# *Generation Interconnection Request*
# *System Impact Study Report*
# *For*
# *PJM Generation Interconnection Request*
# *Queue Position AE1-194*

# *CRETE 345kV*

***December 2021***

## Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The System Impact 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. The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer 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.

## General

The Interconnection Customer (IC) has proposed a Wind generating facility located in Will County, Illinois. The installed facilities will have a total capability of 500 MW with 65 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 9/1/2021, per Attachment N. This study does not imply a TO commitment to this in-service date.

## Point of Interconnection

The AE1-194 will interconnect with the ComEd transmission system via the existing 345kV substation TSS 945 Crete.

## Cost Summary

The AE1-194 project will be responsible for the following costs.

| Description | Cost Estimate |
|---|---|
| Total Physical Interconnection Costs | $14,000,000 |
| Allocation towards System Network Upgrade Costs (PJM Identified - Summer Peak)* | $15,518,136 |
| Allocation towards System Network Upgrade Costs (PJM Identified - Light Load)* | $1,157,690 |
| Allocation towards System Network Upgrade Costs (TO Identified)* | $0 |
| **Total Costs** | $30,675,826 |

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.
This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.
Note 1: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.
Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc., the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required

## Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

| Description | Cost Estimate |
|---|---|
| Attachment Facilities | $1,000,000 |
| Direct Connection Network Upgrades | $0 |
| Non-Direct Connection Network Upgrades | $13,000,000 |

| | |
|---|---|
| **Total Physical Interconnection Costs** | $14,000,000 |

## Attachment Facilities:

The AE1-194 generator lead will interconnect to 345kV bus at TSS 945 Crete. The required Attachment Facilities are one 345kV line MODs, one dead-end structure and one revenue-metering as shown in the one-line diagram.

| 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) | $1,000,000 |

## Non-Direct Connection:

In order to accommodate interconnection of AE1-194, Crete TSS 945 would need to be expanded to create a bus position.
The scope of work includes installation of four 345kV circuit breakers and relocating L94501 termination, to create a line position for AE1-194 generator lead. ComEd would design, engineer and construct expansion of Crete TSS 945.

| Scope of Work | Cost Estimate |
|---|---|
| Installation of four 345kV circuit breaker at 345kV TSS 945 Crete and relocating L94501 termination | $13,000,000 |

**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 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. Interconnection Customer will be responsible for paying actual costs of ComEd's work in accordance with Sections 212.1 and 217 of the PJM Open Access Transmission Tariff.
4) The Interconnection Customer is responsible for all engineering, procurement, testing and construction of all equipment on the Interconnection Customer’s side of the 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 for acquiring property and associated legal costs will be investigation during Facilities Study for this project.

## Schedule:

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

## Revenue Metering and SCADA Requirements

### PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

### Meteorological Data Reporting Requirements

The wind generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Wind speed (meters/second) - (Required)
- Wind direction (decimal degrees from true north) - (Required)
- Ambient air temperature (Fahrenheit) - (Required)
- Air Pressure (Hectopascals) - (Required)
- Humidity (Percent) (Accepted, not required)

## Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

**Network Impacts**

The Queue Project AE1-194 was evaluated as a 500.0 MW (Capacity 65.0 MW) injection at CRETE 345 kV substation in the ComEd area. Project AE1-194 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-194 was studied with a commercial probability of 100%. Potential network impacts were as follows:

# Summer Peak Analysis - 2022

**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)*

| Overload Number | Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Flowgate Appendix |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | LFFB | COMED_P4_023-65-BT2-3__ | MISO NIPS - CE | 17STJOHN-ST JOHN ; T 345 kV line | 255112 | 270886 | 1 | AC | 96.78 | 109.87 | ER | 1091 | 146.07 | 1 |
| 2 | LFFB | AEP_P4_#2978_05DUMONT 765_B | MISO NIPS - CE | 17STJOHN-ST JOHN ; T 345 kV line | 255112 | 270886 | 1 | DC | 95.75 | 109.18 | ER | 1091 | 145.56 | |
| 3 | LFFB | COMED_P4_112-65-BT4-5__ | MISO NIPS - CE | 17STJOHN-ST JOHN ; T 345 kV line | 255112 | 270886 | 1 | DC | 94.99 | 108.47 | ER | 1091 | 146.08 | |
| 4 | LFFB | COMED_P4_112-65-BT3-4__ | MISO NIPS - CE | 17STJOHN-ST JOHN ; T 345 kV line | 255112 | 270886 | 1 | DC | 94.99 | 108.46 | ER | 1091 | 146.08 | |
| 5 | LFFB | COMED_P4_023-65-BT2-3__ | CE - MISO NIPS | ST JOHN ; T-17GREEN_ACRE 345 kV line | 270886 | 255104 | 1 | AC | 96.77 | 109.87 | ER | 1091 | 146.07 | 2 |
| 6 | LFFB | AEP_P4_#2978_05DUMONT 765_B | CE - MISO NIPS | ST JOHN ; T-17GREEN_ACRE 345 kV line | 270886 | 255104 | 1 | DC | 95.74 | 109.17 | ER | 1091 | 145.56 | |
| 7 | LFFB | COMED_P4_112-65-BT4-5__ | CE - MISO NIPS | ST JOHN ; T-17GREEN_ACRE 345 kV line | 270886 | 255104 | 1 | DC | 94.99 | 108.47 | ER | 1091 | 146.08 | |
| 8 | LFFB | COMED_P4_112-65-BT3-4__ | CE - MISO NIPS | ST JOHN ; T-17GREEN_ACRE 345 kV line | 270886 | 255104 | 1 | DC | 94.99 | 108.46 | ER | 1091 | 146.08 | |

## 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)*

| Overload | Contingency | | | | Bus | | | | Loading % | | Rating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Type | Name | Affected Area | Facility Description | From | To | Circuit | Power Flow | Initial | Final | Type | MVA | MW Contribution | Flowgate Appendix |
| 9 | LFFB | AEP_P4_#2978_05DUMONT 765_B | MISO NIPS - AEP | 17STILLWELL-05DUMONT 345 kV line | 255113 | 243219 | 1 | AC | 123.52 | 125.1 | ER | 1409 | 79.21 | 3 |
| 10 | LFFB | AEP_P4_#2978_05DUMONT 765_B | CE - AEP | GREENACRE; T-05OLIVE 345 kV line | 270771 | 243229 | 1 | AC | 111.34 | 111.94 | ER | 971 | 83.95 | 4 |
| 11 | LFFB | COMED_P4_112-65-BT4-5__ | CE - MISO NIPS | CRETE EC ;BP-17STJOHN 345 kV line | 274750 | 255112 | 1 | AC | 113.17 | 131.17 | ER | 1399 | 249.95 | 5 |
| 12 | LFFB | COMED_P4_112-65-BT3-4__ | CE - MISO NIPS | CRETE EC ;BP-17STJOHN 345 kV line | 274750 | 255112 | 1 | AC | 113.16 | 131.16 | ER | 1399 | 249.95 | |
| 13 | LFFB | AEP_P4_#2978_05DUMONT 765_B | CE - MISO NIPS | CRETE EC ;BP-17STJOHN 345 kV line | 274750 | 255112 | 1 | AC | 111.15 | 129.12 | ER | 1399 | 249.47 | |

## Steady-State Voltage Requirements

*(Results of the steady-state voltage studies should be inserted here)*

To be determined

## 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.

| Overload | | Contingency | | | Bus | | | | Loading % | | Rating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Type | Name | Affected Area | Facility Description | From | To | Circuit | Power Flow | Initial | Final | Type | MVA | MW Contribution | Flowgate Appendix |
| 14 | N-1 | AEP_P1-2_#695A | MISO NIPS - CE | 17STJOHN-ST JOHN ; T 345 kV line | 255112 | 270886 | 1 | DC | 95.05 | 108.5 | ER | 1091 | 146.08 | |
| 15 | N-1 | AEP_P1-2_#695A | MISO NIPS - AEP | 17STILLWELL-05DUMONT 345 kV line | 255113 | 243219 | 1 | AC | 120.21 | 121.86 | NR | 1409 | 82.32 | |
| 16 | N-1 | COMED_P1-2_345-L94507_B-S | CE - CE | E FRANKFO; B-GOODINGS ;3B 345 kV line | 270728 | 270766 | 1 | AC | 78.06 | 98.11 | ER | 1726 | 356.95 | |
| 17 | Non | Non | CE - CE | E FRANKFO; B-GOODINGS ;3B 345 kV line | 270728 | 270766 | 1 | AC | 92.62 | 106.17 | NR | 1334 | 187.94 | |
| 18 | N-1 | AEP_P1-2_#695A | CE - MISO NIPS | ST JOHN ; T-17GREEN_ACRE 345 kV line | 270886 | 255104 | 1 | DC | 95.04 | 108.5 | ER | 1091 | 146.08 | |
| 19 | N-1 | AEP_P1-2_#695A | CE - MISO NIPS | CRETE EC ;BP-17STJOHN 345 kV line | 274750 | 255112 | 1 | AC | 110.69 | 128.65 | ER | 1399 | 249.96 | |
| 20 | Non | Non | CE - MISO NIPS | CRETE EC ;BP-17STJOHN 345 kV line | 274750 | 255112 | 1 | AC | 48.15 | 69.61 | NR | 1091 | 234.34 | |
| 21 | N-1 | COMED_P1-2_345-L94507_B-S | CE - CE | CRETE EC ;BP-E FRANKFO; B 345 kV line | 274750 | 270728 | 1 | AC | 56.59 | 91.18 | ER | 1399 | 499.22 | |
| 22 | Non | Non | CE - CE | CRETE EC ;BP-E FRANKFO; B 345 kV line | 274750 | 270728 | 1 | AC | 67.21 | 90.59 | NR | 1091 | 264.89 | |

# Short Circuit

*(Summary of impacted circuit breakers)*

No overdutied breakers identified

# Affected System Analysis & Mitigation

## MISO Impacts:

Preliminary MISO impacts have been identified. Please refer to the MISO Affected System report for details. Final MISO Impacts to be determined in the Facilities Study phase.

# Stability and Reactive Power Requirement

*(Results of the dynamic studies should be inserted here)*

To be determined during the Facilities Study.

# Light Load Analysis – 2022

## Generator Deliverability

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

| Overload Number | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Flowgate Appendix |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N-1 | AEP_P1-2_#695A | MISO NIPS - AEP | 17STILLWELL-05DUMONT 345 kV line | 255113 | 243219 | 1 | DC | 96.3 | 100.65 | NR | 1409 | 63.62 | |

**Note:**
(Summer Peak violation prior to AE1 – Does not receive a cost allocation)

## Multiple Facility Contingency

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

| Overload Number | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Flowgate Appendix |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | LFFB | AEP_P4_#2978_05DUMONT 765_B | MISO NIPS - AEP | 17STILLWELL-05DUMONT 345 kV line | 255113 | 243219 | 1 | DC | 97.57 | 101.89 | ER | 1409 | 61.11 | 1 |

**Note:**
(Summer Peak violation prior to AE1- Does not receive a cost allocation)

## 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)*

| Overload | | Contingency | Affected | | Bus | | | Power | Loading % | | Rating | | MW | Flowgate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution | Appendix |
| 3 | N-1 | AEP_P1-2_#7441-B | AEP - AEP | 05ALLEN-05RPMONE 345 kV line | 243211 | 242933 | 1 | DC | 101.04 | 104.58 | NR | 897 | 30.9 | 2 |
| 4 | N-1 | AEP_P1-2_#7441-A | AEP - AEP | 05ALLEN-05RPMONE 345 kV line | 243211 | 242933 | 1 | DC | 100.99 | 104.53 | NR | 897 | 30.9 | 3 |

**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.

Not Applicable.

# System Reinforcements

## Summer Peak Load Flow Analysis Reinforcement

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

### New System Reinforcements

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

| Facility | Upgrade Description | Cost | Cost Allocation | Upgrade Number |
|---|---|---|---|---|
| **17ST JOHN-ST JOHN ; T 345 kV line** | **ComEd**<br>ComEd SSTE rating is 1134 MVA.<br><br>ComEd Reinforcement:<br>**Project ID**: n5833<br>**Description**: The upgrade will be to mitigate the sag on the line. A preliminary estimate for the upgrade is $ 3.8 M with a construction estimated timeline of 30 months. The estimate provided does not include potential tower upgrades. The cost for this potential work will not be identified until the Facilities Study phase. Upon completion of this work the new line will be a minimum of 1091/1399/1483/1674 MVA (SN/SLTE/SSTE/SLD).<br>**Type**: FAC<br>**Cost:** $3,800,000<br>**Time Estimate**: 30 Months<br>**Ratings**: 1091/1399/1483/1674 MVA (SN/SLTE/SSTE/SLD)<br><br>**Notes**:<br>1. AE1-194 is currently the driver for the upgrade. Since the cost of the upgrade is less than $5M, AE1-194 will receive the allocated cost.<br>2. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study.<br>3. This facility was purchased and is now owned by NEXTERA. NEXTERA will evaluate this violation in the Facility Study phase.<br><br>MISO Reinforcement:<br>MISO-end ratings (1313/1591 MVA SN/SE ) are sufficient. | $3,800,000 | $3,800,000 | n5833 |

| | | | | |
|---|---|---|---|---|
| **17ST JOHN ; T - 17GREEN_ACRE 345 kV line** | **ComEd**<br>ComEd SSTE rating is 1134 MVA.<br><br>ComEd Reinforcement:<br>**Project ID**: n5834<br>**Description**: The upgrade is to mitigate the sag on the line. A preliminary estimate for this upgrade is $3.8 M with a preliminary construction timeline of 30 months. The estimate provided does not include potential tower upgrades. The cost for this potential work will not be identified until the Facilities Study phase. Upon completion of the upgrade the new ratings will be 1091/1399/1483/1674 MVA (SN/SLTE/SSTE/SLD).<br>**Type**: FAC<br>**Cost:** $3,800,000<br>**Time Estimate**: 30 Months<br>**Ratings**: 1091/1399/1483/1674 MVA (SN/SLTE/SSTE/SLD)<br><br>**Notes**:<br>1. AE1-194 is currently the driver for the upgrade. Since the cost of the upgrade is less than $5M, AE1-194 will receive the allocated cost.<br>2. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study.<br>3. This facility was purchased and is now owned by NEXTERA. NEXTERA will evaluate this violation in the Facility Study phase.<br><br>**MISO**<br>MISO-end ratings (1313/1591 MVA -SN/SE) are sufficient. | $3,800,000 | $3,800,000 | n5834 |

## 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)*

| Facility | Upgrade Description | Cost | Cost Allocation | Upgrade Number |
|---|---|---|---|---|
| **17STILLWELL-05DUMONT 345 kV Ckt. 1** | **Project ID**: n4058<br>**Description**: Sag mitigation 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 $1.613M. New SE rating will be 1718 MVA limited by a Dumont wave trap.<br>**Type**: FAC<br>**Cost:** $1,613,000<br>**Time Estimate**: Projected in service date 6/1/2022<br>**Ratings**:<br>AEP SE: 1409 MVA<br>MISO SE: 1779 MVA (MISO rating is sufficient)<br>**Notes**:<br>1. Since the cost of the upgrade is less than $5M, based on PJM cost allocation criteria, AE1-194 currently does not receive cost allocation towards this upgrade.<br>2. As changes to the PJM queue process occur (such as prior queued projects withdrawing from the queue, reducing in size, etc.) AE1-194 could receive cost allocation.<br>3. Although Queue Project AE1-194may not presently have cost responsibility for this upgrade, Queue Project AE1-194 may need this upgrade in-service to be deliverable to the PJM system. | $1,613,000 | $0 | n4058 |

