



**Generation Interconnection  
Feasibility Study Report  
for  
Queue Project AE1-089  
ELDERBERRY-DUMONT 345 KV  
130.65 MW Capacity / 310 MW Energy**

June, 2019

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## Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances, a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a 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.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

## General

The Interconnection Customer has proposed a Solar generating facility located in St. Joseph county, Indiana. The installed facilities will have a total capability of 310 MW with 130.65 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December, 2021. This study does not imply a TO commitment to this in-service date.

The Feasibility Study includes Short Circuit and Peak Load steady state power flow analyses. The conduct of power flow studies at other load levels, stability analysis, and coordination with non-PJM Transmission Planners, as required under the PJM planning process, is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of these additional analyses which shall be performed following execution of the System Impact Study agreement.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required maintaining the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

|                            |                          |
|----------------------------|--------------------------|
| <b>Queue Number</b>        | <b>AE1-089</b>           |
| <b>Project Name</b>        | ELDERBERRY-DUMONT 345 KV |
| <b>State</b>               | Indiana                  |
| <b>County</b>              | St. Joseph               |
| <b>Transmission Owner</b>  | AEP                      |
| <b>MFO</b>                 | 310                      |
| <b>MWE</b>                 | 310                      |
| <b>MWC</b>                 | 130.65                   |
| <b>Fuel</b>                | Solar                    |
| <b>Basecase Study Year</b> | 2022                     |

## Point of Interconnection

AE1-089 will interconnect with the AEP transmission system via a new station cut into Elderberry to Dumont 345 kV station.

To accommodate the interconnection on the Elderberry – Dumont 345kV circuit, a new three (3) circuit breaker 345kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

## Cost Summary

The AE1-089 project will be responsible for the following costs:

| Description                            | Total Cost    |
|----------------------------------------|---------------|
| Attachment Facilities                  | \$ 8,000,000  |
| Direct Connection Network Upgrade      | \$ 1,550,000  |
| Non Direct Connection Network Upgrades | \$700,000     |
| Total Costs                            | \$ 10,250,000 |

In addition, the AE1-089 project may be responsible for a contribution to the following costs

| Description     | Total Cost    |
|-----------------|---------------|
| System Upgrades | \$ 20,133,200 |

Cost allocations for these upgrades will be provided in the System Impact Study Report.

## Transmission Owner Scope of Work

### Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

| Description                                                                                                                                                                                                                                                                                                                                | Total Cost          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <ul style="list-style-type: none"><li>Construct a new three (3) circuit breaker 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus (See Figure 1). Installation of associated protection and control equipment, 345 kV line risers and SCADA will also be required.</li></ul> | \$ 8,000,000        |
| <b>Total Attachment Facility Costs</b>                                                                                                                                                                                                                                                                                                     | <b>\$ 8,000,000</b> |

## Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

| Description                                   | Total Cost          |
|-----------------------------------------------|---------------------|
| Elderberry –Dumont 345 kV T-Line Cut In       | \$ 1,200,000        |
| 345 kV Revenue Metering                       | \$ 350,000          |
| <b>Total Direct Connection Facility Costs</b> | <b>\$ 1,550,000</b> |

## Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

| Description                                                              | Total Cost        |
|--------------------------------------------------------------------------|-------------------|
| Upgrade line protection and controls at the Dumont 345 kV substation     | \$ 350,000        |
| Upgrade line protection and controls at the Elderberry 345 kV substation | \$ 350,000        |
| <b>Total Non-Direct Connection Facility Costs</b>                        | <b>\$ 700,000</b> |

## Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

## Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after Agreement execution.

## Transmission Owner Analysis

Note: Two 345kV breakers G and G1 will be installed to complete the string at Dumont 345kV station under supplemental project s1584, with the projected ISD of 12/31/2020.

## Interconnection Customer Requirements

It is understood that the Interconnection Customer is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to the Dumont – Elderberry 345 kV line are not included in this report; these are assumed to be the Interconnection Customer's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

## 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.

### AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

## Network Impacts

The Queue Project AE1-089 was evaluated as a 310 MW (Capacity 130.65 MW) injection via a new station cut into Elderberry to Dumont 345 kV line in the AEP area. Project AE1-089 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-089 was studied with a commercial probability of 53%. Potential network impacts were as follows:

## Summer Peak Load Flow

## Generation Deliverability

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

None

## Multiple Facility Contingency

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

None

## Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue).

| ID     | FROM BUS# | FROM BUS    | FROM BUS AREA | TO BUS# | TO BUS        | TO BUS AREA | CK T ID | CONT NAME                    | Type    | Rating MVA | PRE PROJECT LOADIN G % | POST PROJECT LOADIN G % | AC/D C | MW IMPACT |
|--------|-----------|-------------|---------------|---------|---------------|-------------|---------|------------------------------|---------|------------|------------------------|-------------------------|--------|-----------|
| 11638  | 242865    | 05JEFRSO    | AEP           | 248000  | 06CLIFTY      | OVEC        | Z1      | AEP_P4_#6189_05HANG R 765_D1 | breaker | 2354.0     | 106.91                 | 107.16                  | DC     | 33.34     |
| 605842 | 242865    | 05JEFRSO    | AEP           | 248000  | 06CLIFTY      | OVEC        | Z1      | AEP_P4_#6189_05HANG R 765_D1 | breaker | 2354.0     | 106.91                 | 107.16                  | DC     | 33.34     |
| 11663  | 256583    | 18MOROCCO   | METC          | 238530  | 02ALLEN       | ATSI        | 1       | ATSI-P2-3-TE-345-030T        | breaker | 1793.0     | 136.12                 | 136.64                  | DC     | 20.39     |
| 11664  | 256583    | 18MOROCCO   | METC          | 238530  | 02ALLEN       | ATSI        | 1       | ATSI-P2-3-TE-345-034T        | breaker | 1793.0     | 136.01                 | 136.54                  | DC     | 20.6      |
| 12765  | 256583    | 18MOROCCO   | METC          | 238530  | 02ALLEN       | ATSI        | 1       | ATSI-P7-1-TE-345-022T        | tower   | 1793.0     | 170.66                 | 171.33                  | DC     | 26.55     |
| 11590  | 264612    | 19MON12     | ITCT          | 241901  | 02LALLENDOR F | ATSI        | 1       | ATSI-P2-3-TE-345-023T        | breaker | 1702.0     | 146.58                 | 147.14                  | DC     | 21.16     |
| 11591  | 264612    | 19MON12     | ITCT          | 241901  | 02LALLENDOR F | ATSI        | 1       | ATSI-P2-3-TE-345-022T        | breaker | 1702.0     | 146.45                 | 147.01                  | DC     | 21.16     |
| 11592  | 264612    | 19MON12     | ITCT          | 241901  | 02LALLENDOR F | ATSI        | 1       | ATSI-P2-3-TE-345-016T        | breaker | 1702.0     | 119.04                 | 119.51                  | DC     | 17.75     |
| 11594  | 264612    | 19MON12     | ITCT          | 241901  | 02LALLENDOR F | ATSI        | 1       | ATSI-P2-3-TE-345-015T        | breaker | 1702.0     | 118.08                 | 118.55                  | DC     | 17.72     |
| 606247 | 932800    | AC2-104 TAP | AEP           | 242928  | 05MARYSV      | AEP         | 1       | AEP_P4_#7334_05JEFRSO 765_A2 | breaker | 4571.0     | 102.88                 | 103.14                  | DC     | 86.96     |
| 605937 | 938670    | AE1-089 TAP | AEP           | 243219  | 05DUMONT      | AEP         | 1       | AEP_P4_#2978_05DUMONT 765_B  | breaker | 1409.0     | 111.22                 | 123.88                  | DC     | 176.89    |

