Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-217

EAST SPRINGFIELD-LONDON 138 KV

108 MW Capacity / 180 MW Energy

July, 2019

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is American Transmission Systems Inc. (ATSI).

2 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 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in

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order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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

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3 General

The Interconnection Customer (IC) has proposed a Solar generating facility located in Clark County, Ohio. The installed facilities will have a total capability of 180 MW with 108 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2021. This study does not imply a Transmission Owner (TO) commitment to this in-service date.

Queue Number	AE2-217
Project Name	EAST SPRINGFIELD-LONDON 138 KV
Interconnection Customer	
State	Ohio
County	Clark
Transmission Owner	ATSI
MFO	180
MWE	180
MWC	108
Fuel	Solar
Basecase Study Year	2022

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3.1 Point of Interconnection

AE2-217 will interconnect with the ATSI transmission system. The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation, looping the East Springfield - London 138 kV line into the new station, and extending a new line exit to the Primary POI. The new substation will be located approximately 9.4 miles from East Springfield substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three breaker ring bus site. The project will also require non-direct connection upgrades at East Springfield and London substations.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-217 generation project to connect to the FirstEnergy ("FE") transmission system. Attachment 2 provides the proposed location for the point of interconnection. IC will be responsible for constructing all the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE transmission system's direct connection facilities.

3.2 Cost Summary

The AE2-217 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$525,440
Direct Connection Network Upgrade	$5,339,360
Non Direct Connection Network Upgrades	$543,600
Total Costs	$6,408,400

In addition, the AE2-217 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$3,200,000

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

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

The required Attachment Facilities and Direct and Non-Direct Connection work for the interconnection of the AE2-217 generation project to the FE Transmission System is detailed in the following sections. The associated one-line with the generation project Attachment Facilities and the Primary Direct and Non-Direct Connection facilities are shown in Attachment 1.

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4 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation, looping the East Springfield - London 138 kV line into the new station, and extending a new line exit to the Primary POI. The new substation will be located approximately 9.4 miles from East Springfield substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three breaker ring bus site. The project will also require non-direct connection upgrades at East Springfield and London substations.

5 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
Install line exit take-off structure, foundations, disconnect switch and associated equipment at substation	$525,440
Total Attachment Facility Costs	$525,440

6 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
Build a three breaker ring bus to connect AE2-217	$4,728,960
Loop in the line ~9 miles from London substation due to AE2-217 developer interconnection @ East Springfield-London 138kV Line Loop	$610,400
Total Direct Connection Facility Costs	$5,339,360

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7 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
Terminal end relay upgrades (@ East Springfield and London)	$543,600
Total Non-Direct Connection Facility Costs	$543,600

8 System Reinforcement Cost Estimates

Upgrade Description	Cost
AEPO0001a (102) : Upgrade/Replace 3-345kV 1600A switches at Beatty station **Project Type : FAC** **Cost : $1,500,000** **Time Estimate : 12-18 Months**	$1,500,000
AEPO0003a (108) : Upgrade/Replace Three 345kV 1600A switches at Beatty station **Project Type : FAC** **Cost : $1,500,000** **Time Estimate : 12-18 Months**	$1,500,000
AEPO0002a (105) : AEP Only: Upgrade relaying at Beatty **Project Type : FAC** **Cost : $200,000** **Time Estimate : 12-18 Months**	$200,000
TOTAL COST	**$3,200,000**

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9 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and Non-Direct Connection facilities, it is expected to take a minimum of 24 months after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the interconnection substation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that all transmission system outages will be allowed when requested.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimate elapsed time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

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10 Transmission Owner Analysis

10.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AE2-217 project did not contribute to any overloads on the FE transmission system

10.2 Stability Analysis

To be performed in the System Impact Study phase.

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11 Interconnection Customer Requirements

11.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

Regarding the Primary POI, the IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side.

11.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 138 kV circuit breaker to protect the AE2-217 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

4. Compliance with the FE and PJM generator power factor and voltage control requirements.

5. The execution of a back-up service agreement to serve the customer load supplied from the AE2-217 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits.

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Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

11.3 Power Factor Requirements

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

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12 Revenue Metering and SCADA Requirements

12.1 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.