<table>
<tr><td></td><td>4. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study.</td><td></td><td></td><td></td></tr>
<tr><td>GREENACRE; T-05OLIVE 345 kV Ckt. 1</td><td><u>Project ID</u>: n5913<br><u>Description</u>: Upgrade is a sag study will be required for the entire 40.64 miles of ACSR/PE ~ 1414 ~ 62/19 Conductor section 1 to determine if the line can be operated above its emergency rating 971 MVA. Estimated Cost: $162,560.<br><br>If deemed necessary to rebuild the entire 40.64 miles of the section of the line, Estimated Cost: $81,280,000. New expected SE rating is 1318 MVA.<br><br><u>Type</u>: FAC<br><u>Cost:</u> $162,560<br><u>Time Estimate</u>: N/A<br><u>Ratings</u>: Existing Ratings are as follows:<br>AEP SE: 971 MVA<br>ComEd SE: 1134 MVA (Rating is sufficient)<br><u>Notes</u>:<br>1. Since the cost of the upgrade is less than $5M, based on PJM cost allocation criteria, AE1-194 currently does not receive cost allocation towards this upgrade.<br>2. As changes to the PJM queue process occur (such as prior queued projects withdrawing from the queue, reducing in size, etc.) AE1-1 could receive cost allocation.<br>3. Although Queue Project AE1-194 may not presently have cost responsibility for this upgrade, Queue Project AE1-194 may need this upgrade in-service to be deliverable to the PJM system.<br>4. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study.</td><td>$162,560</td><td>$0</td><td>n5913</td></tr>
<tr><td>Crete – St John 345 kV line</td><td><u>ComEd</u><br>ComEd SSTE rating is 1483 MVA.<br><br><u>ComEd Reinforcement:</u><br><u>Project ID</u>: n5253<br><u>Description</u>: The upgrade will be to reconductor the line. A preliminary estimate for this upgrade is $14.9M with a preliminary construction timeline of 30-36 months. The estimate provided does not consider potential tower upgrades. This cost component will be determined during the Facilities Study phase. Upon completion of this upgrade, the new will be a minimum of 1334/1726/1837/2084 MVA (SN/SLTE/SSTE/SLD).<br><u>Type</u>: FAC<br><u>Cost:</u> $14,900,000<br><b><u>Time Estimate</u></b>: 30-36 Months<br><b><u>Ratings</u></b>: 1334/1726/1837/2084 MVA (SN/SLTE/SSTE/SLD)<br><br>The cost allocation is as follows:<br><table><tr><th>Queue</th><th>MW contribution</th><th>Percentage of Cost</th><th>$ cost ( $14.9 M)</th></tr><tr><td>AE1-193</td><td>251.82</td><td>50.19%</td><td>$7.48</td></tr><tr><td>AE1-194</td><td>249.95</td><td>49.81%</td><td>$7.42</td></tr></table><br><u>Notes</u>:<br>This facility was purchased and is now owned by NEXTERA. NEXTERA will evaluate this violation in the Facility Study phase.<br><br><u>MISO</u><br>MISO end ratings are 1206/1508 MVA (SN/SE)</td><td>$14,900,000<br>+$1,000,000</td><td>$7,420,000</td><td>n5253</td></tr>
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| | | | | |
|---|---|---|---|---|
| | MISO Reinforcement:<br>**Description**: MISO end upgrade is to upgrade St John substation conductor drop and switch. $1M cost estimate. New MISO end SE rating will be 1900 MVA.<br>**Type**: FAC<br>**Cost:** $1,000,000<br>**Time Estimate**: N/A Months<br>**Ratings**: 1900 MVA SE | | | |
| | **TOTAL COST** | **$25,275,560** | **15,518,136** | |

| Queue | MW contribution | Summer/Light Load | Percentage of Cost | $ cost ( $1 M) |
|---|---|---|---|---|
| AE1-193 | 251.82 | Summer peak | 50.2 | 501,863 |
| AE1-194 | 249.95 | Summer peak | 49.8 | 498,136 |

# Light Load - 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)*

| Facility | Upgrade Description | Cost | Cost Allocation | Upgrade Number |
|---|---|---|---|---|
| **ALLEN – RPMONE 345 kV line** | **Project ID**: n6740 & n6740.1<br>**Description**: A sag study will be required on ACSR/PE~ 1275 ~ 54/19, conductor section 3, 12.25 miles of line. Cost of sag study is $49,000. New SE rating of conductor section 3 after sag study: 1301 MVA SE. New expected SE rating of line to be 971 MVA.<br><br>If the sag study concludes a complete Rebuild/Reconductor is required, the estimated cost is $24.5M. PJM Network Upgrade n6740.<br><br>A sag study will be required on ACSR/PE~ 1414 ~ 62/19, conductor section 2, 6.07 miles of line. The cost of the sag study is expected to be $24,280. New Ratings of conductor section 2 after sag study: S/N: 971 MVA S/E: 1419 MVA. New expected SE rating of line to be 1301 MVA. If the sag study concludes a complete Rebuild/Reconductor, cost: $12.14M.<br>PJM Network Upgrade n6740.1<br>Both Sag studies would be required.<br>**Type**: FAC<br>**Cost:** $73,280<br>**Time Estimate**: N/A<br>**Ratings**: AEP SE: 971 MVA<br><br>**Notes**: | $73,280 | $36,640 | n6740<br>n6740.1 |

| Queue | MW Contribution | Percentage of Cost | Cost($73,280) |
|---|---|---|---|
| AE1-193 | 30.9 | 50.00% | $36,640 |
| AE1-194 | 30.904 | 50.00% | $36,640 |

<table>
<tr><td></td><td>1. If sag study results in reconductor/re-build AE1-194 will incur additional costs.<br>2. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study.</td><td></td><td></td><td></td></tr>
<tr><td>WILTON ; B-WILTON ;3M 345 kV line/ WILTON ; R-WILTON ;4M 345 kV line/ WILTON ; 765/345 kV transformer</td><td><u>Project ID</u>: n5145<br><br><u>Description:</u> Build out the Wilton 765kV bus thereby allowing for 765kV L11216 (currently on Bus 6) to be relocated to Bus 8. Along with this line relocation, installation of 2-765kV BT CB’s (6-8 & 8-2). This will eliminate the stuck breaker contingency '112-65-BT5-6__' and contingency outage of '112-65-BT2-3__'. No other contingency updates needed.<br><br>Estimated Cost: $12,000,000<br><br>Estimated Time : 30 Months<br><br>
<table>
<tr><th>Queue</th><th>MW contribution</th><th>Summer/Light Load</th><th>Percentage of Cost</th><th>$ cost</th></tr>
<tr><td>AD1-100</td><td>116.8</td><td>Light Load</td><td>22.13%</td><td>2.66</td></tr>
<tr><td>AD2-047</td><td>26.4</td><td>Light Load</td><td>5.00%</td><td>0.60</td></tr>
<tr><td>AD2-066</td><td>17.72</td><td>Summer</td><td>3.36%</td><td>0.40</td></tr>
<tr><td>AD2-102</td><td>29.65</td><td>Summer</td><td>5.62%</td><td>0.67</td></tr>
<tr><td>AD2-134</td><td>16.2</td><td>Summer</td><td>3.07%</td><td>0.37</td></tr>
<tr><td>AD2-159</td><td>16.6</td><td>Light Load</td><td>3.15%</td><td>0.38</td></tr>
<tr><td>AD2-194</td><td>19.62</td><td>Summer</td><td>3.72%</td><td>0.45</td></tr>
<tr><td>AE1-113</td><td>45.7</td><td>Summer</td><td>8.66%</td><td>1.04</td></tr>
<tr><td>AE1-114</td><td>21.8</td><td>Summer</td><td>4.13%</td><td>0.50</td></tr>
<tr><td>AE1-163</td><td>53.1</td><td>Summer</td><td>10.06%</td><td>1.21</td></tr>
<tr><td>AE1-166</td><td>25.37</td><td>Summer</td><td>4.81%</td><td>0.58</td></tr>
<tr><td>AE1-172</td><td>47.1</td><td>Summer</td><td>8.93%</td><td>1.07</td></tr>
<tr><td>AE1-193</td><td>45.82</td><td>Light Load</td><td>8.68%</td><td>1.04</td></tr>
<tr><td>AE1-194</td><td>45.82</td><td>Light Load</td><td>8.68%</td><td>1.04</td></tr>
</table></td><td>12,000,000</td><td>1,040,000</td><td>n5145</td></tr>
<tr><td>CRETE EC ;BP-17STJOHN 345 kV</td><td>Refer Summer Peak study for cost allocation</td><td></td><td></td><td></td></tr>
<tr><td>UNIV PK N;RP-05OLIVE 345 kV Ckt. 1</td><td><u>AEP Upgrade:</u><br><u>Project ID</u>: n4057<br><u>Description</u>: To increase SE rating: AEP: a sag check will be required for the ACSR/PE ~ 1414 ~ 62/19 ~ Conductor Section 1 to determine if the line section can be operated above its emergency rating of 971 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 40.61 mile section of line would need to be rebuilt. Estimated Cost: $162,440 (2016 dollars). If deemed necessary to rebuild the entire 40.61 miles of the section of the line, Estimated Cost: $81,220,000.<br>Schedule: (1) Sag Study: 6 to 12 months. (2) Rebuild: The standard time required for construction differs from state to state.<br>An approximate construction time would be 24 to 36 months after signing an interconnection agreement.<br><u>Type</u>: FAC<br><u>Cost:</u> $162,440<br><u>Time Estimate</u>: 6-12 or 24-36 Months<br><u>Ratings</u>: 971/1304 MVA SN/SE</td><td>$162,410</td><td>$81,050</td><td>n4057</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | <table><tr><th>Queue</th><th>MW contribution</th><th>Percentage of Cost</th><th>$ cost</th></tr><tr><td>AE1-193</td><td>23.7</td><td>50.11%</td><td>81.39</td></tr><tr><td>AE1-194</td><td>23.6</td><td>49.89%</td><td>81.05</td></tr></table><br>**Notes**:<br>1. If sag study results in reconductor/re-build AE1-194 will incur additional costs.<br>2. If Queue Project AE1-194 comes into service prior to completion of the upgrade, Queue Project AE1-194 will need an interim study. | | | |
| | **Total Cost** | **12,235,690** | **1,157,690** | |

**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

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

## Short Circuit System Reinforcement

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

No mitigations are required.

# Contingencies (Summer Peak Analysis)

| Contingency Name | Description |
|---|---|
| AEP_P1-2_#695A | CONTINGENCY 'AEP_P1-2_#695A'<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1<br><br>END |

| | |
|---|---|
| AEP_P4_#2978_05DUMONT 765_B | CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207 05GRNTWN 765 1<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1<br><br>END |
| COMED_P1-2_345-L94507_B-S | CONTINGENCY 'COMED_P1-2_345-L94507_B-S'<br><br>TRIP BRANCH FROM BUS 274750 TO BUS 255112 CKT 1 / CRETE;BP 345 17STJOHN 345<br><br>END |
| COMED_P4_023-65-BT2-3__ | CONTINGENCY 'COMED_P4_023-65-BT2-3__'<br><br>TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1 / WILTO; 765 05DUMONT 765<br><br>TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1 / COLLI; 765 PLANO; 765<br><br>END |
| COMED_P4_112-65-BT3-4__ | CONTINGENCY 'COMED_P4_112-65-BT3-4__'<br><br>TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1 / WILTO; 765 05DUMONT 765<br><br>TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1 / WILTO;3M 345 WILTO; 765<br><br>TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1 / WILTO;3M 345 WILTO; B 345<br><br>TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1 / WILTO;3M 345 WILTO;3C 33<br><br>END |
| COMED_P4_112-65-BT4-5__ | CONTINGENCY 'COMED_P4_112-65-BT4-5__'<br><br>TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1 / WILTO; 765 05DUMONT 765<br><br>TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1 / WILTO;4M 345 WILTO; 765<br><br>TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1 / WILTO;4M 345 WILTO; R 345<br><br>TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1 / WILTO;4M 345 WILTO;4C 33<br><br>END |

# Appendices (Summer Peak Analysis)

## Appendix 1

(MISO NIPS - CE) The 17STJOHN-ST JOHN ; T 345 kV line (from bus 255112 to bus 270886 ckt 1) loads from 96.78% to 109.87% (AC power flow) of its emergency rating (1091 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 146.07 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

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *932881* | *AC2-115 1* | *1.78* |
| *932891* | *AC2-115 2* | *1.78* |
| *932921* | *AC2-116* | *0.62* |
| *933411* | *AC2-154 C* | *1.75* |
| *933412* | *AC2-154 E* | *2.85* |
| *933911* | *AD1-013 C* | *1.38* |
| *933912* | *AD1-013 E* | *2.2* |
| *933931* | *AD1-016 C* | *0.7* |
| *933932* | *AD1-016 E* | *1.14* |
| *934101* | *AD1-039 1* | *5.22* |
| *934111* | *AD1-039 2* | *5.55* |
| *934431* | *AD1-067 C* | *0.1* |
| *934432* | *AD1-067 E* | *0.41* |
| *934701* | *AD1-098 C O1* | *5.14* |
| *934702* | *AD1-098 E O1* | *3.76* |
| *934721* | *AD1-100 C* | *14.35* |
| *934722* | *AD1-100 E* | *66.95* |
| *934871* | *AD1-116 C* | *0.68* |
| *934872* | *AD1-116 E* | *1.11* |
| *934971* | *AD1-129 C* | *0.68* |
| *934972* | *AD1-129 E* | *0.45* |
| *935001* | *AD1-133 C O1* | *15.25* |
| *935002* | *AD1-133 E O1* | *10.17* |
| *936291* | *AD2-038 C O1* | *1.72* |
| *936292* | *AD2-038 E O1* | *11.52* |
| *936371* | *AD2-047 C O1* | *3.13* |
| *936372* | *AD2-047 E O1* | *15.27* |

| | | |
|---|---|---|
| *936461* | *AD2-060* | *1.84* |
| *936511* | *AD2-066 C O1* | *6.23* |
| *936512* | *AD2-066 E O1* | *4.15* |
| *936791* | *AD2-102 C* | *10.6* |
| *936792* | *AD2-102 E* | *7.07* |
| *937001* | *AD2-134 C* | *1.94* |
| *937002* | *AD2-134 E* | *7.73* |
| *937311* | *AD2-172 C* | *1.84* |
| *937312* | *AD2-172 E* | *2.54* |
| *937401* | *AD2-194  1* | *5.97* |
| *937411* | *AD2-194  2* | *5.96* |
| *938511* | *AE1-070  1* | *7.01* |
| *938521* | *AE1-070  2* | *6.4* |
| *938851* | *AE1-113 C O1* | *6.08* |
| *938852* | *AE1-113 E O1* | *21.55* |
| *938861* | *AE1-114 C O1* | *2.94* |
| *938862* | *AE1-114 E O1* | *10.02* |
| *939051* | *AE1-134  1* | *1.02* |
| *939061* | *AE1-134  2* | *1.02* |
| *939321* | *AE1-163 C O1* | *4.32* |
| *939322* | *AE1-163 E O1* | *26.57* |
| *939351* | *AE1-166 C O1* | *7.64* |
| *939352* | *AE1-166 E O1* | *7.05* |
| *939401* | *AE1-172 C O1* | *3.83* |
| *939402* | *AE1-172 E O1* | *17.91* |
| *939631* | *AE1-193 C O1* | *18.99* |
| *939632* | *AE1-193 E O1* | *127.09* |
| *939641* | *AE1-194 C* | *18.99* |
| *939642* | *AE1-194 E* | *127.09* |
| *939651* | *AE1-195 C* | *18.99* |
| *939652* | *AE1-195 E* | *127.09* |
| *939681* | *AE1-198 C O1* | *56.38* |
| *939682* | *AE1-198 E O1* | *47.91* |
| *940101* | *AE1-252 C O1* | *7.67* |
| *940102* | *AE1-252 E O1* | *5.12* |
| *LTF* | *BLUEG* | *4.79* |
| *274654* | *BRAIDWOOD;1U* | *22.* |
| *274655* | *BRAIDWOOD;2U* | *21.06* |
| *LTF* | *CALDERWOOD* | *0.06* |
| *LTF* | *CANNELTON* | *0.09* |
| *LTF* | *CARR* | *0.54* |
| *LTF* | *CATAWBA* | *0.21* |
| *274890* | *CAYUG;1U E* | *8.79* |
| *274891* | *CAYUG;2U E* | *8.79* |
| *LTF* | *CBM-S1* | *0.91* |