## Potential Congestion due to Local Energy Deliverability

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

| ID     | FROM BUS# | FROM BUS    | FROM BUS AREA | TO BUS# | TO BUS   | TO BUS AREA | CKT ID | CONT NAME      | Type      | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|--------|-----------|-------------|---------------|---------|----------|-------------|--------|----------------|-----------|------------|-----------------------|------------------------|-------|-----------|
| 12638  | 242865    | 05JEFRSO    | AEP           | 248000  | 06CLIFTY | OVEC        | Z1     | AEP_P1-2_#709  | operation | 2354.0     | 105.55                | 106.03                 | DC    | 33.42     |
| 607115 | 242865    | 05JEFRSO    | AEP           | 248000  | 06CLIFTY | OVEC        | Z1     | AEP_P1-2_#709  | operation | 2354.0     | 105.55                | 106.03                 | DC    | 33.42     |
| 606834 | 938670    | AE1-089 TAP | AEP           | 243219  | 05DUMONT | AEP         | 1      | AEP_P1-2_#695A | operation | 1409.0     | 100.97                | 114.22                 | DC    | 185.16    |

## System Reinforcements

| ID                | Index | Facility                                                      | Upgrade Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Cost        |
|-------------------|-------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 606247            | 4     | <b>AC2-104 TAP 765.0 kV -<br/>05MARYSV 765.0 kV Ckt 1</b>     | <u><b>AEP</b></u><br>Description : Replace three 3000A wavetraps at Marysville.<br>Estimated cost: \$675,000<br>Time Estimate : 24-36 Months<br>Cost : \$675,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | \$675,000   |
| 605937            | 5     | <b>AE1-089 TAP 345.0 kV -<br/>05DUMONT 345.0 kV Ckt<br/>1</b> | <u><b>AEP</b></u><br>AEP ratings are sufficient to mitigate the violation.<br><br>S/N : 1409 MVA S/E : 1868 MVA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | \$0         |
| 11664,12765,11663 | 2     | <b>18MOROCCO 345.0 kV -<br/>02ALLEN 345.0 kV Ckt 1</b>        | <u><b>METC</b></u><br>Description : The external (i.e. Non-PJM) Transmission Owner, METC, will not evaluate this violation until the impact study phase.<br><br><u><b>ATSI</b></u><br>Description : Transmission Line is owned by ITC. ITC recommended building a second Allen Junction-Morocco 345kV line: a) Build new Line exit at Allen Junction 345kV substation for the new (2nd) Allen Junction-Morocco 345kV line. b) Install new 345kV Breaker, Metering, Disconnect Switches and Protection Relaying. c) New Line will be built and owned by ITC. ITC has indicated that the new line rating will be 2036 MVA SN / 2298 MVA SE and plans to use the same size conductor as the existing Allen Junction-Morocco 345kV line. The cost and time is only for FE's portion of the construction.<br>Time Estimate : 18.0 Months<br>Cost : \$3,458,600 | \$3,458,600 |
| 605842,11638      | 1     | <b>05JEFRSO 345.0 kV -<br/>06CLIFTY 345.0 kV Ckt Z1</b>       | <u><b>OVEC</b></u><br>Although this tieline terminates in the OVEC Clifty Creek station, AEP owns the entire tieline, circuit breaker to circuit breaker. The AEP mitigation described below completely identifies the necessary upgrades.<br><br><u><b>AEP</b></u><br>Description :<br>Current AEP End Ratings : S/N : 1740 MVA S/E: 2034 MVA<br>1) Replace 9 Clifty Creek Risers (Sub cond 2-1700 kcm AAC 61 Str ) at Clifty station - Estimated Cost : \$ 175,000.<br><br>2) Replace 4 Clifty Switches (3000A), Estimated cost : \$2,000,000.<br><br>3) 0.75 miles of ACSR ~ 2156 ~ 84/19 ~ BLUEBIRD @ 284 °F - Conductor section 1 needs to be rebuilt/reconductor.<br><br>Estimated cost : 1,500,000.<br><br>Time Estimate : 24-36 Months<br>Cost : \$3,675,000                                                                                      | \$3,675,000 |

| ID                          | Index | Facility                                             | Upgrade Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Cost                |
|-----------------------------|-------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 11592,11594,11590,<br>11591 | 3     | 19MON12 345.0 kV -<br>02LALLENDORF 345.0 kV<br>Ckt 1 | <p><u>ATSI</u><br/>Description : a) Reconductor the existing 6.5 miles of Lallendorf-Monroe 345kV line with bundled (2) 795 26/7 ACSS. b) Replace substation conductor, Line Drop, Wave Trap, Bitronics Meter for the Monroe 345kV exit at Lallendorf substation to increase the Summer Emergency rating to 2578 MVA or greater. c) ITC would need to reconductor their portion of the transmission line (approx 16 miles) in order to mitigate 2505 MVA for SE<br/>Time Estimate : 16.0 Months<br/>Cost : \$12,324,600</p> <p><u>ITCT</u><br/>Description : The external (i.e. Non-PJM) Transmission Owner, ITC, will not evaluate this violation until the impact study phase.</p> | \$12,324,600        |
|                             |       |                                                      | <b>TOTAL COST</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>\$20,133,200</b> |

## Flow Gate Details

The following appendices contain additional information about each flow gate presented in the body of the report. For each appendix, a description of the flow gate 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 flow gate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gauge other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