12.1.1 Meteorological Data Reporting Requirement

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

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

12.2 ATSI Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

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13 Network Impacts

The Queue Project AE2-217 was evaluated as a 180.0 MW (Capacity 108.0 MW) injection tapping the East Springfield to London 138kV line in the ATSI area. Project AE2-217 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-217 was studied with a commercial probability of 53%. Potential network impacts were as follows:

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Summer Peak Load Flow

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13.1 Generation Deliverability

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

None

13.2 Multiple Facility Contingency

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

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
7200955	243453	05BEATTY	AEP	243454	05BIXBY	AEP	1	AEP_P4_#10715_05COLE 345_C	breaker	1203.0	98.36	99.15	DC	20.96
7200777	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P2-3-OES-138-010A	breaker	242.0	72.2	105.45	DC	80.48
7200778	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P2-3-OES-138-011	breaker	242.0	69.6	102.85	DC	80.48
7202223	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P7-1-OES-138-066A-A	tower	242.0	69.36	117.93	DC	117.55
7202224	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1-B	tower	242.0	80.17	104.79	DC	59.59
7202225	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	DAY_P7_BEATTY-S. CHARLESTON 34542_1-A	tower	242.0	80.17	104.79	DC	59.59

13.3 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
7200861	243453	05BEATTY	AEP	244022	05COLE	AEP	1	AEP_P4_#8094_05BIXBY 345_C	breaker	1203.0	106.78	107.26	DC	12.78
7200954	243453	05BEATTY	AEP	243454	05BIXBY	AEP	1	AEP_P4_#3196_05BEATTY 345_302E	breaker	1203.0	100.39	101.06	DC	17.92

13.4 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
7201884	243453	05BEATTY	AEP	244022	05COLE	AEP	1	AEP_P1-2_#713	operation	1203.0	98.92	99.42	DC	13.18

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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
7201965	243453	05BEATTY	AEP	243454	05BIXBY	AEP	1	AEP_P1-2_#10137	operation	1203.0	91.39	92.18	DC	20.96
7201687	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	Base Case	operation	200.0	76.51	106.41	DC	59.8

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13.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
7200861	3	05BEATTY 345.0 kV - 05COLE 345.0 kV Ckt 1	AEPO0001a (102) : Upgrade/Replace 3-345kV 1600A switches at Beatty station Project Type : FAC Cost : $1,500,000 Time Estimate : 12-18 Months	$1,500,000
7200954,7200955	1	05BEATTY 345.0 kV - 05BIXBY 345.0 kV Ckt 1	AEPO0003a (108) : Upgrade/Replace Three 345kV 1600A switches at Beatty station Project Type : FAC Cost : $1,500,000 Time Estimate : 12-18 Months	$1,500,000
7202223,7200777,7200778,7202225,7202224	2	AE2-180 TAP 138.0 kV - 05BEATTY 138.0 kV Ckt 1	AEPO0002a (105) : AEP Only: Upgrade relaying at Beatty Project Type : FAC Cost : $200,000 Time Estimate : 12-18 Months	$200,000
			TOTAL COST	**$3,200,000**

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13.6 Flow Gate Details

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. Although this information is not used "as is" for cost allocation purposes, it can be used to gage 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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13.6.1 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
7200954	243453	05BEATTY	AEP	243454	05BIXBY	AEP	1	AEP_P4_#3196_05BEATTY 345_302E	breaker	1203.0	100.39	101.06	DC	17.92