| | | |
|---|---|---|
| *LTF* | *CBM-W1* | *20.43* |
| *LTF* | *CBM-W2* | *38.51* |
| *LTF* | *CHEOAH* | *0.06* |
| *LTF* | *CHOCTAW /* 35% REVERSE 4566958 4511400* | *< 0.01* |
| *274751* | *CRETE EC ;1U* | *3.87* |
| *274752* | *CRETE EC ;2U* | *3.87* |
| *274753* | *CRETE EC ;3U* | *3.87* |
| *274754* | *CRETE EC ;4U* | *3.87* |
| *274859* | *EASYR;U1 E* | *8.22* |
| *274860* | *EASYR;U2 E* | *8.22* |
| *LTF* | *G-007* | *1.52* |
| *LTF* | *GIBSON* | *0.05* |
| *290051* | *GSG-6; E* | *7.82* |
| *LTF* | *HAMLET* | *0.4* |
| *275149* | *KEMPTON ;1E* | *12.88* |
| *274704* | *KENDALL ;1C* | *3.25* |
| *274705* | *KENDALL ;1S* | *2.17* |
| *274706* | *KENDALL ;2C* | *3.25* |
| *274707* | *KENDALL ;2S* | *2.17* |
| *274661* | *LASCO STA;2U* | *20.32* |
| *290108* | *LEEDK;1U E* | *18.19* |
| *LTF* | *MEC* | *27.81* |
| *293061* | *N-015 E* | *11.68* |
| *293516* | *O-009 E1* | *6.79* |
| *293517* | *O-009 E2* | *3.45* |
| *293518* | *O-009 E3* | *3.8* |
| *293715* | *O-029 E* | *7.26* |
| *293716* | *O-029 E* | *3.98* |
| *293717* | *O-029 E* | *3.66* |
| *LTF* | *O-066* | *9.77* |
| *293644* | *O22 E1* | *8.54* |
| *293645* | *O22 E2* | *16.59* |
| *290021* | *O50 E* | *14.73* |
| *294392* | *P-010 E* | *14.83* |
| *294763* | *P-046 E* | *7.02* |
| *274888* | *PILOT HIL;1E* | *12.88* |
| *270859* | *PWR VTR EC;R* | *9.09* |
| *LTF* | *RENSSELAER* | *0.43* |
| *274722* | *S-055 E* | *8.49* |
| *295111* | *SUBLETTE E* | *2.04* |
| *274861* | *TOP CROP ;1U* | *0.38* |
| *274862* | *TOP CROP ;2U* | *0.73* |
| *LTF* | *TRIMBLE* | *0.56* |
| *LTF* | *WEC* | *6.* |

| | | |
|---|---|---|
| *295109* | *WESTBROOK E* | *4.19* |
| *274687* | *WILL CNTY;4U* | *9.27* |
| *915011* | *Y3-013 1* | *2.83* |
| *915021* | *Y3-013 2* | *2.83* |
| *915031* | *Y3-013 3* | *2.83* |
| *916221* | *Z1-073 E* | *4.03* |
| *916502* | *Z1-106 E1* | *0.95* |
| *916504* | *Z1-106 E2* | *0.95* |
| *916512* | *Z1-107 E* | *1.86* |
| *916522* | *Z1-108 E* | *1.87* |
| *918052* | *AA1-018 E* | *11.7* |
| *919221* | *AA1-146* | *13.12* |
| *919581* | *AA2-030* | *13.12* |
| *920272* | *AA2-123 E* | *1.84* |
| *930481* | *AB1-089* | *49.32* |
| *930501* | *AB1-091 O1* | *50.89* |
| *930741* | *AB1-122 1O1* | *53.27* |
| *930751* | *AB1-122 2O1* | *56.61* |
| *924471* | *AB2-096* | *31.8* |
| *925302* | *AB2-191 E* | *1.04* |
| *926311* | *AC1-109 1* | *1.43* |
| *926321* | *AC1-109 2* | *1.43* |
| *926331* | *AC1-110 1* | *1.43* |
| *926341* | *AC1-110 2* | *1.43* |
| *926351* | *AC1-111 1* | *0.57* |
| *926361* | *AC1-111 2* | *0.57* |
| *926371* | *AC1-111 3* | *0.57* |
| *926381* | *AC1-111 4* | *0.57* |
| *926391* | *AC1-111 5* | *0.57* |
| *926401* | *AC1-111 6* | *0.57* |
| *927511* | *AC1-113 1* | *0.89* |
| *927521* | *AC1-113 2* | *0.89* |
| *926431* | *AC1-114* | *1.78* |
| *927451* | *AC1-142A 1* | *3.22* |
| *927461* | *AC1-142A 2* | *3.22* |
| *926821* | *AC1-168 C O1* | *0.85* |
| *926822* | *AC1-168 E O1* | *5.72* |
| *927091* | *AC1-204 1* | *55.48* |
| *927101* | *AC1-204 2* | *55.4* |

# Appendix 2

(CE - MISO NIPS) The ST JOHN ; T-17GREEN_ACRE 345 kV line (from bus 270886 to bus 255104 ckt 1) loads from 96.77% to 109.87% (AC power flow) of its emergency rating (1091 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 146.07 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

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *932881* | *AC2-115 1* | *1.78* |
| *932891* | *AC2-115 2* | *1.78* |
| *932921* | *AC2-116* | *0.62* |
| *933411* | *AC2-154 C* | *1.75* |
| *933412* | *AC2-154 E* | *2.85* |
| *933911* | *AD1-013 C* | *1.38* |
| *933912* | *AD1-013 E* | *2.2* |
| *933931* | *AD1-016 C* | *0.7* |
| *933932* | *AD1-016 E* | *1.14* |
| *934101* | *AD1-039 1* | *5.22* |
| *934111* | *AD1-039 2* | *5.55* |
| *934431* | *AD1-067 C* | *0.1* |
| *934432* | *AD1-067 E* | *0.41* |
| *934701* | *AD1-098 C O1* | *5.14* |
| *934702* | *AD1-098 E O1* | *3.76* |
| *934721* | *AD1-100 C* | *14.35* |
| *934722* | *AD1-100 E* | *66.95* |
| *934871* | *AD1-116 C* | *0.68* |
| *934872* | *AD1-116 E* | *1.11* |
| *934971* | *AD1-129 C* | *0.68* |
| *934972* | *AD1-129 E* | *0.45* |
| *935001* | *AD1-133 C O1* | *15.25* |
| *935002* | *AD1-133 E O1* | *10.17* |
| *936291* | *AD2-038 C O1* | *1.72* |
| *936292* | *AD2-038 E O1* | *11.52* |
| *936371* | *AD2-047 C O1* | *3.13* |
| *936372* | *AD2-047 E O1* | *15.27* |
| *936461* | *AD2-060* | *1.84* |
| *936511* | *AD2-066 C O1* | *6.23* |
| *936512* | *AD2-066 E O1* | *4.15* |

| | | |
|---|---|---|
| *936791* | *AD2-102 C* | *10.6* |
| *936792* | *AD2-102 E* | *7.07* |
| *937001* | *AD2-134 C* | *1.94* |
| *937002* | *AD2-134 E* | *7.73* |
| *937311* | *AD2-172 C* | *1.84* |
| *937312* | *AD2-172 E* | *2.54* |
| *937401* | *AD2-194 1* | *5.97* |
| *937411* | *AD2-194 2* | *5.96* |
| *938511* | *AE1-070 1* | *7.01* |
| *938521* | *AE1-070 2* | *6.4* |
| *938851* | *AE1-113 C O1* | *6.08* |
| *938852* | *AE1-113 E O1* | *21.55* |
| *938861* | *AE1-114 C O1* | *2.94* |
| *938862* | *AE1-114 E O1* | *10.02* |
| *939051* | *AE1-134 1* | *1.02* |
| *939061* | *AE1-134 2* | *1.02* |
| *939321* | *AE1-163 C O1* | *4.32* |
| *939322* | *AE1-163 E O1* | *26.57* |
| *939351* | *AE1-166 C O1* | *7.64* |
| *939352* | *AE1-166 E O1* | *7.05* |
| *939401* | *AE1-172 C O1* | *3.83* |
| *939402* | *AE1-172 E O1* | *17.91* |
| *939631* | *AE1-193 C O1* | *18.99* |
| *939632* | *AE1-193 E O1* | *127.09* |
| *939641* | *AE1-194 C* | *18.99* |
| *939642* | *AE1-194 E* | *127.09* |
| *939651* | *AE1-195 C* | *18.99* |
| *939652* | *AE1-195 E* | *127.09* |
| *939681* | *AE1-198 C O1* | *56.38* |
| *939682* | *AE1-198 E O1* | *47.91* |
| *940101* | *AE1-252 C O1* | *7.67* |
| *940102* | *AE1-252 E O1* | *5.12* |
| *LTF* | *BLUEG* | *4.79* |
| *274654* | *BRAIDWOOD;1U* | *22.* |
| *274655* | *BRAIDWOOD;2U* | *21.06* |
| *LTF* | *CALDERWOOD* | *0.06* |
| *LTF* | *CANNELTON* | *0.09* |
| *LTF* | *CARR* | *0.54* |
| *LTF* | *CATAWBA* | *0.21* |
| *274890* | *CAYUG;1U E* | *8.79* |
| *274891* | *CAYUG;2U E* | *8.79* |
| *LTF* | *CBM-S1* | *0.91* |
| *LTF* | *CBM-W1* | *20.43* |
| *LTF* | *CBM-W2* | *38.51* |
| *LTF* | *CHEOAH* | *0.06* |

| | | |
|---|---|---|
| *LTF* | *CHOCTAW /* 35% REVERSE 4566958 4511400* | *< 0.01* |
| *274751* | *CRETE EC ;1U* | *3.87* |
| *274752* | *CRETE EC ;2U* | *3.87* |
| *274753* | *CRETE EC ;3U* | *3.87* |
| *274754* | *CRETE EC ;4U* | *3.87* |
| *274859* | *EASYR;U1 E* | *8.22* |
| *274860* | *EASYR;U2 E* | *8.22* |
| *LTF* | *G-007* | *1.52* |
| *LTF* | *GIBSON* | *0.05* |
| *290051* | *GSG-6; E* | *7.82* |
| *LTF* | *HAMLET* | *0.4* |
| *275149* | *KEMPTON ;1E* | *12.88* |
| *274704* | *KENDALL ;1C* | *3.25* |
| *274705* | *KENDALL ;1S* | *2.17* |
| *274706* | *KENDALL ;2C* | *3.25* |
| *274707* | *KENDALL ;2S* | *2.17* |
| *274661* | *LASCO STA;2U* | *20.32* |
| *290108* | *LEEDK;1U E* | *18.19* |
| *LTF* | *MEC* | *27.81* |
| *293061* | *N-015 E* | *11.68* |
| *293516* | *O-009 E1* | *6.79* |
| *293517* | *O-009 E2* | *3.45* |
| *293518* | *O-009 E3* | *3.8* |
| *293715* | *O-029 E* | *7.26* |
| *293716* | *O-029 E* | *3.98* |
| *293717* | *O-029 E* | *3.66* |
| *LTF* | *O-066* | *9.77* |
| *293644* | *O22 E1* | *8.54* |
| *293645* | *O22 E2* | *16.59* |
| *290021* | *O50 E* | *14.73* |
| *294392* | *P-010 E* | *14.83* |
| *294763* | *P-046 E* | *7.02* |
| *274888* | *PILOT HIL;1E* | *12.88* |
| *270859* | *PWR VTR EC;R* | *9.09* |
| *LTF* | *RENSSELAER* | *0.43* |
| *274722* | *S-055 E* | *8.49* |
| *295111* | *SUBLETTE E* | *2.04* |
| *274861* | *TOP CROP ;1U* | *0.38* |
| *274862* | *TOP CROP ;2U* | *0.73* |
| *LTF* | *TRIMBLE* | *0.56* |
| *LTF* | *WEC* | *6.* |
| *295109* | *WESTBROOK E* | *4.19* |
| *274687* | *WILL CNTY;4U* | *9.27* |
| *915011* | *Y3-013 1* | *2.83* |

| | | |
|---|---|---|
| *915021* | *Y3-013 2* | *2.83* |
| *915031* | *Y3-013 3* | *2.83* |
| *916221* | *Z1-073 E* | *4.03* |
| *916502* | *Z1-106 E1* | *0.95* |
| *916504* | *Z1-106 E2* | *0.95* |
| *916512* | *Z1-107 E* | *1.86* |
| *916522* | *Z1-108 E* | *1.87* |
| *918052* | *AA1-018 E* | *11.7* |
| *919221* | *AA1-146* | *13.12* |
| *919581* | *AA2-030* | *13.12* |
| *920272* | *AA2-123 E* | *1.84* |
| *930481* | *AB1-089* | *49.32* |
| *930501* | *AB1-091 O1* | *50.89* |
| *930741* | *AB1-122 1O1* | *53.27* |
| *930751* | *AB1-122 2O1* | *56.61* |
| *924471* | *AB2-096* | *31.8* |
| *925302* | *AB2-191 E* | *1.04* |
| *926311* | *AC1-109 1* | *1.43* |
| *926321* | *AC1-109 2* | *1.43* |
| *926331* | *AC1-110 1* | *1.43* |
| *926341* | *AC1-110 2* | *1.43* |
| *926351* | *AC1-111 1* | *0.57* |
| *926361* | *AC1-111 2* | *0.57* |
| *926371* | *AC1-111 3* | *0.57* |
| *926381* | *AC1-111 4* | *0.57* |
| *926391* | *AC1-111 5* | *0.57* |
| *926401* | *AC1-111 6* | *0.57* |
| *927511* | *AC1-113 1* | *0.89* |
| *927521* | *AC1-113 2* | *0.89* |
| *926431* | *AC1-114* | *1.78* |
| *927451* | *AC1-142A 1* | *3.22* |
| *927461* | *AC1-142A 2* | *3.22* |
| *926821* | *AC1-168 C O1* | *0.85* |
| *926822* | *AC1-168 E O1* | *5.72* |
| *927091* | *AC1-204 1* | *55.48* |
| *927101* | *AC1-204 2* | *55.4* |

# Appendix 3

(MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 123.52% to 125.1% (AC power flow) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765_B'. This project contributes approximately 79.21 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'
OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207 05GRNTWN 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *932881* | *AC2-115 1* | *2.76* |
| *932891* | *AC2-115 2* | *2.76* |
| *932921* | *AC2-116* | *0.96* |
| *932931* | *AC2-117* | *5.85* |
| *933411* | *AC2-154 C* | *3.04* |
| *933412* | *AC2-154 E* | *4.96* |
| *933911* | *AD1-013 C* | *2.13* |
| *933912* | *AD1-013 E* | *3.4* |
| *933931* | *AD1-016 C* | *1.07* |
| *933932* | *AD1-016 E* | *1.75* |
| *934051* | *AD1-031 C O1* | *3.3* |
| *934052* | *AD1-031 E O1* | *5.39* |
| *934101* | *AD1-039 1* | *8.13* |
| *934111* | *AD1-039 2* | *8.37* |
| *934431* | *AD1-067 C* | *0.15* |
| *934432* | *AD1-067 E* | *0.64* |
| *934701* | *AD1-098 C O1* | *7.96* |
| *934702* | *AD1-098 E O1* | *5.81* |
| *934721* | *AD1-100 C* | *22.58* |
| *934722* | *AD1-100 E* | *105.36* |
| *934871* | *AD1-116 C* | *1.1* |
| *934872* | *AD1-116 E* | *1.79* |
| *934971* | *AD1-129 C* | *1.05* |
| *934972* | *AD1-129 E* | *0.7* |
| *935001* | *AD1-133 C O1* | *24.22* |
| *935002* | *AD1-133 E O1* | *16.14* |
| *936291* | *AD2-038 C O1* | *2.71* |
| *936292* | *AD2-038 E O1* | *18.14* |
| *936371* | *AD2-047 C O1* | *5.44* |

| | | |
|---|---|---|
| *936372* | *AD2-047 E O1* | *26.58* |
| *936461* | *AD2-060* | *3.2* |
| *936511* | *AD2-066 C O1* | *9.74* |
| *936512* | *AD2-066 E O1* | *6.49* |
| *936791* | *AD2-102 C* | *16.39* |
| *936792* | *AD2-102 E* | *10.93* |
| *937001* | *AD2-134 C* | *3.* |
| *937002* | *AD2-134 E* | *11.96* |
| *937311* | *AD2-172 C* | *2.85* |
| *937312* | *AD2-172 E* | *3.94* |
| *937401* | *AD2-194  1* | *9.* |
| *937411* | *AD2-194  2* | *9.* |
| *937531* | *AD2-214 C* | *5.12* |
| *937532* | *AD2-214 E* | *3.42* |
| *938511* | *AE1-070  1* | *10.58* |
| *938521* | *AE1-070  2* | *9.68* |
| *938851* | *AE1-113 C O1* | *9.26* |
| *938852* | *AE1-113 E O1* | *32.83* |
| *938861* | *AE1-114 C O1* | *4.56* |
| *938862* | *AE1-114 E O1* | *15.54* |
| *939051* | *AE1-134  1* | *1.59* |
| *939061* | *AE1-134  2* | *1.59* |
| *939321* | *AE1-163 C O1* | *6.81* |
| *939322* | *AE1-163 E O1* | *41.83* |
| *939351* | *AE1-166 C O1* | *11.86* |
| *939352* | *AE1-166 E O1* | *10.95* |
| *939401* | *AE1-172 C O1* | *6.16* |
| *939402* | *AE1-172 E O1* | *28.85* |
| *939631* | *AE1-193 C O1* | *10.3* |
| *939632* | *AE1-193 E O1* | *68.91* |
| *939641* | *AE1-194 C* | *10.3* |
| *939642* | *AE1-194 E* | *68.91* |
| *939651* | *AE1-195 C* | *10.3* |
| *939652* | *AE1-195 E* | *68.91* |
| *939681* | *AE1-198 C O1* | *30.58* |
| *939682* | *AE1-198 E O1* | *25.98* |
| *939741* | *AE1-205 C O1* | *10.32* |
| *939742* | *AE1-205 E O1* | *14.25* |
| *940101* | *AE1-252 C O1* | *12.36* |
| *940102* | *AE1-252 E O1* | *8.24* |
| *LTF* | *BLUEG* | *0.64* |
| *294401* | *BSHIL;1U E* | *9.93* |
| *294410* | *BSHIL;2U E* | *9.93* |
| *LTF* | *CARR* | *0.87* |
| *LTF* | *CATAWBA* | *0.19* |