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## Index 1

| ID     | FROM BUS# | FROM BUS | FROM BUS AREA | TO BUS# | TO BUS   | TO BUS AREA | CKT ID | CONT NAME                       | Type    | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|--------|-----------|----------|---------------|---------|----------|-------------|--------|---------------------------------|---------|------------|-----------------------|------------------------|-------|-----------|
| 605842 | 242865    | 05JEFRSO | AEP           | 248000  | 06CLIFTY | OVEC        | Z1     | AEP_P4_#6189_05HANG<br>R 765_D1 | breaker | 2354.0     | 106.91                | 107.16                 | DC    | 33.34     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 243441 | 05CKG2       | 19.52     |
| 243442 | 05RKG1       | 66.58     |
| 243443 | 05RKG2       | 63.83     |
| 243859 | 05FR-11G C   | 0.41      |
| 243862 | 05FR-12G C   | 0.4       |
| 243864 | 05FR-21G C   | 0.43      |
| 243866 | 05FR-22G C   | 0.41      |
| 243870 | 05FR-3G C    | 0.83      |
| 243873 | 05FR-4G C    | 0.64      |
| 246909 | 05MDL-1G C   | 0.86      |
| 246910 | 05MDL-2G C   | 0.43      |
| 246976 | 05MDL-3G C   | 0.43      |
| 246979 | 05MDL-4G C   | 0.86      |
| 247556 | T-127 C      | 0.42      |
| 247900 | 05FR-11G E   | 10.64     |
| 247901 | 05FR-12G E   | 10.46     |
| 247902 | 05FR-21G E   | 11.18     |
| 247903 | 05FR-22G E   | 10.71     |
| 247904 | 05FR-3G E    | 21.69     |
| 247905 | 05FR-4G E    | 16.31     |
| 247906 | 05MDL-1G E   | 22.31     |
| 247907 | 05MDL-2G E   | 11.07     |
| 247912 | 05MDL-3G E   | 11.57     |
| 247913 | 05MDL-4G E   | 11.18     |
| 247943 | T-127 E      | 11.18     |
| 274888 | PILOT HIL;1E | 14.45     |
| 275149 | KEMPTON ;1E  | 14.45     |
| 900404 | X3-028 C     | 257.79    |
| 900405 | X3-028 E     | 343.72    |
| 909145 | X2-052       | 11.25     |
| 910542 | X3-005 E     | 0.58      |
| 915662 | Y3-099 E     | 0.24      |
| 915672 | Y3-100 E     | 0.24      |
| 916182 | Z1-065 E     | 0.65      |
| 916512 | Z1-107 E     | 2.04      |
| 917712 | Z2-114 E     | 0.26      |
| 925242 | AB2-178 E    | 2.39      |
| 925881 | AC1-067 O1   | 113.33    |
| 927091 | AC1-204 1    | 29.61     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 927101 | AC1-204 2    | 29.61     |
| 930041 | AB1-006 C    | 0.56      |
| 930042 | AB1-006 E    | 24.31     |
| 930391 | AB1-080      | 0.67      |
| 930461 | AB1-087      | 94.52     |
| 930471 | AB1-088      | 94.52     |
| 930501 | AB1-091 O1   | 56.81     |
| 932601 | AC2-080 C O1 | 3.53      |
| 932602 | AC2-080 E O1 | 23.6      |
| 932931 | AC2-117      | 4.77      |
| 933281 | AC2-140 C    | 4.21      |
| 933282 | AC2-140 E    | 0.22      |
| 933411 | AC2-154 C    | 1.96      |
| 933412 | AC2-154 E    | 3.2       |
| 933441 | AC2-157 C    | 13.06     |
| 933442 | AC2-157 E    | 21.31     |
| 934721 | AD1-100 C    | 15.48     |
| 934722 | AD1-100 E    | 72.25     |
| 935271 | AD1-137 C    | 8.83      |
| 935272 | AD1-137 E    | 59.11     |
| 936371 | AD2-047 C O1 | 1.75      |
| 936372 | AD2-047 E O1 | 18.88     |
| 936461 | AD2-060      | 2.06      |
| 936781 | AD2-101 C    | 3.64      |
| 936782 | AD2-101 E    | 17.04     |
| 936961 | AD2-130      | 0.44      |
| 936981 | AD2-132 C    | 4.77      |
| 936982 | AD2-132 E    | 22.36     |
| 937031 | AD2-137 C O1 | 2.76      |
| 937032 | AD2-137 E O1 | 12.91     |
| 937041 | AD2-138 C    | 4.77      |
| 937042 | AD2-138 E    | 22.36     |
| 937051 | AD2-140 C O1 | 2.76      |
| 937052 | AD2-140 E O1 | 12.94     |
| 937061 | AD2-141 C O1 | 2.75      |
| 937062 | AD2-141 E O1 | 12.96     |
| 937071 | AD2-142 C O1 | 5.53      |
| 937072 | AD2-142 E O1 | 25.89     |
| 937121 | AD2-148 C O1 | 2.73      |
| 937122 | AD2-148 E O1 | 12.77     |
| 937131 | AD2-149 C O1 | 2.73      |
| 937132 | AD2-149 E O1 | 12.77     |
| 937141 | AD2-150 C O1 | 2.73      |
| 937142 | AD2-150 E O1 | 12.77     |
| 937181 | AD2-155 C O1 | 2.73      |
| 937182 | AD2-155 E O1 | 12.77     |
| 937321 | AD2-175 C    | 12.7      |
| 937322 | AD2-175 E    | 8.47      |
| 937401 | AD2-194 1    | 6.13      |
| 937411 | AD2-194 2    | 6.13      |
| 938012 | AE1-002 E O1 | 5.54      |
| 938511 | AE1-070 1    | 7.2       |

| Bus #      | Bus          | MW Impact |
|------------|--------------|-----------|
| 938521     | AE1-070 2    | 6.59      |
| 938671     | AE1-089 C    | 14.05     |
| 938672     | AE1-089 E    | 19.29     |
| 939351     | AE1-166 C O1 | 8.05      |
| 939352     | AE1-166 E O1 | 7.43      |
| 939641     | AE1-194 C    | 6.79      |
| 939642     | AE1-194 E    | 45.43     |
| 939651     | AE1-195 C    | 6.79      |
| 939652     | AE1-195 E    | 45.43     |
| 940093     | AE1-251 EBAT | 13.54     |
| AB2-013    | AB2-013      | 14.05     |
| AE1-033    | AE1-033      | 14.5      |
| BLUEG      | BLUEG        | 104.11    |
| CALDERWOOD | CALDERWOOD   | 1.39      |
| CANNELTON  | CANNELTON    | 1.9       |
| CARR       | CARR         | 0.72      |
| CATAWBA    | CATAWBA      | 0.85      |
| CBM-W1     | CBM-W1       | 38.85     |
| CBM-W2     | CBM-W2       | 60.81     |
| CHEOAH     | CHEOAH       | 1.27      |
| CHILHOWEE  | CHILHOWEE    | 0.45      |
| CHOCTAW    | CHOCTAW      | 0.16      |
| CIN        | CIN          | 6.53      |
| ELMERSMITH | ELMERSMITH   | 3.09      |
| G-007      | G-007        | 2.17      |
| HAMLET     | HAMLET       | 2.78      |
| IPL        | IPL          | 3.72      |
| MEC        | MEC          | 33.99     |
| MECS       | MECS         | 18.41     |
| O-066      | O-066        | 7.27      |
| RENSSELAER | RENSSELAER   | 0.57      |
| SANTEETLA  | SANTEETLA    | 0.37      |
| TRIMBLE    | TRIMBLE      | 12.55     |
| TVA        | TVA          | 1.91      |
| WEC        | WEC          | 6.3       |
| Z1-043     | Z1-043       | 24.71     |

## Index 2

| ID    | FROM BUS# | FROM BUS  | FROM BUS AREA | TO BUS# | TO BUS  | TO BUS AREA | CKT ID | CONT NAME             | Type  | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|-------|-----------|-----------|---------------|---------|---------|-------------|--------|-----------------------|-------|------------|-----------------------|------------------------|-------|-----------|
| 12765 | 256583    | 18MOROCCO | METC          | 238530  | 02ALLEN | ATSI        | 1      | ATSI-P7-1-TE-345-022T | tower | 1793.0     | 170.66                | 171.33                 | DC    | 26.55     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 243440 | 05CKG1       | 16.89     |
| 246397 | 05ELKHART HY | 0.36      |
| 246422 | 05MAYFLWER   | 0.1       |
| 246427 | 05BERRIENS   | 0.08      |
| 246431 | 05BUCHANAN   | 0.41      |
| 246536 | 05MOTTVILL   | 0.16      |
| 247528 | 05COVRT1     | 5.36      |
| 247529 | 05COVRT2     | 5.36      |
| 247530 | 05COVRT3     | 5.36      |
| 247531 | 05COVRT4     | 3.22      |
| 247532 | 05COVRT5     | 3.22      |
| 247533 | 05COVRT6     | 3.22      |
| 247604 | X1-042       | 0.06      |
| 247969 | Z2-116 E     | 0.12      |
| 917701 | Z2-113 C     | 0.04      |
| 917702 | Z2-113 E     | 0.27      |
| 917712 | Z2-114 E     | 0.23      |
| 920211 | AA2-116      | 101.55    |
| 925961 | AC1-072      | 0.5       |
| 926581 | AC1-141      | 9.3       |
| 933281 | AC2-140 C    | 3.18      |
| 933282 | AC2-140 E    | 0.17      |
| 936141 | AD2-020 C O1 | 6.77      |
| 936142 | AD2-020 E O1 | 4.17      |
| 936601 | AD2-075      | 23.5      |
| 936631 | AD2-079 C O1 | 1.13      |
| 936632 | AD2-079 E O1 | 0.76      |
| 938261 | AE1-039      | 0.1       |
| 938671 | AE1-089 C    | 11.19     |
| 938672 | AE1-089 E    | 15.36     |
| 939391 | AE1-170 C O1 | 6.52      |
| 939392 | AE1-170 E O1 | 9.0       |
| 950031 | J301 C       | 5.23      |
| 950032 | J301 E       | 20.94     |
| 950041 | J308 C       | 16.2      |
| 950042 | J308 E       | 64.82     |
| 950121 | J392         | 63.43     |
| 950241 | J419         | 36.26     |
| 950311 | G934 C       | 4.92      |
| 950312 | G934 E       | 19.66     |

