*	*4.63*
937212	*AD2-159 E*	*21.69*
937531	*AD2-214 C*	*3.23*
937532	*AD2-214 E*	*1.52*
274832	*ANNAWAN ; 1U*	*8.72*
LTF	*BLUEG*	*5.63*
294401	*BSHIL;1U E*	*7.13*
294410	*BSHIL;2U E*	*7.13*
LTF	*CANNELTON*	*1.2*
LTF	*CARR*	*0.33*
274890	*CAYUG;1U E*	*10.29*
274891	*CAYUG;2U E*	*10.29*

LTF	*CBM-S1*	*9.31*
LTF	*CBM-S2*	*2.76*
LTF	*CBM-W1*	*56.04*
LTF	*CBM-W2*	*138.78*
LTF	*CLIFTY*	*18.96*
LTF	*CPLE*	*0.38*
274849	*CRESCENT ;1U*	*3.95*
LTF	*DEARBORN*	*0.59*
274859	*EASYR;U1 E*	*6.86*
274860	*EASYR;U2 E*	*6.86*
LTF	*ELMERSMITH*	*3.21*
LTF	*G-007*	*0.83*
960018	*G997 E*	*-2.86*
LTF	*GIBSON*	*1.43*
960026	*J196 E*	*5.39*
940291	*J291*	*3.23*
983101	*J339*	*6.2*
938571	*J467 C*	*3.57*
938572	*J467 E*	*14.26*
940541	*J468 C*	*7.15*
940542	*J468 E*	*28.62*
951151	*J474 C*	*2.63*
951152	*J474 E*	*10.54*
951641	*J641 C*	*8.28*
951642	*J641 E*	*2.16*
951661	*J644*	*9.66*
981031	*J734*	*5.2*
939811	*J750 C*	*2.74*
939812	*J750 E*	*10.97*
981361	*J756 C*	*3.21*
981362	*J756 E*	*12.84*
981581	*J757 C*	*5.26*
981582	*J757 E*	*21.02*
938331	*J797*	*18.82*
938391	*J808*	*8.79*
938411	*J811*	*17.92*
939761	*J813*	*43.43*
938791	*J815*	*32.44*
938811	*J817*	*10.29*
938841	*J826*	*10.81*
938891	*J835 C*	*3.46*
938892	*J835 E*	*13.85*
938941	*J845 C*	*2.27*
938942	*J845 E*	*9.07*
938971	*J848 C*	*6.82*

938972	*J848 E*	*27.27*
939171	*J872 C*	*5.75*
939172	*J872 E*	*22.99*
939261	*J884*	*7.9*
939481	*J912*	*14.37*
939741	*J949*	*39.25*
274650	*KINCAID ;1U*	*17.96*
274651	*KINCAID ;2U*	*17.89*
990901	*L-005 E*	*11.23*
LTF	*MEC*	*44.96*
293516	*O-009 E1*	*6.44*
293517	*O-009 E2*	*3.27*
293518	*O-009 E3*	*3.6*
293715	*O-029 E*	*6.89*
293716	*O-029 E*	*3.78*
293717	*O-029 E*	*3.47*
293771	*O-035 E*	*5.23*
LTF	*O-066*	*5.35*
296308	*R-030 C1*	*3.34*
296271	*R-030 C2*	*3.34*
296125	*R-030 C3*	*3.38*
296309	*R-030 E1*	*13.35*
296272	*R-030 E2*	*13.35*
296128	*R-030 E3*	*13.51*
LTF	*RENSSELAER*	*0.26*
LTF	*ROSETON*	*1.86*
290261	*S-027 C*	*0.91*
290265	*S-028 C*	*0.91*
LTF	*TRIMBLE*	*1.09*
274853	*TWINGROVE;U1*	*19.52*
274854	*TWINGROVE;U2*	*19.52*
276150	*W2-048 E*	*2.06*
903433	*W3-046*	*16.12*
905081	*W4-005 C*	*1.19*
905082	*W4-005 E*	*42.87*
905471	*W4-084*	*0.29*
274874	*WALNR;2U*	*1.53*
294502	*WALNR;2U E*	*6.11*
LTF	*WEC*	*4.2*
909052	*X2-022 E*	*28.64*
LTF	*Z1-043*	*22.26*
917501	*Z2-087 C*	*2.62*
917502	*Z2-087 E*	*17.54*
919221	*AA1-146*	*11.73*
919581	*AA2-030*	*11.73*

919621	*AA2-039 C*	*1.74*
919622	*AA2-039 E*	*11.64*
LTF	*AB2-013*	*13.42*
924041	*AB2-047 C O1*	*3.34*
924042	*AB2-047 E O1*	*22.37*
924261	*AB2-070 C O1*	*3.86*
924262	*AB2-070 E O1*	*25.84*
925161	*AB2-173*	*2.09*
925581	*AC1-033 C*	*1.17*
925582	*AC1-033 E*	*7.82*
925771	*AC1-053 C*	*3.9*
925772	*AC1-053 E*	*26.07*
926821	*AC1-168 C*	*0.84*
926822	*AC1-168 E*	*5.65*
926841	*AC1-171 C*	*1.14*
926842	*AC1-171 E*	*7.61*
927531	*AC1-185 1*	*0.43*
927541	*AC1-185 2*	*0.43*
927551	*AC1-185 3*	*0.43*
927561	*AC1-185 4*	*0.43*
927571	*AC1-185 5*	*0.43*
927581	*AC1-185 6*	*0.43*
927591	*AC1-185 7*	*0.43*
927601	*AC1-185 8*	*0.43*
927201	*AC1-214 C*	*1.68*
927202	*AC1-214 E*	*4.46*