| | | |
|---|---|---|
| *274890* | *CAYUG;1U E* | *15.86* |
| *274891* | *CAYUG;2U E* | *15.86* |
| *LTF* | *CBM-S1* | *4.21* |
| *LTF* | *CBM-W1* | *36.52* |
| *LTF* | *CBM-W2* | *84.42* |
| *LTF* | *CHOCTAW /* 35% REVERSE 4566958 4511400* | *< 0.01* |
| *LTF* | *CIN* | *3.51* |
| *274859* | *EASYR;U1 E* | *12.75* |
| *274860* | *EASYR;U2 E* | *12.75* |
| *LTF* | *G-007* | *2.42* |
| *290051* | *GSG-6; E* | *12.09* |
| *LTF* | *HAMLET* | *0.43* |
| *LTF* | *IPL* | *1.25* |
| *954751* | *J351* | *165.42* |
| *275149* | *KEMPTON ;1E* | *22.42* |
| *990901* | *L-005 E* | *14.6* |
| *290108* | *LEEDK;1U E* | *28.09* |
| *LTF* | *MEC* | *45.08* |
| *293061* | *N-015 E* | *17.64* |
| *293516* | *O-009 E1* | *10.59* |
| *293517* | *O-009 E2* | *5.38* |
| *293518* | *O-009 E3* | *5.92* |
| *293715* | *O-029 E* | *11.32* |
| *293716* | *O-029 E* | *6.21* |
| *293717* | *O-029 E* | *5.71* |
| *293771* | *O-035 E* | *7.42* |
| *LTF* | *O-066* | *15.53* |
| *293644* | *O22 E1* | *12.02* |
| *293645* | *O22 E2* | *23.33* |
| *290021* | *O50 E* | *22.45* |
| *294392* | *P-010 E* | *22.4* |
| *294763* | *P-046 E* | *10.86* |
| *274888* | *PILOT HIL;1E* | *22.42* |
| *270859* | *PWR VTR EC;R* | *14.01* |
| *LTF* | *RENSSELAER* | *0.69* |
| *274724* | *RIVER EC ;11* | *5.49* |
| *274722* | *S-055 E* | *13.02* |
| *274795* | *SE CHICAG;2U* | *1.29* |
| *274788* | *SE CHICAG;5U* | *1.31* |
| *274789* | *SE CHICAG;6U* | *1.31* |
| *274790* | *SE CHICAG;7U* | *1.31* |
| *274791* | *SE CHICAG;8U* | *1.31* |
| *295111* | *SUBLETTE E* | *3.15* |
| *LTF* | *TRIMBLE* | *0.12* |

| LTF | WEC | 9.25 |
|---|---|---|
| 295109 | WESTBROOK E | 6.48 |
| 910542 | X3-005 E | 1. |
| 915011 | Y3-013 1 | 4.34 |
| 915021 | Y3-013 2 | 4.34 |
| 915031 | Y3-013 3 | 4.34 |
| 916211 | Z1-072 E | 5.61 |
| 916221 | Z1-073 E | 6.24 |
| 916502 | Z1-106 E1 | 1.46 |
| 916504 | Z1-106 E2 | 1.46 |
| 916512 | Z1-107 E | 3.05 |
| 916522 | Z1-108 E | 2.88 |
| 917502 | Z2-087 E | 21.38 |
| 918052 | AA1-018 E | 18.85 |
| 919221 | AA1-146 | 20.41 |
| 919581 | AA2-030 | 20.41 |
| 920272 | AA2-123 E | 2.83 |
| 930481 | AB1-089 | 76.13 |
| 930501 | AB1-091 O1 | 88.69 |
| 930741 | AB1-122 1O1 | 82.91 |
| 930751 | AB1-122 2O1 | 85.44 |
| 924041 | AB2-047 C O1 | 3.99 |
| 924042 | AB2-047 E O1 | 26.73 |
| 924471 | AB2-096 | 49.02 |
| 925302 | AB2-191 E | 1.6 |
| 925581 | AC1-033 C | 1.63 |
| 925582 | AC1-033 E | 10.89 |
| 926311 | AC1-109 1 | 2.2 |
| 926321 | AC1-109 2 | 2.2 |
| 926331 | AC1-110 1 | 2.19 |
| 926341 | AC1-110 2 | 2.19 |
| 926351 | AC1-111 1 | 0.88 |
| 926361 | AC1-111 2 | 0.88 |
| 926371 | AC1-111 3 | 0.88 |
| 926381 | AC1-111 4 | 0.88 |
| 926391 | AC1-111 5 | 0.88 |
| 926401 | AC1-111 6 | 0.88 |
| 927511 | AC1-113 1 | 1.38 |
| 927521 | AC1-113 2 | 1.38 |
| 926431 | AC1-114 | 2.76 |
| 927451 | AC1-142A 1 | 4.86 |
| 927461 | AC1-142A 2 | 4.86 |
| 926821 | AC1-168 C O1 | 1.33 |
| 926822 | AC1-168 E O1 | 8.91 |
| 927091 | AC1-204 1 | 83.73 |

| | | |
|---|---|---|
| *927101* | *AC1-204  2* | *83.7* |
| *927201* | *AC1-214 C O1* | *2.38* |
| *927202* | *AC1-214 E O1* | *7.57* |

# Appendix 4

(CE - AEP) The GREENACRE; T-05OLIVE 345 kV line (from bus 270771 to bus 243229 ckt 1) loads from 111.34% to 111.94% (AC power flow) of its emergency rating (971 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765_B'. This project contributes approximately 83.95 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'
OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207 05GRNTWN 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *932881* | *AC2-115 1* | *1.59* |
| *932891* | *AC2-115 2* | *1.59* |
| *932921* | *AC2-116* | *0.56* |
| *933411* | *AC2-154 C* | *1.69* |
| *933412* | *AC2-154 E* | *2.76* |
| *933911* | *AD1-013 C* | *1.23* |
| *933912* | *AD1-013 E* | *1.96* |
| *933931* | *AD1-016 C* | *0.62* |
| *933932* | *AD1-016 E* | *1.02* |
| *934051* | *AD1-031 C O1* | *1.88* |
| *934052* | *AD1-031 E O1* | *3.07* |
| *934101* | *AD1-039 1* | *4.69* |
| *934111* | *AD1-039 2* | *4.9* |
| *934431* | *AD1-067 C* | *0.09* |
| *934432* | *AD1-067 E* | *0.37* |
| *934701* | *AD1-098 C O1* | *4.6* |
| *934702* | *AD1-098 E O1* | *3.35* |
| *934721* | *AD1-100 C* | *13.01* |
| *934722* | *AD1-100 E* | *60.71* |
| *934871* | *AD1-116 C* | *0.62* |
| *934872* | *AD1-116 E* | *1.01* |
| *934971* | *AD1-129 C* | *0.61* |
| *934972* | *AD1-129 E* | *0.4* |
| *935001* | *AD1-133 C O1* | *13.81* |
| *935002* | *AD1-133 E O1* | *9.21* |
| *936291* | *AD2-038 C O1* | *1.55* |
| *936292* | *AD2-038 E O1* | *10.38* |
| *936371* | *AD2-047 C O1* | *3.03* |
| *936372* | *AD2-047 E O1* | *14.78* |
| *936461* | *AD2-060* | *1.78* |

| | | |
|---|---|---|
| *936511* | *AD2-066 C O1* | *5.6* |
| *936512* | *AD2-066 E O1* | *3.73* |
| *936791* | *AD2-102 C* | *9.47* |
| *936792* | *AD2-102 E* | *6.31* |
| *937001* | *AD2-134 C* | *1.73* |
| *937002* | *AD2-134 E* | *6.9* |
| *937311* | *AD2-172 C* | *1.65* |
| *937312* | *AD2-172 E* | *2.27* |
| *937401* | *AD2-194 1* | *5.27* |
| *937411* | *AD2-194 2* | *5.27* |
| *937531* | *AD2-214 C* | *2.94* |
| *937532* | *AD2-214 E* | *1.96* |
| *938511* | *AE1-070 1* | *6.19* |
| *938521* | *AE1-070 2* | *5.66* |
| *938851* | *AE1-113 C O1* | *5.39* |
| *938852* | *AE1-113 E O1* | *19.1* |
| *938861* | *AE1-114 C O1* | *2.63* |
| *938862* | *AE1-114 E O1* | *8.96* |
| *939051* | *AE1-134 1* | *0.91* |
| *939061* | *AE1-134 2* | *0.91* |
| *939321* | *AE1-163 C O1* | *3.9* |
| *939322* | *AE1-163 E O1* | *23.94* |
| *939351* | *AE1-166 C O1* | *6.87* |
| *939352* | *AE1-166 E O1* | *6.34* |
| *939401* | *AE1-172 C O1* | *3.5* |
| *939402* | *AE1-172 E O1* | *16.4* |
| *939631* | *AE1-193 C O1* | *10.91* |
| *939632* | *AE1-193 E O1* | *73.04* |
| *939641* | *AE1-194 C* | *10.91* |
| *939642* | *AE1-194 E* | *73.04* |
| *939651* | *AE1-195 C* | *10.91* |
| *939652* | *AE1-195 E* | *73.04* |
| *939681* | *AE1-198 C O1* | *32.41* |
| *939682* | *AE1-198 E O1* | *27.54* |
| *939741* | *AE1-205 C O1* | *5.79* |
| *939742* | *AE1-205 E O1* | *8.* |
| *940101* | *AE1-252 C O1* | *7.02* |
| *940102* | *AE1-252 E O1* | *4.68* |
| *LTF* | *BLUEG* | *2.63* |
| *294401* | *BSHIL;1U E* | *5.66* |
| *294410* | *BSHIL;2U E* | *5.66* |
| *LTF* | *CARR* | *0.48* |
| *LTF* | *CATAWBA* | *0.15* |
| *274890* | *CAYUG;1U E* | *8.97* |
| *274891* | *CAYUG;2U E* | *8.97* |

| | | |
|---|---|---|
| *LTF* | *CBM-S1* | *1.49* |
| *LTF* | *CBM-W1* | *20.35* |
| *LTF* | *CBM-W2* | *39.71* |
| *LTF* | *CHOCTAW /* 35% REVERSE 4566958 4511400* | *< 0.01* |
| *LTF* | *CIN* | *0.23* |
| *274751* | *CRETE EC ;1U* | *2.22* |
| *274752* | *CRETE EC ;2U* | *2.22* |
| *274753* | *CRETE EC ;3U* | *2.22* |
| *274754* | *CRETE EC ;4U* | *2.22* |
| *274859* | *EASYR;U1 E* | *7.34* |
| *274860* | *EASYR;U2 E* | *7.34* |
| *LTF* | *G-007* | *1.33* |
| *290051* | *GSG-6; E* | *6.98* |
| *LTF* | *HAMLET* | *0.3* |
| *953871* | *J847* | *2.7* |
| *275149* | *KEMPTON ;1E* | *12.46* |
| *990901* | *L-005 E* | *8.29* |
| *290108* | *LEEDK;1U E* | *16.23* |
| *LTF* | *MEC* | *25.26* |
| *293061* | *N-015 E* | *10.29* |
| *293516* | *O-009 E1* | *6.08* |
| *293517* | *O-009 E2* | *3.09* |
| *293518* | *O-009 E3* | *3.4* |
| *293715* | *O-029 E* | *6.5* |
| *293716* | *O-029 E* | *3.56* |
| *293717* | *O-029 E* | *3.28* |
| *293771* | *O-035 E* | *4.23* |
| *LTF* | *O-066* | *8.55* |
| *293644* | *O22 E1* | *7.28* |
| *293645* | *O22 E2* | *14.13* |
| *290021* | *O50 E* | *13.06* |
| *294392* | *P-010 E* | *13.07* |
| *294763* | *P-046 E* | *6.27* |
| *274888* | *PILOT HIL;1E* | *12.46* |
| *270859* | *PWR VTR EC;R* | *8.1* |
| *LTF* | *RENSSELAER* | *0.38* |
| *274722* | *S-055 E* | *7.56* |
| *295111* | *SUBLETTE E* | *1.82* |
| *LTF* | *TRIMBLE* | *0.32* |
| *LTF* | *WEC* | *5.35* |
| *295109* | *WESTBROOK E* | *3.74* |
| *910542* | *X3-005 E* | *0.52* |
| *915011* | *Y3-013 1* | *2.52* |
| *915021* | *Y3-013 2* | *2.52* |

| | | |
|---|---|---|
| *915031* | *Y3-013 3* | *2.52* |
| *916211* | *Z1-072 E* | *3.2* |
| *916221* | *Z1-073 E* | *3.6* |
| *916502* | *Z1-106 E1* | *0.85* |
| *916504* | *Z1-106 E2* | *0.85* |
| *916512* | *Z1-107 E* | *1.72* |
| *916522* | *Z1-108 E* | *1.67* |
| *917502* | *Z2-087 E* | *11.99* |
| *918052* | *AA1-018 E* | *10.68* |
| *919221* | *AA1-146* | *11.73* |
| *919581* | *AA2-030* | *11.73* |
| *920272* | *AA2-123 E* | *1.64* |
| *930481* | *AB1-089* | *44.01* |
| *930501* | *AB1-091 O1* | *49.4* |
| *930741* | *AB1-122 1O1* | *47.85* |
| *930751* | *AB1-122 2O1* | *50.02* |
| *924041* | *AB2-047 C O1* | *2.24* |
| *924042* | *AB2-047 E O1* | *14.99* |
| *924471* | *AB2-096* | *28.36* |
| *925302* | *AB2-191 E* | *0.92* |
| *925581* | *AC1-033 C* | *0.93* |
| *925582* | *AC1-033 E* | *6.21* |
| *926311* | *AC1-109 1* | *1.28* |
| *926321* | *AC1-109 2* | *1.28* |
| *926331* | *AC1-110 1* | *1.27* |
| *926341* | *AC1-110 2* | *1.27* |
| *926351* | *AC1-111 1* | *0.51* |
| *926361* | *AC1-111 2* | *0.51* |
| *926371* | *AC1-111 3* | *0.51* |
| *926381* | *AC1-111 4* | *0.51* |
| *926391* | *AC1-111 5* | *0.51* |
| *926401* | *AC1-111 6* | *0.51* |
| *927511* | *AC1-113 1* | *0.8* |
| *927521* | *AC1-113 2* | *0.8* |
| *926431* | *AC1-114* | *1.59* |
| *927451* | *AC1-142A 1* | *2.85* |
| *927461* | *AC1-142A 2* | *2.85* |
| *926821* | *AC1-168 C O1* | *0.76* |
| *926822* | *AC1-168 E O1* | *5.11* |
| *927091* | *AC1-204 1* | *49.02* |
| *927101* | *AC1-204 2* | *48.98* |
| *927201* | *AC1-214 C O1* | *1.36* |
| *927202* | *AC1-214 E O1* | *4.32* |

# Appendix 5

(CE - MISO NIPS) The CRETE EC ;BP-17STJOHN 345 kV line (from bus 274750 to bus 255112 ckt 1) loads from 113.17% to 131.17% (AC power flow) of its emergency rating (1399 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT4-5__'. This project contributes approximately 249.95 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