| Bus #  | Bus    | MW Impact |
|--------|--------|-----------|
| 950351 | J466   | 7.56      |
| 950361 | J469   | 0.35      |
| 950791 | J201 C | 0.91      |
| 950792 | J201 E | 3.66      |
| 950871 | J246 C | 0.3       |
| 950872 | J246 E | 1.2       |
| 950942 | J325 E | 1.04      |
| 950951 | J327 C | 7.78      |
| 950952 | J327 E | 23.34     |
| 951011 | J340 C | 5.18      |
| 951012 | J340 E | 15.55     |
| 951051 | J354 C | 2.69      |
| 951052 | J354 E | 8.08      |
| 951531 | J533 C | 7.09      |
| 951532 | J533 E | 28.37     |
| 951571 | J538 C | 8.61      |
| 951572 | J538 E | 34.45     |
| 951581 | J540   | 7.51      |
| 951941 | J602 C | 6.83      |
| 951942 | J602 E | 36.96     |
| 952161 | J571   | 0.73      |
| 952201 | J589 C | 5.98      |
| 952202 | J589 E | 32.36     |
| 952312 | J646 E | 0.45      |
| 952401 | J752 C | 3.85      |
| 952402 | J752 E | 20.85     |
| 952611 | J717 C | 6.47      |
| 952612 | J717 E | 35.0      |
| 952761 | J728 C | 6.02      |
| 952762 | J728 E | 32.59     |
| 952881 | J758   | 31.55     |
| 952941 | J921 C | 2.58      |
| 952942 | J921 E | 13.95     |
| 952961 | J203 C | 8.4       |
| 952962 | J203 E | 45.44     |
| 952971 | J793   | 369.31    |
| 952981 | J579 C | 2.8       |
| 952982 | J579 E | 15.12     |
| 953071 | J794 C | 0.39      |
| 953072 | J794 E | 2.1       |
| 953271 | J701 C | 1.86      |
| 953272 | J701 E | 10.09     |
| 953291 | J796   | 51.25     |
| 953321 | J799   | 66.24     |
| 953361 | J806   | 28.82     |
| 953381 | J809   | 10.78     |
| 953421 | J841   | 151.26    |
| 953771 | J832   | 17.89     |
| 953781 | J833   | 36.26     |
| 953811 | J839   | 27.14     |
| 953861 | J846   | 31.81     |
| 953941 | J857   | 22.22     |

| <b>Bus #</b> | <b>Bus</b> | <b>MW Impact</b> |
|--------------|------------|------------------|
| 954011       | J865       | 22.36            |
| 954111       | J875       | 49.72            |
| 954231       | J890 C     | 2.75             |
| 954232       | J890 E     | 14.9             |
| 954381       | J906 C     | 1.85             |
| 954382       | J906 E     | 10.03            |
| 954431       | J914       | 3.87             |
| 954541       | J931 C     | 2.69             |
| 954542       | J931 E     | 14.55            |
| 954581       | J936       | 88.06            |
| 954591       | J937       | 47.94            |
| AB2-013      | AB2-013    | 9.76             |
| AE1-033      | AE1-033    | 10.43            |
| CARR         | CARR       | 0.83             |
| CBM-S1       | CBM-S1     | 8.3              |
| CBM-S2       | CBM-S2     | 1.28             |
| CBM-W1       | CBM-W1     | 89.18            |
| CBM-W2       | CBM-W2     | 88.66            |
| CIN          | CIN        | 10.49            |
| CPL          | CPL        | 0.25             |
| G-007        | G-007      | 2.02             |
| IPL          | IPL        | 6.39             |
| LGEE         | LGEE       | 1.95             |
| MEC          | MEC        | 25.95            |
| MECS         | MECS       | 123.47           |
| O-066        | O-066      | 6.85             |
| RENSSELAER   | RENSSELAER | 0.66             |
| WEC          | WEC        | 4.52             |
| Z1-043       | Z1-043     | 17.13            |

## Index 3

| ID    | FROM BUS# | FROM BUS | FROM BUS AREA | TO BUS# | TO BUS       | TO BUS AREA | CKT ID | CONT NAME             | Type    | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|-------|-----------|----------|---------------|---------|--------------|-------------|--------|-----------------------|---------|------------|-----------------------|------------------------|-------|-----------|
| 11591 | 264612    | 19MON12  | ITCT          | 241901  | 02LALLENDORF | ATSI        | 1      | ATSI-P2-3-TE-345-022T | breaker | 1702.0     | 146.45                | 147.01                 | DC    | 21.16     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 246397 | 05ELKHART HY | 0.28      |
| 246431 | 05BUCHANAN   | 0.33      |
| 246536 | 05MOTTVILL   | 0.13      |
| 247528 | 05COVRT1     | 4.22      |
| 247529 | 05COVRT2     | 4.22      |
| 247530 | 05COVRT3     | 4.22      |
| 247531 | 05COVRT4     | 2.53      |
| 247532 | 05COVRT5     | 2.53      |
| 247533 | 05COVRT6     | 2.53      |
| 247969 | Z2-116 E     | 0.1       |
| 917702 | Z2-113 E     | 0.22      |
| 917712 | Z2-114 E     | 0.18      |
| 920211 | AA2-116      | 80.63     |
| 925961 | AC1-072      | 0.39      |
| 926581 | AC1-141      | 7.38      |
| 933281 | AC2-140 C    | 2.54      |
| 933282 | AC2-140 E    | 0.13      |
| 936141 | AD2-020 C O1 | 5.36      |
| 936142 | AD2-020 E O1 | 3.3       |
| 936601 | AD2-075      | 18.5      |
| 936631 | AD2-079 C O1 | 0.9       |
| 936632 | AD2-079 E O1 | 0.6       |
| 938261 | AE1-039      | 0.08      |
| 938671 | AE1-089 C    | 8.92      |
| 938672 | AE1-089 E    | 12.24     |
| 939391 | AE1-170 C O1 | 5.17      |
| 939392 | AE1-170 E O1 | 7.14      |
| 950031 | J301 C       | 4.52      |
| 950032 | J301 E       | 18.06     |
| 950041 | J308 C       | 14.05     |
| 950042 | J308 E       | 56.19     |
| 950121 | J392         | 51.24     |
| 950241 | J419         | 25.06     |
| 950311 | G934 C       | 3.97      |
| 950312 | G934 E       | 15.89     |
| 950351 | J466         | 6.5       |
| 950361 | J469         | 0.29      |
| 950791 | J201 C       | 0.77      |
| 950792 | J201 E       | 3.08      |
| 950871 | J246 C       | 0.25      |