Bus #	Bus	MW Impact
253038	09KILLEN	52.29
253077	09STUART	214.43
253110	09ADKINS	24.08
253261	09MON D	0.21
902531	W2-040 C	0.97
902532	W2-040 E	1.58
904722	V4-073 E	0.21
913222	Y1-054 E	1.61
914372	Y2-111 E	1.61
915582	Y3-080 E	1.07
915662	Y3-099 E	0.15
915672	Y3-100 E	0.15
916182	Z1-065 E	0.5
916272	Z1-080 E	0.49
918802	AA1-099 E	0.32
925242	AB2-178 E	1.5
925921	AC1-068 C	11.33
925922	AC1-068 E	5.3
925931	AC1-069 C	11.33
925932	AC1-069 E	5.3
925981	AC1-074 C O1	4.21
925982	AC1-074 E O1	1.8
926011	AC1-078 C O1	8.49
926012	AC1-078 E O1	14.15
926061	AC1-085 C O1	20.6
926062	AC1-085 E O1	33.61
926101	AC1-089 C O1	4.17
926102	AC1-089 E O1	6.8
926791	AC1-165 C	11.2
926792	AC1-165 E	5.43
926801	AC1-166 C	11.2
926802	AC1-166 E	5.43
927182	AC1-212 E	1.27
930062	AB1-014 E	8.46
931181	AB1-169	135.05
932381	AC2-055 C	1.77
932382	AC2-055 E	2.89
932421	AC2-060 C	6.29
932422	AC2-060 E	3.54
932431	AC2-061 C	4.26
932432	AC2-061 E	4.32
932462	AC2-066 E	0.27

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Bus #	Bus	MW Impact
932481	AC2-068 C	3.29
932482	AC2-068 E	5.39
932551	AC2-075 C	1.0
932552	AC2-075 E	0.5
932651	AC2-087 C O1	4.66
932652	AC2-087 E O1	3.7
932661	AC2-088 C O1	4.24
932662	AC2-088 E O1	3.49
932841	AC2-111 C O1	2.16
932842	AC2-111 E O1	3.52
934491	AD1-073 C	1.3
934492	AD1-073 E	0.67
934561	AD1-081 C	1.7
934562	AD1-081 E	0.87
935031	AD1-136 C	0.6
935032	AD1-136 E	0.51
935041	AD1-140 C O1	12.37
935042	AD1-140 E O1	10.23
936251	AD2-031 C O1	2.51
936252	AD2-031 E O1	4.09
936281	AD2-036 C	3.01
936282	AD2-036 E	1.5
936381	AD2-048 C	3.42
936382	AD2-048 E	1.71
937111	AD2-147 C O1	13.71
937112	AD2-147 E O1	18.93
937151	AD2-151 C O1	4.66
937152	AD2-151 E O1	6.43
938051	AE1-007 C	0.94
938052	AE1-007 E	1.54
938061	AE1-008 C	0.54
938062	AE1-008 E	0.88
938271	AE1-040 C O1	4.04
938272	AE1-040 E O1	2.03
938921	AE1-120	4.8
939141	AE1-144 C O1	7.14
939142	AE1-144 E O1	3.54
940531	AE2-038 C O1	4.76
940532	AE2-038 E O1	2.36
941411	AE2-138 C	14.74
941412	AE2-138 E	5.45
941511	AE2-148 C	169.93
941512	AE2-148 E	76.86
941771	AE2-180 C	7.08
941772	AE2-180 E	4.72
941941	AE2-206 C O1	2.91
941942	AE2-206 E O1	4.02
941981	AE2-210 C O1	5.04
941982	AE2-210 E O1	1.89
942051	AE2-217 C	10.75
942052	AE2-217 E	7.17
942061	AE2-218 C	11.36

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Bus #	Bus	MW Impact
942062	AE2-218 E	7.72
942091	AE2-221 C	26.7
942092	AE2-221 E	17.8
942231	AE2-235 C O1	3.55
942232	AE2-235 E O1	1.54
942521	AE2-267 C O1	2.88
942522	AE2-267 E O1	1.78
942621	AE2-278 C	7.48
942622	AE2-278 E	4.99
942781	AE2-296 O1	13.29
942951	AE2-315	3.23
942981	AE2-320 C O1	22.29
942982	AE2-320 E O1	11.03
943111	AE2-339 C	2.36
943112	AE2-339 E	1.16
943191	AE2-318 C	6.94
943192	AE2-318 E	3.39
943201	AE2-319 C O1	22.29
943202	AE2-319 E O1	11.03
CARR	CARR	0.55
CBM-S1	CBM-S1	8.63
CBM-S2	CBM-S2	0.95
CBM-W1	CBM-W1	9.32
CBM-W2	CBM-W2	59.99
CIN	CIN	8.94
CPLE	CPLE	0.14
G-007	G-007	1.49
IPL	IPL	6.15
LGEE	LGEE	3.45
MEC	MEC	10.24
MECS	MECS	1.52
O-066	O-066	9.56
RENSSELAER	RENSSELAER	0.43
WEC	WEC	1.36