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *932881* | *AC2-115 1* | *2.5* |
| *932891* | *AC2-115 2* | *2.5* |
| *932921* | *AC2-116* | *0.87* |
| *933411* | *AC2-154 C* | *2.32* |
| *933412* | *AC2-154 E* | *3.78* |
| *933911* | *AD1-013 C* | *1.92* |
| *933912* | *AD1-013 E* | *3.07* |
| *933931* | *AD1-016 C* | *0.98* |
| *933932* | *AD1-016 E* | *1.59* |
| *934101* | *AD1-039 1* | *7.31* |
| *934111* | *AD1-039 2* | *7.82* |
| *934431* | *AD1-067 C* | *0.14* |
| *934432* | *AD1-067 E* | *0.58* |
| *934701* | *AD1-098 C O1* | *7.19* |
| *934702* | *AD1-098 E O1* | *5.25* |
| *934721* | *AD1-100 C* | *19.9* |
| *934722* | *AD1-100 E* | *92.88* |
| *934871* | *AD1-116 C* | *0.94* |
| *934872* | *AD1-116 E* | *1.54* |
| *934971* | *AD1-129 C* | *0.95* |
| *934972* | *AD1-129 E* | *0.63* |
| *935001* | *AD1-133 C O1* | *21.27* |
| *935002* | *AD1-133 E O1* | *14.18* |
| *936291* | *AD2-038 C O1* | *2.4* |
| *936292* | *AD2-038 E O1* | *16.06* |
| *936371* | *AD2-047 C O1* | *4.15* |
| *936372* | *AD2-047 E O1* | *20.26* |

| | | |
|---|---|---|
| *936461* | *AD2-060* | *2.44* |
| *936511* | *AD2-066 C O1* | *8.7* |
| *936512* | *AD2-066 E O1* | *5.8* |
| *936791* | *AD2-102 C* | *14.83* |
| *936792* | *AD2-102 E* | *9.89* |
| *937001* | *AD2-134 C* | *2.71* |
| *937002* | *AD2-134 E* | *10.8* |
| *937311* | *AD2-172 C* | *2.58* |
| *937312* | *AD2-172 E* | *3.56* |
| *937401* | *AD2-194  1* | *8.41* |
| *937411* | *AD2-194  2* | *8.4* |
| *938511* | *AE1-070  1* | *9.89* |
| *938521* | *AE1-070  2* | *9.03* |
| *938851* | *AE1-113 C O1* | *8.56* |
| *938852* | *AE1-113 E O1* | *30.35* |
| *938861* | *AE1-114 C O1* | *4.11* |
| *938862* | *AE1-114 E O1* | *14.02* |
| *939051* | *AE1-134  1* | *1.43* |
| *939061* | *AE1-134  2* | *1.43* |
| *939321* | *AE1-163 C O1* | *6.03* |
| *939322* | *AE1-163 E O1* | *37.03* |
| *939351* | *AE1-166 C O1* | *10.65* |
| *939352* | *AE1-166 E O1* | *9.83* |
| *939401* | *AE1-172 C O1* | *5.29* |
| *939402* | *AE1-172 E O1* | *24.78* |
| *939631* | *AE1-193 C O1* | *32.49* |
| *939632* | *AE1-193 E O1* | *217.46* |
| *939641* | *AE1-194 C* | *32.49* |
| *939642* | *AE1-194 E* | *217.46* |
| *939651* | *AE1-195 C* | *32.49* |
| *939652* | *AE1-195 E* | *217.46* |
| *939681* | *AE1-198 C O1* | *96.48* |
| *939682* | *AE1-198 E O1* | *81.98* |
| *940101* | *AE1-252 C O1* | *10.61* |
| *940102* | *AE1-252 E O1* | *7.08* |
| *LTF* | *BLUEG* | *7.1* |
| *274654* | *BRAIDWOOD;1U* | *31.29* |
| *274655* | *BRAIDWOOD;2U* | *29.94* |
| *LTF* | *CALDERWOOD* | *0.11* |
| *LTF* | *CANNELTON* | *0.16* |
| *LTF* | *CARR* | *0.77* |
| *LTF* | *CATAWBA* | *0.32* |
| *LTF* | *CBM-S1* | *1.08* |
| *LTF* | *CBM-W1* | *26.5* |
| *LTF* | *CBM-W2* | *52.14* |

| | | |
|---|---|---|
| *LTF* | *CHEOAH* | *0.11* |
| *LTF* | *CHOCTAW /* 35% REVERSE 4566958 4511400* | *< 0.01* |
| *274751* | *CRETE EC ;1U* | *6.62* |
| *274752* | *CRETE EC ;2U* | *6.62* |
| *274753* | *CRETE EC ;3U* | *6.62* |
| *274754* | *CRETE EC ;4U* | *6.62* |
| *274859* | *EASYR;U1 E* | *11.49* |
| *274860* | *EASYR;U2 E* | *11.49* |
| *LTF* | *G-007* | *2.16* |
| *LTF* | *GIBSON* | *0.09* |
| *290051* | *GSG-6; E* | *10.92* |
| *LTF* | *HAMLET* | *0.59* |
| *275149* | *KEMPTON ;1E* | *17.08* |
| *274704* | *KENDALL ;1C* | *4.59* |
| *274705* | *KENDALL ;1S* | *3.06* |
| *274706* | *KENDALL ;2C* | *4.59* |
| *274707* | *KENDALL ;2S* | *3.06* |
| *274661* | *LASCO STA;2U* | *28.64* |
| *290108* | *LEEDK;1U E* | *25.39* |
| *LTF* | *MEC* | *38.8* |
| *293061* | *N-015 E* | *16.42* |
| *293516* | *O-009 E1* | *9.5* |
| *293517* | *O-009 E2* | *4.82* |
| *293518* | *O-009 E3* | *5.31* |
| *293715* | *O-029 E* | *10.16* |
| *293716* | *O-029 E* | *5.57* |
| *293717* | *O-029 E* | *5.12* |
| *LTF* | *O-066* | *13.85* |
| *293644* | *O22 E1* | *12.32* |
| *293645* | *O22 E2* | *23.92* |
| *290021* | *O50 E* | *20.75* |
| *294392* | *P-010 E* | *20.85* |
| *294763* | *P-046 E* | *9.81* |
| *274888* | *PILOT HIL;1E* | *17.08* |
| *270859* | *PWR VTR EC;R* | *12.71* |
| *LTF* | *RENSSELAER* | *0.61* |
| *274722* | *S-055 E* | *11.9* |
| *295111* | *SUBLETTE E* | *2.84* |
| *274861* | *TOP CROP ;1U* | *0.54* |
| *274862* | *TOP CROP ;2U* | *1.05* |
| *LTF* | *TRIMBLE* | *0.83* |
| *LTF* | *WEC* | *8.41* |
| *295109* | *WESTBROOK E* | *5.85* |
| *274687* | *WILL CNTY;4U* | *13.05* |

| | | |
|---|---|---|
| *915011* | *Y3-013 1* | *3.97* |
| *915021* | *Y3-013 2* | *3.97* |
| *915031* | *Y3-013 3* | *3.97* |
| *916221* | *Z1-073 E* | *5.64* |
| *916502* | *Z1-106 E1* | *1.33* |
| *916504* | *Z1-106 E2* | *1.33* |
| *916512* | *Z1-107 E* | *2.55* |
| *916522* | *Z1-108 E* | *2.62* |
| *918052* | *AA1-018 E* | *16.17* |
| *919221* | *AA1-146* | *18.35* |
| *919581* | *AA2-030* | *18.35* |
| *920272* | *AA2-123 E* | *2.57* |
| *930481* | *AB1-089* | *68.97* |
| *930501* | *AB1-091 O1* | *67.31* |
| *930741* | *AB1-122 1O1* | *74.6* |
| *930751* | *AB1-122 2O1* | *79.79* |
| *924471* | *AB2-096* | *44.48* |
| *925302* | *AB2-191 E* | *1.45* |
| *926311* | *AC1-109 1* | *2.* |
| *926321* | *AC1-109 2* | *2.* |
| *926331* | *AC1-110 1* | *2.* |
| *926341* | *AC1-110 2* | *2.* |
| *926351* | *AC1-111 1* | *0.8* |
| *926361* | *AC1-111 2* | *0.8* |
| *926371* | *AC1-111 3* | *0.8* |
| *926381* | *AC1-111 4* | *0.8* |
| *926391* | *AC1-111 5* | *0.8* |
| *926401* | *AC1-111 6* | *0.8* |
| *927511* | *AC1-113 1* | *1.25* |
| *927521* | *AC1-113 2* | *1.25* |
| *926431* | *AC1-114* | *2.5* |
| *927451* | *AC1-142A 1* | *4.53* |
| *927461* | *AC1-142A 2* | *4.53* |
| *926821* | *AC1-168 C O1* | *1.19* |
| *926822* | *AC1-168 E O1* | *8.01* |
| *927091* | *AC1-204 1* | *78.25* |
| *927101* | *AC1-204 2* | *78.11* |

# Contingencies (Light Load Analysis)

| Contingency Name | Description |
|---|---|
| AEP_P1-2_#695A | CONTINGENCY 'AEP_P1-2_#695A'<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 /<br>243206 05DUMONT 765 270644 WILTON ; 765 1<br><br>END |
| AEP_P1-2_#7441-A | CONTINGENCY 'AEP_P1-2_#7441-A'<br><br>OPEN BRANCH FROM BUS 242928 TO BUS 932800 CKT 1 /<br>242928 05MARYSV 765 932800 AC2-104 TAP 765 1<br><br>END |
| AEP_P1-2_#7441-B | CONTINGENCY 'AEP_P1-2_#7441-B'<br><br>OPEN BRANCH FROM BUS 932800 TO BUS 246999 CKT 1 /<br>932800 AC2-104 TAP 765 246999 05SORENS 765 1<br><br>END |
| AEP_P4_#2978_05DUMONT 765_B | CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 /<br>243206 05DUMONT 765 243207 05GRNTWN 765 1<br><br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 /<br>243206 05DUMONT 765 270644 WILTON ; 765 1<br><br>END |

# Appendices (Light Load Analysis)

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 97.57% to 101.89% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765_B'. This project contributes approximately 61.11 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'
OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207 05GRNTWN 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.12* |
| *934432* | *AD1-067 E* | *0.49* |
| *934721* | *AD1-100 C* | *17.37* |
| *934722* | *AD1-100 E* | *81.06* |
| *935141* | *AD1-148* | *3.42* |
| *936291* | *AD2-038 C O1* | *2.08* |
| *936292* | *AD2-038 E O1* | *13.92* |
| *936371* | *AD2-047 C O1* | *4.21* |
| *936372* | *AD2-047 E O1* | *20.53* |
| *936972* | *AD2-131 E* | *3.73* |
| *937001* | *AD2-134 C* | *2.3* |
| *937002* | *AD2-134 E* | *9.18* |
| *937211* | *AD2-159 C* | *2.5* |
| *937212* | *AD2-159 E* | *11.7* |
| *938851* | *AE1-113 C O1* | *7.8* |
| *938852* | *AE1-113 E O1* | *24.51* |
| *938861* | *AE1-114 C O1* | *3.19* |
| *938862* | *AE1-114 E O1* | *12.21* |
| *939321* | *AE1-163 C O1* | *5.23* |
| *939322* | *AE1-163 E O1* | *32.1* |
| *939401* | *AE1-172 C* | *4.72* |
| *939402* | *AE1-172 E* | *22.14* |
| *939631* | *AE1-193 C* | *7.94* |
| *939632* | *AE1-193 E* | *53.17* |
| *939641* | *AE1-194 C* | *7.94* |
| *939642* | *AE1-194 E* | *53.17* |
| *939651* | *AE1-195 C* | *7.94* |
| *939652* | *AE1-195 E* | *53.17* |
| *274857* | *BIG SKY ;U1* | *1.23* |
| *274858* | *BIG SKY ;U2* | *1.23* |

| | | |
|---|---|---|
| *274877* | *BISHOP HL;1U* | *0.95* |
| *274878* | *BISHOP HL;2U* | *0.95* |
| *294401* | *BSHIL;1U E* | *3.8* |
| *294410* | *BSHIL;2U E* | *3.8* |
| *274848* | *CAMPGROVE;RU* | *1.39* |
| *274890* | *CAYUG;1U E* | *6.1* |
| *274891* | *CAYUG;2U E* | *6.1* |
| *274863* | *CAYUGA RI;1U* | *1.53* |
| *274864* | *CAYUGA RI;2U* | *1.53* |
| *274849* | *CRESCENT ;1U* | *0.47* |
| *274859* | *EASYR;U1 E* | *4.91* |
| *274860* | *EASYR;U2 E* | *4.91* |
| *274856* | *ECOGROVE ;U1* | *1.05* |
| *274871* | *GR RIDGE ;2U* | *2.16* |
| *274847* | *GR RIDGE ;BU* | *1.7* |
| *274855* | *GSG-6 ;RU* | *1.17* |
| *290051* | *GSG-6; E* | *4.66* |
| *950591* | *H008* | *1.93* |
| *950671* | *J112* | *0.27* |
| *950141* | *J395* | *6.71* |
| *950491* | *J443* | *2.2* |
| *950501* | *J449* | *10.62* |
| *952021* | *J614* | *3.51* |
| *953201* | *J715* | *6.91* |
| *954701* | *J844* | *8.79* |
| *953921* | *J855* | *5.21* |
| *954091* | *J873* | *9.18* |
| *954301* | *J898* | *5.32* |
| *954511* | *J926* | *5.71* |
| *954741* | *J928* | *5.8* |
| *275149* | *KEMPTON ;1E* | *8.7* |
| *990901* | *L-005 E* | *5.58* |
| *274872* | *LEE DEKAL;1U* | *2.6* |
| *290108* | *LEEDK;1U E* | *10.83* |
| *274850* | *MENDOTA H;RU* | *0.32* |
| *274879* | *MINONK ;1U* | *2.16* |
| *293061* | *N-015 E* | *6.82* |
| *293513* | *O-009 C1* | *1.01* |
| *293514* | *O-009 C2* | *0.51* |
| *293515* | *O-009 C3* | *0.57* |
| *293516* | *O-009 E1* | *4.05* |
| *293517* | *O-009 E2* | *2.06* |
| *293518* | *O-009 E3* | *2.26* |
| *293712* | *O-029 C* | *1.08* |
| *293713* | *O-029 C* | *0.59* |

| | | |
|---|---|---|
| *293714* | *O-029 C* | *0.55* |
| *293715* | *O-029 E* | *4.33* |
| *293716* | *O-029 E* | *2.37* |
| *293717* | *O-029 E* | *2.18* |
| *293771* | *O-035 E* | *2.84* |
| *293644* | *O22 E1* | *4.65* |
| *293645* | *O22 E2* | *9.02* |
| *290021* | *O50 E* | *8.66* |
| *294392* | *P-010 E* | *8.66* |
| *294763* | *P-046 E* | *4.18* |
| *274888* | *PILOT HIL;1E* | *8.7* |
| *274887* | *PILOT HIL;1U* | *2.18* |
| *274881* | *PLEAS RDG;2U* | *2.18* |
| *274851* | *PROVIDENC;RU* | *0.71* |
| *290261* | *S-027 E* | *6.65* |
| *290265* | *S-028 E* | *6.65* |
| *295110* | *SUBLETTE C* | *0.17* |
| *295111* | *SUBLETTE E* | *1.21* |
| *274861* | *TOP CROP ;1U* | *1.16* |
| *274862* | *TOP CROP ;2U* | *2.25* |
| *274853* | *TWINGROVE;U1* | *1.66* |
| *274854* | *TWINGROVE;U2* | *1.66* |
| *295108* | *WESTBROOK C* | *0.38* |
| *295109* | *WESTBROOK E* | *2.48* |
| *909052* | *X2-022 E* | *13.08* |
| *916211* | *Z1-072 E* | *2.15* |
| *916221* | *Z1-073 E* | *2.41* |
| *917501* | *Z2-087 C* | *2.44* |
| *917502* | *Z2-087 E* | *16.33* |
| *918051* | *AA1-018 C* | *2.16* |
| *918052* | *AA1-018 E* | *14.49* |
| *920272* | *AA2-123 E* | *2.72* |
| *924041* | *AB2-047 C O1* | *3.02* |
| *924042* | *AB2-047 E O1* | *20.19* |
| *924261* | *AB2-070 C O1* | *1.86* |
| *924262* | *AB2-070 E O1* | *12.43* |
| *925301* | *AB2-191 C* | *0.67* |
| *925302* | *AB2-191 E* | *0.92* |
| *925581* | *AC1-033 C* | *1.24* |
| *925582* | *AC1-033 E* | *8.3* |
| *925771* | *AC1-053 C* | *1.84* |
| *925772* | *AC1-053 E* | *12.34* |
| *926821* | *AC1-168 C O1* | *1.02* |
| *926822* | *AC1-168 E O1* | *6.82* |
| *926841* | *AC1-171 C O1* | *0.87* |

| | | |
|---|---|---|
| *926842* | *AC1-171 E O1* | *5.83* |
| *927201* | *AC1-214 C O1* | *1.82* |
| *927202* | *AC1-214 E O1* | *5.77* |