| Bus #  | Bus    | MW Impact |
|--------|--------|-----------|
| 950872 | J246 E | 1.0       |
| 950942 | J325 E | 0.89      |
| 950951 | J327 C | 6.71      |
| 950952 | J327 E | 20.14     |
| 951011 | J340 C | 4.47      |
| 951012 | J340 E | 13.42     |
| 951051 | J354 C | 2.32      |
| 951052 | J354 E | 6.97      |
| 951531 | J533 C | 5.79      |
| 951532 | J533 E | 23.18     |
| 951571 | J538 C | 4.9       |
| 951572 | J538 E | 19.58     |
| 951581 | J540   | 5.99      |
| 951941 | J602 C | 5.68      |
| 951942 | J602 E | 30.72     |
| 952161 | J571   | 0.49      |
| 952201 | J589 C | 4.93      |
| 952202 | J589 E | 26.65     |
| 952312 | J646 E | 0.39      |
| 952401 | J752 C | 3.3       |
| 952402 | J752 E | 17.87     |
| 952611 | J717 C | 5.4       |
| 952612 | J717 E | 29.21     |
| 952761 | J728 C | 5.03      |
| 952762 | J728 E | 27.2      |
| 952881 | J758   | 20.92     |
| 952941 | J921 C | 1.91      |
| 952942 | J921 E | 10.35     |
| 952961 | J203 C | 7.28      |
| 952962 | J203 E | 39.39     |
| 952971 | J793   | 323.44    |
| 953071 | J794 C | 0.32      |
| 953072 | J794 E | 1.74      |
| 953271 | J701 C | 1.6       |
| 953272 | J701 E | 8.63      |
| 953291 | J796   | 42.86     |
| 953321 | J799   | 48.62     |
| 953361 | J806   | 19.04     |
| 953381 | J809   | 7.91      |
| 953421 | J841   | 127.0     |
| 953771 | J832   | 14.63     |
| 953781 | J833   | 25.06     |
| 953811 | J839   | 23.62     |
| 953861 | J846   | 18.6      |
| 953941 | J857   | 14.56     |
| 954011 | J865   | 19.6      |
| 954111 | J875   | 30.15     |
| 954231 | J890 C | 2.25      |
| 954232 | J890 E | 12.16     |
| 954381 | J906 C | 1.4       |
| 954382 | J906 E | 7.55      |
| 954431 | J914   | 2.98      |

| <b>Bus #</b> | <b>Bus</b> | <b>MW Impact</b> |
|--------------|------------|------------------|
| 954541       | J931 C     | 2.01             |
| 954542       | J931 E     | 10.9             |
| 954581       | J936       | 59.28            |
| AB2-013      | AB2-013    | 7.83             |
| AE1-033      | AE1-033    | 8.36             |
| CARR         | CARR       | 0.68             |
| CBM-S1       | CBM-S1     | 6.84             |
| CBM-S2       | CBM-S2     | 1.1              |
| CBM-W1       | CBM-W1     | 76.5             |
| CBM-W2       | CBM-W2     | 72.11            |
| CIN          | CIN        | 8.56             |
| CPL          | CPL        | 0.23             |
| G-007        | G-007      | 1.64             |
| IPL          | IPL        | 5.23             |
| LGEE         | LGEE       | 1.62             |
| MEC          | MEC        | 20.88            |
| MECS         | MECS       | 108.35           |
| O-066        | O-066      | 5.55             |
| RENSSELAER   | RENSSELAER | 0.54             |
| WEC          | WEC        | 3.62             |
| Z1-043       | Z1-043     | 13.75            |