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13.6.2 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
7202223	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P7-1-OES-138-066A-A	tower	242.0	69.36	117.93	DC	117.55

Bus #	Bus	MW Impact
926011	AC1-078 C O1	50.0
926012	AC1-078 E O1	83.34
934561	AD1-081 C	10.0
934562	AD1-081 E	5.15
941771	AE2-180 C	39.97
941772	AE2-180 E	26.65
942051	AE2-217 C	70.53
942052	AE2-217 E	47.02
BLUEG	BLUEG	0.43
CALDERWOOD	CALDERWOOD	0.03
CANNELTON	CANNELTON	0.02
CATAWBA	CATAWBA	0.01
CBM-N	CBM-N	0.02
CBM-W1	CBM-W1	0.28
CHEOAH	CHEOAH	0.03
CHILHOWEE	CHILHOWEE	0.01
COFFEEN	COFFEEN	0.01
COTTONWOOD	COTTONWOOD	0.08
ELMERSMITH	ELMERSMITH	0.03
FARMERCITY	FARMERCITY	0.0
G-007A	G-007A	0.04
GIBSON	GIBSON	0.01
HAMLET	HAMLET	0.02
MECS	MECS	0.48
NEWTON	NEWTON	0.03
NYISO	NYISO	0.07
PRAIRIE	PRAIRIE	0.06
SANTEETLA	SANTEETLA	0.01
SMITHLAND	SMITHLAND	0.01
TILTON	TILTON	0.01
TRIMBLE	TRIMBLE	0.05
TVA	TVA	0.08
UNIONPOWER	UNIONPOWER	0.03
VFT	VFT	0.1
WEC	WEC	0.01

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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
7200861	243453	05BEATTY	AEP	244022	05COLE	AEP	1	AEP_P4_#8094_05BIXBY 345_C	breaker	1203.0	106.78	107.26	DC	12.78

Bus #	Bus	MW Impact
247965	Y1-063 E	0.31
253038	09KILLEN	57.08
253077	09STUART	203.01
253110	09ADKINS	20.92
902531	W2-040 C	0.83
902532	W2-040 E	1.35
904722	V4-073 E	0.18
913222	Y1-054 E	1.48
914372	Y2-111 E	1.36
915582	Y3-080 E	0.91
915662	Y3-099 E	0.14
915672	Y3-100 E	0.14
916182	Z1-065 E	0.45
916272	Z1-080 E	0.48
918802	AA1-099 E	0.32
924371	AB2-085 C O1	3.61
924372	AB2-085 E O1	1.7
925242	AB2-178 E	1.41
925921	AC1-068 C	9.96
925922	AC1-068 E	4.66
925931	AC1-069 C	9.96
925932	AC1-069 E	4.66
925981	AC1-074 C O1	3.98
925982	AC1-074 E O1	1.71
926011	AC1-078 C O1	7.53
926012	AC1-078 E O1	12.54
926061	AC1-085 C O1	18.91
926062	AC1-085 E O1	30.86
926101	AC1-089 C O1	4.31
926102	AC1-089 E O1	7.03
926791	AC1-165 C	9.84
926792	AC1-165 E	4.77
926801	AC1-166 C	9.84
926802	AC1-166 E	4.77
930062	AB1-014 E	7.84
931181	AB1-169	127.85
932201	AC2-029 C	2.07
932202	AC2-029 E	3.38
932381	AC2-055 C	2.19
932382	AC2-055 E	3.57
932411	AC2-059 C	4.02
932412	AC2-059 E	4.14