# Appendix 2

(AEP - AEP) The 05ALLEN-05RPMONE 345 kV line (from bus 243211 to bus 242933 ckt 1) loads from 101.04% to 104.58% (**DC power flow**) of its normal rating (897 MVA) for the single line contingency outage of 'AEP_P1-2_#7441-B'. This project contributes approximately 30.9 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#7441-B'
OPEN BRANCH FROM BUS 932800 TO BUS 246999 CKT 1 / 932800 AC2-104 TAP 765 246999 05SORENS 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *243859* | *05FR-11G C* | *0.53* |
| *243862* | *05FR-12G C* | *0.52* |
| *247901* | *05FR-12G E* | *2.08* |
| *243864* | *05FR-21G C* | *0.56* |
| *247902* | *05FR-21G E* | *2.22* |
| *243866* | *05FR-22G C* | *0.53* |
| *243870* | *05FR-3G C* | *1.08* |
| *247904* | *05FR-3G E* | *4.31* |
| *243873* | *05FR-4G C* | *0.83* |
| *247905* | *05FR-4G E* | *3.24* |
| *243795* | *05HDWTR1G C* | *0.68* |
| *247963* | *05HDWTR1G E* | *1.64* |
| *246909* | *05MDL-1G C* | *1.13* |
| *247906* | *05MDL-1G E* | *4.49* |
| *246910* | *05MDL-2G C* | *0.56* |
| *247907* | *05MDL-2G E* | *2.23* |
| *246976* | *05MDL-3G C* | *0.56* |
| *247912* | *05MDL-3G E* | *2.33* |
| *246979* | *05MDL-4G C* | *1.13* |
| *247913* | *05MDL-4G E* | *2.25* |
| *246953* | *05TIMB G C* | *1.11* |
| *247911* | *05TIMB G E* | *4.46* |
| *246991* | *05WLD G1 C* | *0.34* |
| *247914* | *05WLD G1 E* | *4.51* |
| *247255* | *05WLD G2 C* | *0.35* |
| *247958* | *05WLD G2 E* | *2.38* |
| *933281* | *AC2-140 C* | *3.13* |
| *933282* | *AC2-140 E* | *0.16* |
| *933591* | *AC2-176 C O1* | *0.96* |
| *933592* | *AC2-176 E O1* | *6.39* |
| *934431* | *AD1-067 C* | *0.06* |
| *934432* | *AD1-067 E* | *0.26* |
| *934721* | *AD1-100 C* | *8.87* |

| | | |
|---|---|---|
| *934722* | *AD1-100 E* | *41.39* |
| *935141* | *AD1-148* | *2.41* |
| *936291* | *AD2-038 C O1* | *1.1* |
| *936292* | *AD2-038 E O1* | *7.39* |
| *936371* | *AD2-047 C O1* | *2.03* |
| *936372* | *AD2-047 E O1* | *9.93* |
| *936721* | *AD2-091* | *6.85* |
| *936751* | *AD2-096 O1* | *3.17* |
| *936972* | *AD2-131 E* | *2.89* |
| *937001* | *AD2-134 C* | *1.22* |
| *937002* | *AD2-134 E* | *4.87* |
| *937211* | *AD2-159 C* | *1.67* |
| *937212* | *AD2-159 E* | *7.82* |
| *938851* | *AE1-113 C O1* | *4.11* |
| *938852* | *AE1-113 E O1* | *12.93* |
| *938861* | *AE1-114 C O1* | *1.72* |
| *938862* | *AE1-114 E O1* | *6.56* |
| *939321* | *AE1-163 C O1* | *2.77* |
| *939322* | *AE1-163 E O1* | *17.04* |
| *939401* | *AE1-172 C* | *2.55* |
| *939402* | *AE1-172 E* | *11.98* |
| *939631* | *AE1-193 C* | *4.02* |
| *939632* | *AE1-193 E* | *26.89* |
| *939641* | *AE1-194 C* | *4.02* |
| *939642* | *AE1-194 E* | *26.89* |
| *939651* | *AE1-195 C* | *4.02* |
| *939652* | *AE1-195 E* | *26.89* |
| *939781* | *AE1-209 C* | *0.76* |
| *939782* | *AE1-209 E* | *5.11* |
| *939791* | *AE1-210 C O1* | *0.76* |
| *939792* | *AE1-210 E O1* | *5.11* |
| *274857* | *BIG SKY ;U1* | *0.66* |
| *274858* | *BIG SKY ;U2* | *0.66* |
| *274877* | *BISHOP HL;1U* | *0.54* |
| *274878* | *BISHOP HL;2U* | *0.54* |
| *294401* | *BSHIL;1U E* | *2.16* |
| *294410* | *BSHIL;2U E* | *2.16* |
| *274848* | *CAMPGROVE;RU* | *0.8* |
| *274890* | *CAYUG;1U E* | *3.38* |
| *274891* | *CAYUG;2U E* | *3.38* |
| *274863* | *CAYUGA RI;1U* | *0.85* |
| *274864* | *CAYUGA RI;2U* | *0.85* |
| *274849* | *CRESCENT ;1U* | *0.26* |
| *274859* | *EASYR;U1 E* | *2.65* |
| *274860* | *EASYR;U2 E* | *2.65* |

| | | |
|---|---|---|
| *274856* | *ECOGROVE ;U1* | *0.56* |
| *274871* | *GR RIDGE ;2U* | *1.12* |
| *274847* | *GR RIDGE ;BU* | *0.88* |
| *274855* | *GSG-6 ;RU* | *0.62* |
| *290051* | *GSG-6; E* | *2.48* |
| *275149* | *KEMPTON ;1E* | *4.21* |
| *990901* | *L-005 E* | *3.21* |
| *274872* | *LEE DEKAL;1U* | *1.37* |
| *290108* | *LEEDK;1U E* | *5.71* |
| *274850* | *MENDOTA H;RU* | *0.17* |
| *274879* | *MINONK ;1U* | *1.14* |
| *293061* | *N-015 E* | *3.54* |
| *293513* | *O-009 C1* | *0.56* |
| *293514* | *O-009 C2* | *0.28* |
| *293515* | *O-009 C3* | *0.31* |
| *293516* | *O-009 E1* | *2.23* |
| *293517* | *O-009 E2* | *1.13* |
| *293518* | *O-009 E3* | *1.25* |
| *293712* | *O-029 C* | *0.6* |
| *293713* | *O-029 C* | *0.33* |
| *293714* | *O-029 C* | *0.3* |
| *293715* | *O-029 E* | *2.39* |
| *293716* | *O-029 E* | *1.31* |
| *293717* | *O-029 E* | *1.2* |
| *293771* | *O-035 E* | *1.61* |
| *293644* | *O22 E1* | *2.37* |
| *293645* | *O22 E2* | *4.61* |
| *290021* | *O50 E* | *4.57* |
| *294392* | *P-010 E* | *4.49* |
| *294763* | *P-046 E* | *2.23* |
| *274888* | *PILOT HIL;1E* | *4.21* |
| *274887* | *PILOT HIL;1U* | *1.05* |
| *274881* | *PLEAS RDG;2U* | *1.05* |
| *274851* | *PROVIDENC;RU* | *0.4* |
| *290261* | *S-027 E* | *4.16* |
| *290265* | *S-028 E* | *4.16* |
| *247536* | *S-071 C* | *0.63* |
| *247929* | *S-071 E* | *2.53* |
| *295110* | *SUBLETTE C* | *0.09* |
| *247943* | *T-127 E* | *2.25* |
| *247521* | *T-131 C* | *1.3* |
| *247925* | *T-131 E* | *5.2* |
| *274861* | *TOP CROP ;1U* | *0.59* |
| *274862* | *TOP CROP ;2U* | *1.15* |
| *274853* | *TWINGROVE;U1* | *1.04* |

| | | |
|---|---|---|
| *274854* | *TWINGROVE;U2* | *1.04* |
| *247543* | *V3-007 C* | *1.35* |
| *247935* | *V3-007 E* | *9.06* |
| *905081* | *W4-005 C* | *1.16* |
| *905082* | *W4-005 E* | *5.49* |
| *295108* | *WESTBROOK C* | *0.2* |
| *909052* | *X2-022 E* | *9.23* |
| *916211* | *Z1-072 E* | *1.21* |
| *916221* | *Z1-073 E* | *1.28* |
| *917501* | *Z2-087 C* | *1.42* |
| *917502* | *Z2-087 E* | *9.5* |
| *918051* | *AA1-018 C* | *1.13* |
| *918052* | *AA1-018 E* | *7.54* |
| *920272* | *AA2-123 E* | *1.42* |
| *924041* | *AB2-047 C O1* | *1.77* |
| *924042* | *AB2-047 E O1* | *11.83* |
| *924261* | *AB2-070 C O1* | *1.29* |
| *924262* | *AB2-070 E O1* | *8.66* |
| *925301* | *AB2-191 C* | *0.35* |
| *925302* | *AB2-191 E* | *0.49* |
| *925581* | *AC1-033 C* | *0.7* |
| *925582* | *AC1-033 E* | *4.7* |
| *925771* | *AC1-053 C* | *1.29* |
| *925772* | *AC1-053 E* | *8.63* |
| *926821* | *AC1-168 C O1* | *0.56* |
| *926822* | *AC1-168 E O1* | *3.77* |
| *926841* | *AC1-171 C O1* | *0.53* |
| *926842* | *AC1-171 E O1* | *3.56* |
| *926861* | *AC1-173 C* | *0.85* |
| *926862* | *AC1-173 E* | *5.69* |
| *927201* | *AC1-214 C O1* | *1.03* |
| *927202* | *AC1-214 E O1* | *3.26* |

# Appendix 3

(CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 119.08% to 120.99% (**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 44.86 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* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.12* |
| *934432* | *AD1-067 E* | *0.52* |
| *934721* | *AD1-100 C* | *23.03* |
| *934722* | *AD1-100 E* | *107.45* |
| *935141* | *AD1-148* | *3.82* |
| *936291* | *AD2-038 C O1* | *2.23* |
| *936292* | *AD2-038 E O1* | *14.91* |
| *936371* | *AD2-047 C O1* | *4.42* |
| *936372* | *AD2-047 E O1* | *21.59* |
| *936972* | *AD2-131 E* | *3.96* |
| *937001* | *AD2-134 C* | *2.45* |
| *937002* | *AD2-134 E* | *9.78* |
| *937211* | *AD2-159 C* | *2.89* |
| *937212* | *AD2-159 E* | *13.51* |
| *938851* | *AE1-113 C O1* | *8.31* |
| *938852* | *AE1-113 E O1* | *26.11* |
| *938861* | *AE1-114 C O1* | *3.4* |
| *938862* | *AE1-114 E O1* | *12.99* |
| *939321* | *AE1-163 C O1* | *5.6* |
| *939322* | *AE1-163 E O1* | *34.38* |
| *939401* | *AE1-172 C* | *6.3* |
| *939402* | *AE1-172 E* | *29.55* |
| *939631* | *AE1-193 C* | *5.83* |
| *939632* | *AE1-193 E* | *39.03* |
| *939641* | *AE1-194 C* | *5.83* |
| *939642* | *AE1-194 E* | *39.03* |
| *939651* | *AE1-195 C* | *5.83* |

| | | |
|---|---|---|
| *939652* | *AE1-195 E* | *39.03* |
| *274857* | *BIG SKY ;U1* | *1.3* |
| *274858* | *BIG SKY ;U2* | *1.3* |
| *274877* | *BISHOP HL;1U* | *1.02* |
| *274878* | *BISHOP HL;2U* | *1.02* |
| *294401* | *BSHIL;1U E* | *4.08* |
| *294410* | *BSHIL;2U E* | *4.08* |
| *274848* | *CAMPGROVE;RU* | *1.5* |
| *274890* | *CAYUG;1U E* | *7.92* |
| *274891* | *CAYUG;2U E* | *7.92* |
| *274863* | *CAYUGA RI;1U* | *1.98* |
| *274864* | *CAYUGA RI;2U* | *1.98* |
| *274849* | *CRESCENT ;1U* | *0.5* |
| *274859* | *EASYR;U1 E* | *5.22* |
| *274860* | *EASYR;U2 E* | *5.22* |
| *274856* | *ECOGROVE ;U1* | *1.11* |
| *274871* | *GR RIDGE ;2U* | *2.4* |
| *274847* | *GR RIDGE ;BU* | *1.89* |
| *274855* | *GSG-6 ;RU* | *1.24* |
| *290051* | *GSG-6; E* | *4.97* |
| *950591* | *H008* | *2.1* |
| *950671* | *J112* | *0.3* |
| *950141* | *J395* | *7.32* |
| *950491* | *J443* | *2.39* |
| *950501* | *J449* | *11.52* |
| *952021* | *J614* | *3.8* |
| *953201* | *J715* | *7.81* |
| *954701* | *J844* | *9.72* |
| *953921* | *J855* | *5.63* |
| *954091* | *J873* | *0.37* |
| *954301* | *J898* | *5.77* |
| *954511* | *J926* | *6.19* |
| *954741* | *J928* | *6.32* |
| *275149* | *KEMPTON ;1E* | *9.15* |
| *990901* | *L-005 E* | *6.* |
| *274872* | *LEE DEKAL;1U* | *2.77* |
| *290108* | *LEEDK;1U E* | *11.55* |
| *274850* | *MENDOTA H;RU* | *0.34* |
| *274879* | *MINONK ;1U* | *2.31* |
| *293061* | *N-015 E* | *7.57* |
| *293513* | *O-009 C1* | *1.08* |
| *293514* | *O-009 C2* | *0.55* |
| *293515* | *O-009 C3* | *0.61* |
| *293516* | *O-009 E1* | *4.32* |
| *293517* | *O-009 E2* | *2.19* |

| | | |
|---|---|---|
| *293518* | *O-009 E3* | *2.42* |
| *293712* | *O-029 C* | *1.15* |
| *293713* | *O-029 C* | *0.63* |
| *293714* | *O-029 C* | *0.58* |
| *293715* | *O-029 E* | *4.62* |
| *293716* | *O-029 E* | *2.53* |
| *293717* | *O-029 E* | *2.33* |
| *293771* | *O-035 E* | *3.06* |
| *293644* | *O22 E1* | *4.88* |
| *293645* | *O22 E2* | *9.48* |
| *290021* | *O50 E* | *9.22* |
| *294392* | *P-010 E* | *9.61* |
| *294763* | *P-046 E* | *4.45* |
| *274888* | *PILOT HIL;1E* | *9.15* |
| *274887* | *PILOT HIL;1U* | *2.29* |
| *274881* | *PLEAS RDG;2U* | *2.29* |
| *274851* | *PROVIDENC;RU* | *0.76* |
| *290261* | *S-027 E* | *7.9* |
| *290265* | *S-028 E* | *7.9* |
| *295110* | *SUBLETTE C* | *0.18* |
| *295111* | *SUBLETTE E* | *1.29* |
| *274861* | *TOP CROP ;1U* | *1.22* |
| *274862* | *TOP CROP ;2U* | *2.37* |
| *274853* | *TWINGROVE;U1* | *1.97* |
| *274854* | *TWINGROVE;U2* | *1.97* |
| *905081* | *W4-005 C* | *2.* |
| *905082* | *W4-005 E* | *9.48* |
| *295108* | *WESTBROOK C* | *0.41* |
| *295109* | *WESTBROOK E* | *2.64* |
| *909052* | *X2-022 E* | *14.61* |
| *916211* | *Z1-072 E* | *2.32* |
| *916221* | *Z1-073 E* | *2.56* |
| *917501* | *Z2-087 C* | *2.98* |
| *917502* | *Z2-087 E* | *19.95* |
| *918051* | *AA1-018 C* | *2.33* |
| *918052* | *AA1-018 E* | *15.58* |
| *920272* | *AA2-123 E* | *2.89* |
| *924041* | *AB2-047 C O1* | *3.68* |
| *924042* | *AB2-047 E O1* | *24.61* |
| *924261* | *AB2-070 C O1* | *2.09* |
| *924262* | *AB2-070 E O1* | *14.01* |
| *925301* | *AB2-191 C* | *0.71* |
| *925302* | *AB2-191 E* | *0.98* |
| *925581* | *AC1-033 C* | *1.33* |
| *925582* | *AC1-033 E* | *8.91* |

| | | |
|---|---|---|
| *925771* | *AC1-053 C* | *2.07* |
| *925772* | *AC1-053 E* | *13.87* |
| *926821* | *AC1-168 C O1* | *1.1* |
| *926822* | *AC1-168 E O1* | *7.4* |
| *926841* | *AC1-171 C O1* | *0.94* |
| *926842* | *AC1-171 E O1* | *6.29* |
| *927201* | *AC1-214 C O1* | *1.95* |
| *927202* | *AC1-214 E O1* | *6.21* |