## Index 4

| ID     | FROM BUS# | FROM BUS    | FROM BUS AREA | TO BUS# | TO BUS   | TO BUS AREA | CKT ID | CONT NAME                    | Type    | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|--------|-----------|-------------|---------------|---------|----------|-------------|--------|------------------------------|---------|------------|-----------------------|------------------------|-------|-----------|
| 606247 | 932800    | AC2-104 TAP | AEP           | 242928  | 05MARYSV | AEP         | 1      | AEP_P4_#7334_05JEFRSO 765_A2 | breaker | 4571.0     | 102.88                | 103.14                 | DC    | 86.96     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 243440 | 05CKG1       | 42.14     |
| 243441 | 05CKG2       | 52.39     |
| 246397 | 05ELKHART HY | 1.01      |
| 246416 | 05TWIN BRCH1 | 0.2       |
| 246422 | 05MAYFLWER   | 0.26      |
| 246431 | 05BUCHANAN   | 1.1       |
| 246536 | 05MOTTVILL   | 0.42      |
| 247643 | Z2-116 C     | 0.05      |
| 247906 | 05MDL-1G E   | 39.75     |
| 247907 | 05MDL-2G E   | 19.72     |
| 247912 | 05MDL-3G E   | 20.61     |
| 247913 | 05MDL-4G E   | 19.91     |
| 247943 | T-127 E      | 19.91     |
| 247969 | Z2-116 E     | 0.35      |
| 274722 | S-055 E      | 22.69     |
| 274774 | LINCOLN ;5U  | 3.14      |
| 274775 | LINCOLN ;6U  | 3.14      |
| 274776 | LINCOLN ;7U  | 3.14      |
| 274777 | LINCOLN ;8U  | 3.14      |
| 274888 | PILOT HIL;1E | 36.42     |
| 275149 | KEMPTON ;1E  | 36.42     |
| 290108 | LEEDK;1U E   | 49.86     |
| 293061 | N-015 E      | 30.86     |
| 293644 | O22 E1       | 20.61     |
| 293645 | O22 E2       | 40.01     |
| 294392 | P-010 E      | 39.19     |
| 909145 | X2-052       | 28.34     |
| 910542 | X3-005 E     | 1.47      |
| 914641 | Y2-103       | 90.77     |
| 915011 | Y3-013 1     | 7.56      |
| 915021 | Y3-013 2     | 7.56      |
| 915031 | Y3-013 3     | 7.56      |
| 916502 | Z1-106 E1    | 2.55      |
| 916504 | Z1-106 E2    | 2.55      |
| 916512 | Z1-107 E     | 5.16      |
| 916522 | Z1-108 E     | 5.04      |
| 917702 | Z2-113 E     | 0.6       |
| 917711 | Z2-114 C     | 0.1       |
| 917712 | Z2-114 E     | 0.68      |
| 918052 | AA1-018 E    | 32.95     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 920211 | AA2-116      | 268.49    |
| 920272 | AA2-123 E    | 4.99      |
| 925881 | AC1-067 O1   | 286.44    |
| 926311 | AC1-109 1    | 3.84      |
| 926321 | AC1-109 2    | 3.84      |
| 926331 | AC1-110 1    | 3.82      |
| 926341 | AC1-110 2    | 3.82      |
| 926351 | AC1-111 1    | 1.54      |
| 926361 | AC1-111 2    | 1.54      |
| 926371 | AC1-111 3    | 1.54      |
| 926381 | AC1-111 4    | 1.54      |
| 926391 | AC1-111 5    | 1.54      |
| 926401 | AC1-111 6    | 1.54      |
| 926581 | AC1-141      | 24.58     |
| 927091 | AC1-204 1    | 143.52    |
| 927101 | AC1-204 2    | 143.52    |
| 927451 | AC1-142A 1   | 8.26      |
| 927461 | AC1-142A 2   | 8.26      |
| 930042 | AB1-006 E    | 43.31     |
| 930391 | AB1-080      | 1.68      |
| 930501 | AB1-091 O1   | 143.28    |
| 930741 | AB1-122 1O1  | 146.79    |
| 930751 | AB1-122 2O1  | 147.02    |
| 932601 | AC2-080 C O1 | 6.66      |
| 932602 | AC2-080 E O1 | 44.56     |
| 932801 | AC2-104 C    | 35.99     |
| 932802 | AC2-104 E    | 240.86    |
| 932931 | AC2-117      | 12.03     |
| 933281 | AC2-140 C    | 11.31     |
| 933282 | AC2-140 E    | 0.6       |
| 933411 | AC2-154 C    | 4.94      |
| 933412 | AC2-154 E    | 8.06      |
| 933431 | AC2-156 C O1 | 1.94      |
| 933432 | AC2-156 E O1 | 3.16      |
| 933931 | AD1-016 C    | 1.9       |
| 933932 | AD1-016 E    | 3.09      |
| 934101 | AD1-039 1    | 14.39     |
| 934111 | AD1-039 2    | 14.41     |
| 934721 | AD1-100 C    | 38.86     |
| 934722 | AD1-100 E    | 181.33    |
| 934771 | AD1-104 C    | 29.01     |
| 934772 | AD1-104 E    | 194.13    |
| 934871 | AD1-116 C    | 1.92      |
| 934872 | AD1-116 E    | 3.13      |
| 935001 | AD1-133 C O1 | 44.87     |
| 935002 | AD1-133 E O1 | 29.91     |
| 936141 | AD2-020 C O1 | 16.34     |
| 936142 | AD2-020 E O1 | 10.06     |
| 936371 | AD2-047 C O1 | 4.42      |
| 936372 | AD2-047 E O1 | 47.6      |
| 936461 | AD2-060      | 5.2       |
| 936511 | AD2-066 C O1 | 17.37     |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 936512 | AD2-066 E O1 | 11.58     |
| 936631 | AD2-079 C O1 | 3.23      |
| 936632 | AD2-079 E O1 | 2.15      |
| 936781 | AD2-101 C    | 9.18      |
| 936782 | AD2-101 E    | 42.98     |
| 936961 | AD2-130      | 1.11      |
| 936981 | AD2-132 C    | 9.01      |
| 936982 | AD2-132 E    | 42.2      |
| 937031 | AD2-137 C O1 | 6.99      |
| 937032 | AD2-137 E O1 | 32.75     |
| 937041 | AD2-138 C    | 9.01      |
| 937042 | AD2-138 E    | 42.2      |
| 937051 | AD2-140 C O1 | 7.03      |
| 937052 | AD2-140 E O1 | 32.91     |
| 937061 | AD2-141 C O1 | 6.99      |
| 937062 | AD2-141 E O1 | 32.95     |
| 937071 | AD2-142 C O1 | 14.06     |
| 937072 | AD2-142 E O1 | 65.83     |
| 937121 | AD2-148 C O1 | 6.87      |
| 937122 | AD2-148 E O1 | 32.16     |
| 937131 | AD2-149 C O1 | 6.87      |
| 937132 | AD2-149 E O1 | 32.16     |
| 937141 | AD2-150 C O1 | 6.87      |
| 937142 | AD2-150 E O1 | 32.16     |
| 937181 | AD2-155 C O1 | 6.87      |
| 937182 | AD2-155 E O1 | 32.16     |
| 937321 | AD2-175 C    | 32.0      |
| 937322 | AD2-175 E    | 21.33     |
| 937331 | AD2-176 C O1 | 14.97     |
| 937332 | AD2-176 E O1 | 9.98      |
| 937401 | AD2-194 1    | 15.43     |
| 937411 | AD2-194 2    | 15.43     |
| 938012 | AE1-002 E O1 | 14.04     |
| 938261 | AE1-039      | 0.21      |
| 938511 | AE1-070 1    | 18.13     |
| 938521 | AE1-070 2    | 16.59     |
| 938671 | AE1-089 C    | 36.65     |
| 938672 | AE1-089 E    | 50.31     |
| 938851 | AE1-113 C O1 | 14.11     |
| 938852 | AE1-113 E O1 | 44.35     |
| 939351 | AE1-166 C O1 | 20.24     |
| 939352 | AE1-166 E O1 | 18.68     |
| 939391 | AE1-170 C O1 | 16.87     |
| 939392 | AE1-170 E O1 | 23.3      |
| 939401 | AE1-172 C O1 | 13.26     |
| 939402 | AE1-172 E O1 | 62.08     |
| 939641 | AE1-194 C    | 17.06     |
| 939642 | AE1-194 E    | 114.19    |
| 939651 | AE1-195 C    | 17.06     |
| 939652 | AE1-195 E    | 114.19    |
| 939701 | AE1-201 C    | 4.09      |
| 939702 | AE1-201 E    | 0.9       |

| <b>Bus #</b> | <b>Bus</b>   | <b>MW Impact</b> |
|--------------|--------------|------------------|
| 939732       | AE1-204 E    | 0.59             |
| 939861       | AE1-222 1    | 162.11           |
| 939871       | AE1-222 2    | 162.36           |
| 939961       | AE1-233 C O1 | 4.76             |
| 939962       | AE1-233 E O1 | 19.65            |
| AB2-013      | AB2-013      | 35.55            |
| AE1-033      | AE1-033      | 37.8             |
| AE1-042      | AE1-042      | 10.86            |
| CARR         | CARR         | 2.36             |
| CATAWBA      | CATAWBA      | 0.63             |
| CBM-S1       | CBM-S1       | 20.07            |
| CBM-W1       | CBM-W1       | 112.29           |
| CBM-W2       | CBM-W2       | 293.15           |
| CIN          | CIN          | 39.78            |
| G-007        | G-007        | 6.85             |
| HAMLET       | HAMLET       | 2.77             |
| IPL          | IPL          | 24.98            |
| LGEE         | LGEE         | 4.88             |
| MEC          | MEC          | 92.49            |
| MECS         | MECS         | 52.19            |
| O-066        | O-066        | 23.05            |
| RENSSELAER   | RENSSELAER   | 1.87             |
| WEC          | WEC          | 16.38            |
| Z1-043       | Z1-043       | 62.52            |

## Index 5

| ID     | FROM BUS# | FROM BUS    | FROM BUS AREA | TO BUS# | TO BUS   | TO BUS AREA | CKT ID | CONT NAME                   | Type    | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC DC | MW IMPACT |
|--------|-----------|-------------|---------------|---------|----------|-------------|--------|-----------------------------|---------|------------|-----------------------|------------------------|-------|-----------|
| 605937 | 938670    | AE1-089 TAP | AEP           | 243219  | 05DUMONT | AEP         | 1      | AEP_P4_#2978_05DUMONT 765_B | breaker | 1409.0     | 111.22                | 123.88                 | DC    | 176.89    |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 247900 | 05FR-11G E   | 6.85      |
| 247901 | 05FR-12G E   | 6.74      |
| 247902 | 05FR-21G E   | 7.2       |
| 247903 | 05FR-22G E   | 6.89      |
| 247904 | 05FR-3G E    | 13.96     |
| 247905 | 05FR-4G E    | 10.5      |
| 247906 | 05MDL-1G E   | 15.63     |
| 247907 | 05MDL-2G E   | 7.75      |
| 247912 | 05MDL-3G E   | 8.11      |
| 247913 | 05MDL-4G E   | 7.83      |
| 247943 | T-127 E      | 7.83      |
| 270859 | PWR VTR EC;R | 7.11      |
| 274722 | S-055 E      | 6.55      |
| 274809 | UNIV PK N;5U | 0.8       |
| 274811 | UNIV PK N;7U | 0.8       |
| 274812 | UNIV PK N;8U | 0.8       |
| 274814 | UNIV PK N;0U | 0.8       |
| 274815 | UNIV PK N;XU | 0.8       |
| 274888 | PILOT HIL;1E | 10.33     |
| 275149 | KEMPTON ;1E  | 10.33     |
| 290021 | O50 E        | 11.46     |
| 290051 | GSG-6; E     | 6.16      |
| 290108 | LEEDK;1U E   | 14.23     |
| 293061 | N-015 E      | 8.96      |
| 293644 | O22 E1       | 5.93      |
| 293645 | O22 E2       | 11.51     |
| 294392 | P-010 E      | 11.38     |
| 295109 | WESTBROOK E  | 3.3       |
| 909145 | X2-052       | 36.23     |
| 914641 | Y2-103       | 26.18     |
| 915011 | Y3-013 1     | 2.18      |
| 915021 | Y3-013 2     | 2.18      |
| 915031 | Y3-013 3     | 2.18      |
| 916221 | Z1-073 E     | 3.18      |
| 916502 | Z1-106 E1    | 0.73      |
| 916504 | Z1-106 E2    | 0.73      |
| 916512 | Z1-107 E     | 1.5       |
| 916522 | Z1-108 E     | 1.45      |
| 917711 | Z2-114 C     | 0.06      |
| 917712 | Z2-114 E     | 0.4       |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 918052 | AA1-018 E    | 9.8       |
| 920272 | AA2-123 E    | 1.43      |
| 924471 | AB2-096      | 24.87     |
| 925302 | AB2-191 E    | 0.82      |
| 926311 | AC1-109 1    | 1.1       |
| 926321 | AC1-109 2    | 1.1       |
| 926331 | AC1-110 1    | 1.1       |
| 926341 | AC1-110 2    | 1.1       |
| 926351 | AC1-111 1    | 0.44      |
| 926361 | AC1-111 2    | 0.44      |
| 926371 | AC1-111 3    | 0.44      |
| 926381 | AC1-111 4    | 0.44      |
| 926391 | AC1-111 5    | 0.44      |
| 926401 | AC1-111 6    | 0.44      |
| 926431 | AC1-114      | 1.4       |
| 927091 | AC1-204 1    | 41.9      |
| 927101 | AC1-204 2    | 41.91     |
| 927451 | AC1-142A 1   | 2.42      |
| 927461 | AC1-142A 2   | 2.42      |
| 927511 | AC1-113 1    | 0.7       |
| 927521 | AC1-113 2    | 0.7       |
| 930042 | AB1-006 E    | 17.03     |
| 930391 | AB1-080      | 2.15      |
| 930481 | AB1-089      | 38.75     |
| 930501 | AB1-091 O1   | 40.32     |
| 930741 | AB1-122 1O1  | 41.99     |
| 930751 | AB1-122 2O1  | 42.66     |
| 932601 | AC2-080 C O1 | 3.72      |
| 932602 | AC2-080 E O1 | 24.91     |
| 932881 | AC2-115 1    | 1.4       |
| 932891 | AC2-115 2    | 1.4       |
| 932921 | AC2-116      | 0.49      |
| 932931 | AC2-117      | 5.17      |
| 933411 | AC2-154 C    | 1.4       |
| 933412 | AC2-154 E    | 2.29      |
| 933431 | AC2-156 C O1 | 0.55      |
| 933432 | AC2-156 E O1 | 0.9       |
| 933911 | AD1-013 C    | 1.08      |
| 933912 | AD1-013 E    | 1.73      |
| 933931 | AD1-016 C    | 0.54      |
| 933932 | AD1-016 E    | 0.89      |
| 934101 | AD1-039 1    | 4.12      |
| 934111 | AD1-039 2    | 4.18      |
| 934401 | AD1-064 C O1 | 1.88      |
| 934402 | AD1-064 E O1 | 8.8       |
| 934431 | AD1-067 C    | 0.08      |
| 934432 | AD1-067 E    | 0.33      |
| 934701 | AD1-098 C O1 | 4.06      |
| 934702 | AD1-098 E O1 | 2.96      |
| 934721 | AD1-100 C    | 11.11     |
| 934722 | AD1-100 E    | 51.86     |
| 934871 | AD1-116 C    | 0.57      |

| Bus #  | Bus          | MW Impact |
|--------|--------------|-----------|
| 934872 | AD1-116 E    | 0.93      |
| 934971 | AD1-129 C    | 0.53      |
| 934972 | AD1-129 E    | 0.35      |
| 935001 | AD1-133 C O1 | 12.63     |
| 935002 | AD1-133 E O1 | 8.42      |
| 935271 | AD1-137 C    | 5.69      |
| 935272 | AD1-137 E    | 38.05     |
| 936291 | AD2-038 C O1 | 1.41      |
| 936292 | AD2-038 E O1 | 9.44      |
| 936371 | AD2-047 C O1 | 1.25      |
| 936372 | AD2-047 E O1 | 13.5      |
| 936461 | AD2-060      | 1.48      |
| 936511 | AD2-066 C O1 | 4.99      |
| 936512 | AD2-066 E O1 | 3.33      |
| 936781 | AD2-101 C    | 2.47      |
| 936782 | AD2-101 E    | 11.56     |
| 936961 | AD2-130      | 0.32      |
| 936981 | AD2-132 C    | 5.04      |
| 936982 | AD2-132 E    | 23.6      |
| 937001 | AD2-134 C    | 1.61      |
| 937002 | AD2-134 E    | 6.66      |
| 937031 | AD2-137 C O1 | 1.92      |
| 937032 | AD2-137 E O1 | 9.0       |
| 937041 | AD2-138 C    | 5.04      |
| 937042 | AD2-138 E    | 23.6      |
| 937051 | AD2-140 C O1 | 1.92      |
| 937052 | AD2-140 E O1 | 8.99      |
| 937061 | AD2-141 C O1 | 1.91      |
| 937062 | AD2-141 E O1 | 9.0       |
| 937071 | AD2-142 C O1 | 3.84      |
| 937072 | AD2-142 E O1 | 17.97     |
| 937121 | AD2-148 C O1 | 1.92      |
| 937122 | AD2-148 E O1 | 8.98      |
| 937131 | AD2-149 C O1 | 1.92      |
| 937132 | AD2-149 E O1 | 8.98      |
| 937141 | AD2-150 C O1 | 1.92      |
| 937142 | AD2-150 E O1 | 8.98      |
| 937181 | AD2-155 C O1 | 1.92      |
| 937182 | AD2-155 E O1 | 8.98      |
| 937321 | AD2-175 C    | 8.94      |
| 937322 | AD2-175 E    | 5.96      |
| 937331 | AD2-176 C O1 | 4.29      |
| 937332 | AD2-176 E O1 | 2.86      |
| 937401 | AD2-194 1    | 4.51      |
| 937411 | AD2-194 2    | 4.51      |
| 938012 | AE1-002 E O1 | 3.86      |
| 938511 | AE1-070 1    | 5.29      |
| 938521 | AE1-070 2    | 4.84      |
| 938671 | AE1-089 C    | 74.55     |
| 938672 | AE1-089 E    | 102.34    |
| 938851 | AE1-113 C O1 | 5.18      |
| 938852 | AE1-113 E O1 | 16.3      |