# Appendix 4

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 121.59% to 123.54% (**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 45.82 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* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.13* |
| *934432* | *AD1-067 E* | *0.53* |
| *934721* | *AD1-100 C* | *23.48* |
| *934722* | *AD1-100 E* | *109.58* |
| *935141* | *AD1-148* | *3.9* |
| *936291* | *AD2-038 C O1* | *2.28* |
| *936292* | *AD2-038 E O1* | *15.23* |
| *936371* | *AD2-047 C O1* | *4.51* |
| *936372* | *AD2-047 E O1* | *22.04* |
| *936972* | *AD2-131 E* | *4.04* |
| *937001* | *AD2-134 C* | *2.5* |
| *937002* | *AD2-134 E* | *9.98* |
| *937211* | *AD2-159 C* | *2.94* |
| *937212* | *AD2-159 E* | *13.78* |
| *938851* | *AE1-113 C O1* | *8.48* |
| *938852* | *AE1-113 E O1* | *26.67* |
| *938861* | *AE1-114 C O1* | *3.47* |
| *938862* | *AE1-114 E O1* | *13.26* |
| *939321* | *AE1-163 C O1* | *5.72* |
| *939322* | *AE1-163 E O1* | *35.12* |
| *939401* | *AE1-172 C* | *6.42* |
| *939402* | *AE1-172 E* | *30.13* |
| *939631* | *AE1-193 C* | *5.96* |
| *939632* | *AE1-193 E* | *39.86* |
| *939641* | *AE1-194 C* | *5.96* |
| *939642* | *AE1-194 E* | *39.86* |
| *939651* | *AE1-195 C* | *5.96* |

| | | |
|---|---|---|
| *939652* | *AE1-195 E* | *39.86* |
| *274857* | *BIG SKY ;U1* | *1.33* |
| *274858* | *BIG SKY ;U2* | *1.33* |
| *274877* | *BISHOP HL;1U* | *1.04* |
| *274878* | *BISHOP HL;2U* | *1.04* |
| *294401* | *BSHIL;1U E* | *4.17* |
| *294410* | *BSHIL;2U E* | *4.17* |
| *274848* | *CAMPGROVE;RU* | *1.53* |
| *274890* | *CAYUG;1U E* | *8.08* |
| *274891* | *CAYUG;2U E* | *8.08* |
| *274863* | *CAYUGA RI;1U* | *2.02* |
| *274864* | *CAYUGA RI;2U* | *2.02* |
| *274849* | *CRESCENT ;1U* | *0.51* |
| *274859* | *EASYR;U1 E* | *5.33* |
| *274860* | *EASYR;U2 E* | *5.33* |
| *274856* | *ECOGROVE ;U1* | *1.14* |
| *274871* | *GR RIDGE ;2U* | *2.45* |
| *274847* | *GR RIDGE ;BU* | *1.93* |
| *274855* | *GSG-6 ;RU* | *1.27* |
| *290051* | *GSG-6; E* | *5.07* |
| *950591* | *H008* | *2.14* |
| *950671* | *J112* | *0.3* |
| *950141* | *J395* | *7.48* |
| *950491* | *J443* | *2.45* |
| *950501* | *J449* | *11.76* |
| *952021* | *J614* | *3.88* |
| *953201* | *J715* | *7.97* |
| *954701* | *J844* | *9.92* |
| *953921* | *J855* | *4.75* |
| *954301* | *J898* | *5.89* |
| *954511* | *J926* | *6.33* |
| *954741* | *J928* | *6.46* |
| *275149* | *KEMPTON ;1E* | *9.34* |
| *990901* | *L-005 E* | *6.12* |
| *274872* | *LEE DEKAL;1U* | *2.83* |
| *290108* | *LEEDK;1U E* | *11.79* |
| *274850* | *MENDOTA H;RU* | *0.35* |
| *274879* | *MINONK ;1U* | *2.35* |
| *293061* | *N-015 E* | *7.73* |
| *293513* | *O-009 C1* | *1.1* |
| *293514* | *O-009 C2* | *0.56* |
| *293515* | *O-009 C3* | *0.62* |
| *293516* | *O-009 E1* | *4.41* |
| *293517* | *O-009 E2* | *2.24* |
| *293518* | *O-009 E3* | *2.47* |

| | | |
|---|---|---|
| *293712* | *O-029 C* | *1.18* |
| *293713* | *O-029 C* | *0.65* |
| *293714* | *O-029 C* | *0.6* |
| *293715* | *O-029 E* | *4.71* |
| *293716* | *O-029 E* | *2.58* |
| *293717* | *O-029 E* | *2.38* |
| *293771* | *O-035 E* | *3.12* |
| *293644* | *O22 E1* | *4.99* |
| *293645* | *O22 E2* | *9.68* |
| *290021* | *O50 E* | *9.42* |
| *294392* | *P-010 E* | *9.81* |
| *294763* | *P-046 E* | *4.55* |
| *274888* | *PILOT HIL;1E* | *9.34* |
| *274887* | *PILOT HIL;1U* | *2.34* |
| *274881* | *PLEAS RDG;2U* | *2.34* |
| *274851* | *PROVIDENC;RU* | *0.78* |
| *290261* | *S-027 E* | *8.06* |
| *290265* | *S-028 E* | *8.06* |
| *295110* | *SUBLETTE C* | *0.18* |
| *295111* | *SUBLETTE E* | *1.32* |
| *274861* | *TOP CROP ;1U* | *1.25* |
| *274862* | *TOP CROP ;2U* | *2.42* |
| *274853* | *TWINGROVE;U1* | *2.01* |
| *274854* | *TWINGROVE;U2* | *2.01* |
| *905081* | *W4-005 C* | *2.04* |
| *905082* | *W4-005 E* | *9.67* |
| *295108* | *WESTBROOK C* | *0.42* |
| *295109* | *WESTBROOK E* | *2.7* |
| *909052* | *X2-022 E* | *14.91* |
| *916211* | *Z1-072 E* | *2.36* |
| *916221* | *Z1-073 E* | *2.62* |
| *917501* | *Z2-087 C* | *3.04* |
| *917502* | *Z2-087 E* | *20.36* |
| *918051* | *AA1-018 C* | *2.38* |
| *918052* | *AA1-018 E* | *15.92* |
| *920272* | *AA2-123 E* | *2.95* |
| *924041* | *AB2-047 C O1* | *3.75* |
| *924042* | *AB2-047 E O1* | *25.11* |
| *924261* | *AB2-070 C O1* | *2.14* |
| *924262* | *AB2-070 E O1* | *14.3* |
| *925301* | *AB2-191 C* | *0.73* |
| *925302* | *AB2-191 E* | *1.* |
| *925581* | *AC1-033 C* | *1.36* |
| *925582* | *AC1-033 E* | *9.1* |
| *925771* | *AC1-053 C* | *2.11* |

| | | |
|---|---|---|
| *925772* | *AC1-053 E* | *14.15* |
| *926821* | *AC1-168 C O1* | *1.13* |
| *926822* | *AC1-168 E O1* | *7.55* |
| *926841* | *AC1-171 C O1* | *0.96* |
| *926842* | *AC1-171 E O1* | *6.42* |
| *927201* | *AC1-214 C O1* | *2.* |
| *927202* | *AC1-214 E O1* | *6.34* |

# Appendix 5

(CE - MISO NIPS) The CRETE EC ;BP-17STJOHN 345 kV line (from bus 274750 to bus 255112 ckt 1) loads from 105.12% to 117.5% (AC power flow) of its emergency rating (1557 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#2978_05DUMONT 765_B'. This project contributes approximately 197.48 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'
OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207 05GRNTWN 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.1* |
| *934432* | *AD1-067 E* | *0.44* |
| *934721* | *AD1-100 C* | *15.25* |
| *934722* | *AD1-100 E* | *71.18* |
| *935141* | *AD1-148* | *2.69* |
| *936291* | *AD2-038 C O1* | *1.83* |
| *936292* | *AD2-038 E O1* | *12.23* |
| *936371* | *AD2-047 C O1* | *3.15* |
| *936372* | *AD2-047 E O1* | *15.37* |
| *936972* | *AD2-131 E* | *2.82* |
| *937001* | *AD2-134 C* | *2.06* |
| *937002* | *AD2-134 E* | *8.23* |
| *937211* | *AD2-159 C* | *2.01* |
| *937212* | *AD2-159 E* | *9.4* |
| *938851* | *AE1-113 C O1* | *7.17* |
| *938852* | *AE1-113 E O1* | *22.54* |
| *938861* | *AE1-114 C O1* | *2.86* |
| *938862* | *AE1-114 E O1* | *10.94* |
| *939321* | *AE1-163 C O1* | *4.59* |
| *939322* | *AE1-163 E O1* | *28.21* |
| *939401* | *AE1-172 C* | *4.03* |
| *939402* | *AE1-172 E* | *18.92* |
| *939631* | *AE1-193 C* | *25.67* |
| *939632* | *AE1-193 E* | *171.81* |
| *939641* | *AE1-194 C* | *25.67* |
| *939642* | *AE1-194 E* | *171.81* |
| *939651* | *AE1-195 C* | *25.67* |
| *939652* | *AE1-195 E* | *171.81* |
| *274857* | *BIG SKY ;U1* | *1.1* |
| *274858* | *BIG SKY ;U2* | *1.1* |

| | | |
|---|---|---|
| *274877* | *BISHOP HL;1U* | *0.84* |
| *274878* | *BISHOP HL;2U* | *0.84* |
| *294401* | *BSHIL;1U E* | *3.35* |
| *294410* | *BSHIL;2U E* | *3.35* |
| *274848* | *CAMPGROVE;RU* | *1.22* |
| *274890* | *CAYUG;1U E* | *5.2* |
| *274891* | *CAYUG;2U E* | *5.2* |
| *274863* | *CAYUGA RI;1U* | *1.3* |
| *274864* | *CAYUGA RI;2U* | *1.3* |
| *274849* | *CRESCENT ;1U* | *0.41* |
| *274859* | *EASYR;U1 E* | *4.39* |
| *274860* | *EASYR;U2 E* | *4.39* |
| *274856* | *ECOGROVE ;U1* | *0.94* |
| *950751* | *G858* | *1.93* |
| *274871* | *GR RIDGE ;2U* | *2.* |
| *274847* | *GR RIDGE ;BU* | *1.58* |
| *274855* | *GSG-6 ;RU* | *1.05* |
| *290051* | *GSG-6; E* | *4.18* |
| *950591* | *H008* | *1.96* |
| *950761* | *H071* | *2.03* |
| *950671* | *J112* | *0.28* |
| *950141* | *J395* | *6.8* |
| *950221* | *J416* | *7.61* |
| *950491* | *J443* | *2.23* |
| *950501* | *J449* | *10.79* |
| *952021* | *J614* | *3.56* |
| *953201* | *J715* | *6.89* |
| *954701* | *J844* | *8.88* |
| *953921* | *J855* | *5.3* |
| *954091* | *J873* | *10.4* |
| *954301* | *J898* | *5.41* |
| *954511* | *J926* | *5.81* |
| *954741* | *J928* | *5.89* |
| *275149* | *KEMPTON ;1E* | *6.51* |
| *990901* | *L-005 E* | *4.89* |
| *274872* | *LEE DEKAL;1U* | *2.33* |
| *290108* | *LEEDK;1U E* | *9.73* |
| *274850* | *MENDOTA H;RU* | *0.29* |
| *274879* | *MINONK ;1U* | *1.99* |
| *293061* | *N-015 E* | *6.31* |
| *293513* | *O-009 C1* | *0.9* |
| *293514* | *O-009 C2* | *0.46* |
| *293515* | *O-009 C3* | *0.5* |
| *293516* | *O-009 E1* | *3.6* |
| *293517* | *O-009 E2* | *1.83* |

| | | |
|---|---|---|
| *293518* | *O-009 E3* | *2.01* |
| *293712* | *O-029 C* | *0.96* |
| *293713* | *O-029 C* | *0.53* |
| *293714* | *O-029 C* | *0.49* |
| *293715* | *O-029 E* | *3.85* |
| *293716* | *O-029 E* | *2.11* |
| *293717* | *O-029 E* | *1.94* |
| *293771* | *O-035 E* | *2.51* |
| *293644* | *O22 E1* | *4.76* |
| *293645* | *O22 E2* | *9.24* |
| *290021* | *O50 E* | *7.96* |
| *294392* | *P-010 E* | *8.01* |
| *294763* | *P-046 E* | *3.76* |
| *274888* | *PILOT HIL;1E* | *6.51* |
| *274887* | *PILOT HIL;1U* | *1.63* |
| *274881* | *PLEAS RDG;2U* | *1.63* |
| *274851* | *PROVIDENC;RU* | *0.63* |
| *295110* | *SUBLETTE C* | *0.15* |
| *295111* | *SUBLETTE E* | *1.09* |
| *274861* | *TOP CROP ;1U* | *1.19* |
| *274862* | *TOP CROP ;2U* | *2.31* |
| *295108* | *WESTBROOK C* | *0.34* |
| *295109* | *WESTBROOK E* | *2.22* |
| *909052* | *X2-022 E* | *10.28* |
| *916211* | *Z1-072 E* | *1.9* |
| *916221* | *Z1-073 E* | *2.16* |
| *917501* | *Z2-087 C* | *2.06* |
| *917502* | *Z2-087 E* | *13.78* |
| *918051* | *AA1-018 C* | *1.84* |
| *918052* | *AA1-018 E* | *12.31* |
| *920272* | *AA2-123 E* | *2.45* |
| *924041* | *AB2-047 C O1* | *2.54* |
| *924042* | *AB2-047 E O1* | *17.01* |
| *924261* | *AB2-070 C O1* | *1.47* |
| *924262* | *AB2-070 E O1* | *9.82* |
| *925301* | *AB2-191 C* | *0.6* |
| *925302* | *AB2-191 E* | *0.83* |
| *925581* | *AC1-033 C* | *1.09* |
| *925582* | *AC1-033 E* | *7.32* |
| *925771* | *AC1-053 C* | *1.45* |
| *925772* | *AC1-053 E* | *9.73* |
| *926821* | *AC1-168 C O1* | *0.91* |
| *926822* | *AC1-168 E O1* | *6.08* |
| *926841* | *AC1-171 C O1* | *0.75* |
| *926842* | *AC1-171 E O1* | *4.98* |

| | | |
|---|---|---|
| *927201* | *AC1-214 C O1* | *1.6* |
| *927202* | *AC1-214 E O1* | *5.09* |

# Appendix 6

(CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 100.81% to 103.24% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of 'AEP_P1-2_#695A'. This project contributes approximately 23.62 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#695A'
OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644 WILTON ; 765 1
END

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.08* |
| *934432* | *AD1-067 E* | *0.35* |
| *934721* | *AD1-100 C* | *12.14* |
| *934722* | *AD1-100 E* | *56.67* |
| *935141* | *AD1-148* | *2.14* |
| *936291* | *AD2-038 C O1* | *1.53* |
| *936292* | *AD2-038 E O1* | *10.26* |
| *936371* | *AD2-047 C O1* | *2.83* |
| *936372* | *AD2-047 E O1* | *13.8* |
| *937001* | *AD2-134 C* | *1.62* |
| *937002* | *AD2-134 E* | *6.47* |
| *937211* | *AD2-159 C* | *1.6* |
| *937212* | *AD2-159 E* | *7.49* |
| *938851* | *AE1-113 C O1* | *5.49* |
| *938852* | *AE1-113 E O1* | *17.27* |
| *938861* | *AE1-114 C O1* | *2.24* |
| *938862* | *AE1-114 E O1* | *8.58* |
| *939321* | *AE1-163 C O1* | *3.85* |
| *939322* | *AE1-163 E O1* | *23.66* |
| *939401* | *AE1-172 C* | *3.23* |
| *939402* | *AE1-172 E* | *15.14* |
| *939631* | *AE1-193 C* | *3.07* |
| *939632* | *AE1-193 E* | *20.55* |
| *939641* | *AE1-194 C* | *3.07* |
| *939642* | *AE1-194 E* | *20.55* |
| *939651* | *AE1-195 C* | *3.07* |
| *939652* | *AE1-195 E* | *20.55* |
| *274857* | *BIG SKY ;U1* | *0.86* |
| *274858* | *BIG SKY ;U2* | *0.86* |
| *274877* | *BISHOP HL;1U* | *0.66* |
| *274878* | *BISHOP HL;2U* | *0.66* |
| *294401* | *BSHIL;1U E* | *2.63* |
| *294410* | *BSHIL;2U E* | *2.63* |