| <b>Bus #</b> | <b>Bus</b>   | <b>MW Impact</b> |
|--------------|--------------|------------------|
| 939321       | AE1-163 C O1 | 3.47             |
| 939322       | AE1-163 E O1 | 21.3             |
| 939351       | AE1-166 C O1 | 5.85             |
| 939352       | AE1-166 E O1 | 5.4              |
| 939401       | AE1-172 C O1 | 3.71             |
| 939402       | AE1-172 E O1 | 17.38            |
| 939641       | AE1-194 C    | 5.61             |
| 939642       | AE1-194 E    | 37.52            |
| 939651       | AE1-195 C    | 5.61             |
| 939652       | AE1-195 E    | 37.52            |
| 939691       | AE1-199      | 1.41             |
| 939701       | AE1-201 C    | 1.17             |
| 939702       | AE1-201 E    | 0.26             |
| 939732       | AE1-204 E    | 0.17             |
| 939861       | AE1-222 1    | 46.37            |
| 939871       | AE1-222 2    | 47.11            |
| 939921       | AE1-228 C O1 | 5.92             |
| 939922       | AE1-228 E O1 | 3.95             |
| 939961       | AE1-233 C O1 | 1.36             |
| 939962       | AE1-233 E O1 | 5.62             |
| AB2-013      | AB2-013      | 10.01            |
| AE1-033      | AE1-033      | 10.77            |
| CARR         | CARR         | 0.59             |
| CATAWBA      | CATAWBA      | 0.05             |
| CBM-S1       | CBM-S1       | 4.59             |
| CBM-W1       | CBM-W1       | 19.73            |
| CBM-W2       | CBM-W2       | 68.12            |
| CIN          | CIN          | 7.05             |
| DEARBORN     | DEARBORN     | 1.82             |
| G-007        | G-007        | 1.65             |
| HAMLET       | HAMLET       | 0.34             |
| IPL          | IPL          | 3.27             |
| LGEE         | LGEE         | 0.73             |
| MEC          | MEC          | 25.32            |
| O-066        | O-066        | 5.54             |
| RENSSELAER   | RENSSELAER   | 0.47             |
| WEC          | WEC          | 4.7              |
| Z1-043       | Z1-043       | 17.64            |

## Affected Systems

## **LG&E**

LG&E Impacts to be determined during later study phases (as applicable).

## **MISO**

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

## **TVA**

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

## **Duke Energy Progress**

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

## **NYISO**

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

| Contingency Name             | Contingency Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ATSI-P2-3-TE-345-016T        | CONTINGENCY 'ATSI-P2-3-TE-345-016T' /* LEMOYNE BK-34506 345<br>DISCONNECT BRANCH FROM BUS 238889 TO BUS 264599 CKT 1 /* 02LEMOYN 345 19MAJTC 345<br>DISCONNECT BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 /* 02LEMOYN 345 05FOSTOR 345<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ATSI-P2-3-TE-345-022T        | CONTINGENCY 'ATSI-P2-3-TE-345-022T' /* ALLEN JCT BK-34531 345<br>DISCONNECT BRANCH FROM BUS 238530 TO BUS 256583 CKT 1 /* 02ALLEN 345 18LENAWEE 345<br>DISCONNECT BRANCH FROM BUS 238530 TO BUS 239018 CKT 1 /* 02ALLEN 345 02FULTON 345<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| ATSI-P2-3-TE-345-023T        | CONTINGENCY 'ATSI-P2-3-TE-345-023T' /* ALLEN JCT BK-34532 345<br>DISCONNECT BRANCH FROM BUS 238530 TO BUS 256583 CKT 1 /* 02ALLEN 345 18LENAWEE 345<br>DISCONNECT BRANCH FROM BUS 238530 TO BUS 239344 CKT 3 /* 02ALLEN 345 02ALLEN-2 138<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| AEP_P1-2_#709                | CONTINGENCY 'AEP_P1-2_#709'<br>OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208<br>05JEFRSO 765 1<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ATSI-P2-3-TE-345-015T        | CONTINGENCY 'ATSI-P2-3-TE-345-015T' /* LEMOYNE BK-34505 345<br>DISCONNECT BRANCH FROM BUS 238889 TO BUS 238890 CKT 1 /* 02LEMOYN 345 02LEMOYN 138<br>DISCONNECT BRANCH FROM BUS 238889 TO BUS 264599 CKT 1 /* 02LEMOYN 345 19MAJTC 345<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ATSI-P7-1-TE-345-022T        | CONTINGENCY 'ATSI-P7-1-TE-345-022T' /* Y1-069-MONROE/LEMOYNE-MAJ 345<br>DISCONNECT BRANCH FROM BUS 241901 TO BUS 264612 CKT 1 /* 02_Y1-069 345 19MON12 345<br>DISCONNECT BRANCH FROM BUS 238889 TO BUS 264599 CKT 1 /* 02LEMOYN 345 19MAJTC 345<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| AEP_P4_#6189_05HANG R 765_D1 | CONTINGENCY 'AEP_P4_#6189_05HANG R 765_D1'<br>OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 / 242921 05CORN 765 242924<br>05HANG R 765 1<br>OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208<br>05JEFRSO 765 1<br>OPEN BRANCH FROM BUS 242921 TO BUS 242934 CKT 1 / 242921 05CORN 765 242934<br>05CORN 765 1<br>REMOVE UNIT 1A FROM BUS 247245 / 247245 05HRKG1A 18.0<br>REMOVE UNIT 1B FROM BUS 247246 / 247246 05HRKG1B 18.0<br>REMOVE UNIT 1S FROM BUS 247247 / 247247 05HRKG1S 18.0<br>REMOVE UNIT 2A FROM BUS 247248 / 247248 05HRKG2A 18.0<br>REMOVE UNIT 2B FROM BUS 247249 / 247249 05HRKG2B 18.0<br>REMOVE UNIT 2S FROM BUS 247250 / 247250 05HRKG2S 18.0<br>END |
| ATSI-P2-3-TE-345-030T        | CONTINGENCY 'ATSI-P2-3-TE-345-030T' /* Y1-069 345 BREAKER B2<br>DISCONNECT BRANCH FROM BUS 241901 TO BUS 264612 CKT 1 /* 02_Y1-069 345 19MON12 345<br>DISCONNECT BRANCH FROM BUS 241901 TO BUS 238563 CKT 1 /* 02_Y1-069 345 02BAY SH 345<br>END                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| Contingency Name                    | Contingency Definition                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AEP_P4_#7334_05JEFRSO 765_A2</b> | CONTINGENCY 'AEP_P4_#7334_05JEFRSO 765_A2'<br>OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208<br>05JEFRSO 765 1<br>OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 2 / 243208 05JEFRSO 765 242865<br>05JEFRSO 345 2<br>OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO 345 248000<br>06CLIFTY 345 Z1<br>END |
| <b>AEP_P4_#2978_05DUMONT 765_B</b>  | CONTINGENCY 'AEP_P4_#2978_05DUMONT 765_B'<br>OPEN BRANCH FROM BUS 243206 TO BUS 243207 CKT 1 / 243206 05DUMONT 765 243207<br>05GRNTWN 765 1<br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644<br>WILTON ; 765 1<br>END                                                                                                      |
| <b>AEP_P1-2_#695A</b>               | CONTINGENCY 'AEP_P1-2_#695A'<br>OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1 / 243206 05DUMONT 765 270644<br>WILTON ; 765 1<br>END                                                                                                                                                                                                                     |
| <b>ATSI-P2-3-TE-345-034T</b>        | CONTINGENCY 'ATSI-P2-3-TE-345-034T' /* Y1-069 345 BREAKER B6<br>DISCONNECT BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 /* 02_Y1-069 345 05FOSTOR 345<br>DISCONNECT BRANCH FROM BUS 241901 TO BUS 264612 CKT 1 /* 02_Y1-069 345 19MON12 345<br>END                                                                                                          |

## Short Circuit

## Short Circuit

The following Breakers are overduty:

None