| | | |
|---|---|---|
| *274848* | *CAMPGROVE;RU* | *0.96* |
| *274890* | *CAYUG;1U E* | *4.15* |
| *274891* | *CAYUG;2U E* | *4.15* |
| *274863* | *CAYUGA RI;1U* | *1.04* |
| *274864* | *CAYUGA RI;2U* | *1.04* |
| *274849* | *CRESCENT ;1U* | *0.32* |
| *274859* | *EASYR;U1 E* | *3.44* |
| *274860* | *EASYR;U2 E* | *3.44* |
| *274856* | *ECOGROVE ;U1* | *0.74* |
| *274871* | *GR RIDGE ;2U* | *1.57* |
| *274847* | *GR RIDGE ;BU* | *1.24* |
| *274855* | *GSG-6 ;RU* | *0.82* |
| *290051* | *GSG-6; E* | *3.29* |
| *950141* | *J395* | *5.2* |
| *953201* | *J715* | *5.32* |
| *954741* | *J928* | *4.51* |
| *275149* | *KEMPTON ;1E* | *5.85* |
| *990901* | *L-005 E* | *3.84* |
| *274872* | *LEE DEKAL;1U* | *1.84* |
| *290108* | *LEEDK;1U E* | *7.66* |
| *274850* | *MENDOTA H;RU* | *0.23* |
| *274879* | *MINONK ;1U* | *1.52* |
| *293061* | *N-015 E* | *4.94* |
| *293513* | *O-009 C1* | *0.7* |
| *293514* | *O-009 C2* | *0.36* |
| *293515* | *O-009 C3* | *0.4* |
| *293516* | *O-009 E1* | *2.82* |
| *293517* | *O-009 E2* | *1.43* |
| *293518* | *O-009 E3* | *1.58* |
| *293712* | *O-029 C* | *0.75* |
| *293713* | *O-029 C* | *0.41* |
| *293714* | *O-029 C* | *0.38* |
| *293715* | *O-029 E* | *3.02* |
| *293716* | *O-029 E* | *1.65* |
| *293717* | *O-029 E* | *1.52* |
| *293771* | *O-035 E* | *1.97* |
| *293644* | *O22 E1* | *3.08* |
| *293645* | *O22 E2* | *5.98* |
| *290021* | *O50 E* | *6.1* |
| *294392* | *P-010 E* | *6.27* |
| *294763* | *P-046 E* | *2.95* |
| *274888* | *PILOT HIL;1E* | *5.85* |
| *274887* | *PILOT HIL;1U* | *1.46* |
| *274881* | *PLEAS RDG;2U* | *1.46* |
| *274851* | *PROVIDENC;RU* | *0.49* |

| | | |
|---|---|---|
| *290261* | *S-027 E* | *4.37* |
| *290265* | *S-028 E* | *4.37* |
| *295110* | *SUBLETTE C* | *0.12* |
| *274861* | *TOP CROP ;1U* | *0.77* |
| *274862* | *TOP CROP ;2U* | *1.49* |
| *274853* | *TWINGROVE;U1* | *1.09* |
| *274854* | *TWINGROVE;U2* | *1.09* |
| *905081* | *W4-005 C* | *1.11* |
| *905082* | *W4-005 E* | *5.26* |
| *295108* | *WESTBROOK C* | *0.27* |
| *909052* | *X2-022 E* | *8.17* |
| *916211* | *Z1-072 E* | *1.49* |
| *916221* | *Z1-073 E* | *1.7* |
| *917501* | *Z2-087 C* | *1.64* |
| *917502* | *Z2-087 E* | *11.* |
| *918051* | *AA1-018 C* | *1.67* |
| *918052* | *AA1-018 E* | *11.16* |
| *920272* | *AA2-123 E* | *1.93* |
| *924041* | *AB2-047 C O1* | *2.03* |
| *924042* | *AB2-047 E O1* | *13.58* |
| *924261* | *AB2-070 C O1* | *1.17* |
| *924262* | *AB2-070 E O1* | *7.81* |
| *925301* | *AB2-191 C* | *0.47* |
| *925302* | *AB2-191 E* | *0.65* |
| *925581* | *AC1-033 C* | *0.86* |
| *925582* | *AC1-033 E* | *5.74* |
| *925771* | *AC1-053 C* | *1.16* |
| *925772* | *AC1-053 E* | *7.74* |
| *926821* | *AC1-168 C O1* | *0.71* |
| *926822* | *AC1-168 E O1* | *4.78* |
| *926841* | *AC1-171 C O1* | *0.59* |
| *926842* | *AC1-171 E O1* | *3.91* |
| *927201* | *AC1-214 C O1* | *1.26* |
| *927202* | *AC1-214 E O1* | *4.* |

# Appendix 7

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 108.98% to 112.23% (**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 44.86 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* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.12* |
| *934432* | *AD1-067 E* | *0.52* |
| *934721* | *AD1-100 C* | *23.03* |
| *934722* | *AD1-100 E* | *107.45* |
| *936291* | *AD2-038 C O1* | *2.23* |
| *936292* | *AD2-038 E O1* | *14.91* |
| *936371* | *AD2-047 C O1* | *4.42* |
| *936372* | *AD2-047 E O1* | *21.59* |
| *937001* | *AD2-134 C* | *2.45* |
| *937002* | *AD2-134 E* | *9.78* |
| *937211* | *AD2-159 C* | *2.89* |
| *937212* | *AD2-159 E* | *13.51* |
| *938851* | *AE1-113 C O1* | *8.31* |
| *938852* | *AE1-113 E O1* | *26.11* |
| *938861* | *AE1-114 C O1* | *3.4* |
| *938862* | *AE1-114 E O1* | *12.99* |
| *939321* | *AE1-163 C O1* | *5.6* |
| *939322* | *AE1-163 E O1* | *34.38* |
| *939401* | *AE1-172 C* | *6.3* |
| *939402* | *AE1-172 E* | *29.55* |
| *939631* | *AE1-193 C* | *5.83* |
| *939632* | *AE1-193 E* | *39.03* |
| *939641* | *AE1-194 C* | *5.83* |
| *939642* | *AE1-194 E* | *39.03* |
| *939651* | *AE1-195 C* | *5.83* |
| *939652* | *AE1-195 E* | *39.03* |
| *274857* | *BIG SKY ;U1* | *1.3* |

| | | |
|---|---|---|
| *274858* | *BIG SKY ;U2* | *1.3* |
| *274877* | *BISHOP HL;1U* | *1.02* |
| *274878* | *BISHOP HL;2U* | *1.02* |
| *294401* | *BSHIL;1U E* | *4.08* |
| *294410* | *BSHIL;2U E* | *4.08* |
| *274848* | *CAMPGROVE;RU* | *1.5* |
| *274890* | *CAYUG;1U E* | *7.92* |
| *274891* | *CAYUG;2U E* | *7.92* |
| *274863* | *CAYUGA RI;1U* | *1.98* |
| *274864* | *CAYUGA RI;2U* | *1.98* |
| *274849* | *CRESCENT ;1U* | *0.5* |
| *274859* | *EASYR;U1 E* | *5.22* |
| *274860* | *EASYR;U2 E* | *5.22* |
| *274856* | *ECOGROVE ;U1* | *1.11* |
| *274871* | *GR RIDGE ;2U* | *2.4* |
| *274847* | *GR RIDGE ;BU* | *1.89* |
| *274855* | *GSG-6 ;RU* | *1.24* |
| *290051* | *GSG-6; E* | *4.97* |
| *275149* | *KEMPTON ;1E* | *9.15* |
| *990901* | *L-005 E* | *6.* |
| *274872* | *LEE DEKAL;1U* | *2.77* |
| *290108* | *LEEDK;1U E* | *11.55* |
| *274850* | *MENDOTA H;RU* | *0.34* |
| *274879* | *MINONK ;1U* | *2.31* |
| *293061* | *N-015 E* | *7.57* |
| *293513* | *O-009 C1* | *1.08* |
| *293514* | *O-009 C2* | *0.55* |
| *293515* | *O-009 C3* | *0.61* |
| *293516* | *O-009 E1* | *4.32* |
| *293517* | *O-009 E2* | *2.19* |
| *293518* | *O-009 E3* | *2.42* |
| *293712* | *O-029 C* | *1.15* |
| *293713* | *O-029 C* | *0.63* |
| *293714* | *O-029 C* | *0.58* |
| *293715* | *O-029 E* | *4.62* |
| *293716* | *O-029 E* | *2.53* |
| *293717* | *O-029 E* | *2.33* |
| *293771* | *O-035 E* | *3.06* |
| *293644* | *O22 E1* | *4.88* |
| *293645* | *O22 E2* | *9.48* |
| *290021* | *O50 E* | *9.22* |
| *294392* | *P-010 E* | *9.61* |
| *294763* | *P-046 E* | *4.45* |
| *274888* | *PILOT HIL;1E* | *9.15* |
| *274887* | *PILOT HIL;1U* | *2.29* |

| | | |
|---|---|---|
| *274881* | *PLEAS RDG;2U* | *2.29* |
| *274851* | *PROVIDENC;RU* | *0.76* |
| *290261* | *S-027 E* | *7.9* |
| *290265* | *S-028 E* | *7.9* |
| *295110* | *SUBLETTE C* | *0.18* |
| *295111* | *SUBLETTE E* | *1.29* |
| *274861* | *TOP CROP ;1U* | *1.22* |
| *274862* | *TOP CROP ;2U* | *2.37* |
| *274853* | *TWINGROVE;U1* | *1.97* |
| *274854* | *TWINGROVE;U2* | *1.97* |
| *905081* | *W4-005 C* | *2.* |
| *905082* | *W4-005 E* | *9.48* |
| *295108* | *WESTBROOK C* | *0.41* |
| *295109* | *WESTBROOK E* | *2.64* |
| *916211* | *Z1-072 E* | *2.32* |
| *916221* | *Z1-073 E* | *2.56* |
| *917501* | *Z2-087 C* | *2.98* |
| *917502* | *Z2-087 E* | *19.95* |
| *918051* | *AA1-018 C* | *2.33* |
| *918052* | *AA1-018 E* | *15.58* |
| *920272* | *AA2-123 E* | *2.89* |
| *924041* | *AB2-047 C O1* | *3.68* |
| *924042* | *AB2-047 E O1* | *24.61* |
| *924261* | *AB2-070 C O1* | *2.09* |
| *924262* | *AB2-070 E O1* | *14.01* |
| *925301* | *AB2-191 C* | *0.71* |
| *925302* | *AB2-191 E* | *0.98* |
| *925581* | *AC1-033 C* | *1.33* |
| *925582* | *AC1-033 E* | *8.91* |
| *926821* | *AC1-168 C O1* | *1.1* |
| *926822* | *AC1-168 E O1* | *7.4* |
| *926841* | *AC1-171 C O1* | *0.94* |
| *926842* | *AC1-171 E O1* | *6.29* |
| *927201* | *AC1-214 C O1* | *1.95* |
| *927202* | *AC1-214 E O1* | *6.21* |

# Appendix 8

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 112.36% to 115.69% (**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 45.82 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* |
|---|---|---|
| *934431* | *AD1-067 C* | *0.13* |
| *934432* | *AD1-067 E* | *0.53* |
| *934721* | *AD1-100 C* | *23.48* |
| *934722* | *AD1-100 E* | *109.58* |
| *936291* | *AD2-038 C O1* | *2.28* |
| *936292* | *AD2-038 E O1* | *15.23* |
| *936371* | *AD2-047 C O1* | *4.51* |
| *936372* | *AD2-047 E O1* | *22.04* |
| *937001* | *AD2-134 C* | *2.5* |
| *937002* | *AD2-134 E* | *9.98* |
| *937211* | *AD2-159 C* | *2.94* |
| *937212* | *AD2-159 E* | *13.78* |
| *938851* | *AE1-113 C O1* | *8.48* |
| *938852* | *AE1-113 E O1* | *26.67* |
| *938861* | *AE1-114 C O1* | *3.47* |
| *938862* | *AE1-114 E O1* | *13.26* |
| *939321* | *AE1-163 C O1* | *5.72* |
| *939322* | *AE1-163 E O1* | *35.12* |
| *939401* | *AE1-172 C* | *6.42* |
| *939402* | *AE1-172 E* | *30.13* |
| *939631* | *AE1-193 C* | *5.96* |
| *939632* | *AE1-193 E* | *39.86* |
| *939641* | *AE1-194 C* | *5.96* |
| *939642* | *AE1-194 E* | *39.86* |
| *939651* | *AE1-195 C* | *5.96* |
| *939652* | *AE1-195 E* | *39.86* |
| *274857* | *BIG SKY ;U1* | *1.33* |

| | | |
|---|---|---|
| *274858* | *BIG SKY ;U2* | *1.33* |
| *274877* | *BISHOP HL;1U* | *1.04* |
| *274878* | *BISHOP HL;2U* | *1.04* |
| *294401* | *BSHIL;1U E* | *4.17* |
| *294410* | *BSHIL;2U E* | *4.17* |
| *274848* | *CAMPGROVE;RU* | *1.53* |
| *274890* | *CAYUG;1U E* | *8.08* |
| *274891* | *CAYUG;2U E* | *8.08* |
| *274863* | *CAYUGA RI;1U* | *2.02* |
| *274864* | *CAYUGA RI;2U* | *2.02* |
| *274849* | *CRESCENT ;1U* | *0.51* |
| *274859* | *EASYR;U1 E* | *5.33* |
| *274860* | *EASYR;U2 E* | *5.33* |
| *274856* | *ECOGROVE ;U1* | *1.14* |
| *274871* | *GR RIDGE ;2U* | *2.45* |
| *274847* | *GR RIDGE ;BU* | *1.93* |
| *274855* | *GSG-6 ;RU* | *1.27* |
| *290051* | *GSG-6; E* | *5.07* |
| *275149* | *KEMPTON ;1E* | *9.34* |
| *990901* | *L-005 E* | *6.12* |
| *274872* | *LEE DEKAL;1U* | *2.83* |
| *290108* | *LEEDK;1U E* | *11.79* |
| *274850* | *MENDOTA H;RU* | *0.35* |
| *274879* | *MINONK ;1U* | *2.35* |
| *293061* | *N-015 E* | *7.73* |
| *293513* | *O-009 C1* | *1.1* |
| *293514* | *O-009 C2* | *0.56* |
| *293515* | *O-009 C3* | *0.62* |
| *293516* | *O-009 E1* | *4.41* |
| *293517* | *O-009 E2* | *2.24* |
| *293518* | *O-009 E3* | *2.47* |
| *293712* | *O-029 C* | *1.18* |
| *293713* | *O-029 C* | *0.65* |
| *293714* | *O-029 C* | *0.6* |
| *293715* | *O-029 E* | *4.71* |
| *293716* | *O-029 E* | *2.58* |
| *293717* | *O-029 E* | *2.38* |
| *293771* | *O-035 E* | *3.12* |
| *293644* | *O22 E1* | *4.99* |
| *293645* | *O22 E2* | *9.68* |
| *290021* | *O50 E* | *9.42* |
| *294392* | *P-010 E* | *9.81* |
| *294763* | *P-046 E* | *4.55* |
| *274888* | *PILOT HIL;1E* | *9.34* |
| *274887* | *PILOT HIL;1U* | *2.34* |

| | | |
|---|---|---|
| *274881* | *PLEAS RDG;2U* | *2.34* |
| *274851* | *PROVIDENC;RU* | *0.78* |
| *290261* | *S-027 E* | *8.06* |
| *290265* | *S-028 E* | *8.06* |
| *295110* | *SUBLETTE C* | *0.18* |
| *295111* | *SUBLETTE E* | *1.32* |
| *274861* | *TOP CROP ;1U* | *1.25* |
| *274862* | *TOP CROP ;2U* | *2.42* |
| *274853* | *TWINGROVE;U1* | *2.01* |
| *274854* | *TWINGROVE;U2* | *2.01* |
| *905081* | *W4-005 C* | *2.04* |
| *905082* | *W4-005 E* | *9.67* |
| *295108* | *WESTBROOK C* | *0.42* |
| *295109* | *WESTBROOK E* | *2.7* |
| *916211* | *Z1-072 E* | *2.36* |
| *916221* | *Z1-073 E* | *2.62* |
| *917501* | *Z2-087 C* | *3.04* |
| *917502* | *Z2-087 E* | *20.36* |
| *918051* | *AA1-018 C* | *2.38* |
| *918052* | *AA1-018 E* | *15.92* |
| *920272* | *AA2-123 E* | *2.95* |
| *924041* | *AB2-047 C O1* | *3.75* |
| *924042* | *AB2-047 E O1* | *25.11* |
| *924261* | *AB2-070 C O1* | *2.14* |
| *924262* | *AB2-070 E O1* | *14.3* |
| *925301* | *AB2-191 C* | *0.73* |
| *925302* | *AB2-191 E* | *1.* |
| *925581* | *AC1-033 C* | *1.36* |
| *925582* | *AC1-033 E* | *9.1* |
| *925771* | *AC1-053 C* | *2.11* |
| *925772* | *AC1-053 E* | *14.15* |
| *926821* | *AC1-168 C O1* | *1.13* |
| *926822* | *AC1-168 E O1* | *7.55* |
| *926841* | *AC1-171 C O1* | *0.96* |
| *926842* | *AC1-171 E O1* | *6.42* |
| *927201* | *AC1-214 C O1* | *2.* |
| *927202* | *AC1-214 E O1* | *6.34* |

## Attachment 1: Single Line Diagram