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Bus #	Bus	MW Impact
932421	AC2-060 C	7.76
932422	AC2-060 E	4.36
932431	AC2-061 C	4.42
932432	AC2-061 E	4.49
932462	AC2-066 E	0.25
932481	AC2-068 C	2.78
932482	AC2-068 E	4.55
932551	AC2-075 C	0.95
932552	AC2-075 E	0.48
932651	AC2-087 C O1	5.74
932652	AC2-087 E O1	4.56
932661	AC2-088 C O1	3.98
932662	AC2-088 E O1	3.28
934481	AD1-072 C	0.88
934482	AD1-072 E	0.4
934491	AD1-073 C	1.6
934492	AD1-073 E	0.82
934561	AD1-081 C	1.51
934562	AD1-081 E	0.78
935031	AD1-136 C	0.56
935032	AD1-136 E	0.48
935041	AD1-140 C O1	9.8
935042	AD1-140 E O1	8.1
936111	AD2-016 C	4.02
936112	AD2-016 E	4.14
936251	AD2-031 C O1	2.35
936252	AD2-031 E O1	3.83
936281	AD2-036 C	2.85
936282	AD2-036 E	1.42
936381	AD2-048 C	3.26
936382	AD2-048 E	1.63
936751	AD2-096 C O1	1.34
936752	AD2-096 E O1	0.34
937111	AD2-147 C O1	11.82
937112	AD2-147 E O1	16.32
937151	AD2-151 C O1	4.31
937152	AD2-151 E O1	5.95
937231	AD2-162 C	5.05
937232	AD2-162 E	2.48
938051	AE1-007 C	0.8
938052	AE1-007 E	1.3
938271	AE1-040 C O1	4.45
938272	AE1-040 E O1	2.24
938921	AE1-120	4.45
939141	AE1-144 C O1	6.81
939142	AE1-144 E O1	3.38
940531	AE2-038 C O1	4.54
940532	AE2-038 E O1	2.25
941411	AE2-138 C	13.95
941412	AE2-138 E	5.16
941511	AE2-148 C	146.53
941512	AE2-148 E	66.28

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Bus #	Bus	MW Impact
941771	AE2-180 C	6.83
941772	AE2-180 E	4.56
941981	AE2-210 C O1	4.77
941982	AE2-210 E O1	1.79
942051	AE2-217 C	7.67
942052	AE2-217 E	5.11
942061	AE2-218 C	8.97
942062	AE2-218 E	6.09
942091	AE2-221 C	23.88
942092	AE2-221 E	15.92
942231	AE2-235 C O1	3.4
942232	AE2-235 E O1	1.47
942521	AE2-267 C O1	2.6
942522	AE2-267 E O1	1.61
942781	AE2-296 O1	11.35
942951	AE2-315	2.77
942981	AE2-320 C O1	19.59
942982	AE2-320 E O1	9.69
943041	AE2-327 C	2.14
943042	AE2-327 E	1.43
943111	AE2-339 C	2.24
943112	AE2-339 E	1.1
943191	AE2-318 C	6.42
943192	AE2-318 E	3.14
943201	AE2-319 C O1	19.59
943202	AE2-319 E O1	9.69
CARR	CARR	0.47
CBM-S1	CBM-S1	8.19
CBM-S2	CBM-S2	1.35
CBM-W1	CBM-W1	4.99
CBM-W2	CBM-W2	51.55
CIN	CIN	7.52
CPLE	CPLE	0.33
G-007	G-007	1.24
IPL	IPL	5.21
LGEE	LGEE	3.21
MEC	MEC	7.31
O-066	O-066	8.0
RENSSELAER	RENSSELAER	0.37
WEC	WEC	0.81

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Affected Systems

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13.7 Affected Systems

13.7.1 LG&E

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

13.7.2 MISO

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

13.7.3 TVA

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

13.7.4 Duke Energy Progress

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

13.7.5 NYISO

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

13.8 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P2-3-OES-138-011	CONTINGENCY 'ATSI-P2-3-OES-138-011' /* TANGY B-2 FAILURE TO TRIP DISCONNECT BRANCH FROM BUS 239134 TO BUS 239264 CKT 1 /* 02TANGY 138 02DBP 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239218 CKT 1 /* 02TANGY 138 02SSCIOT 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 238574 CKT 1 /* 02TANGY 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 239264 TO BUS 238640 CKT 1 /* 02DBP 138 02CRISS 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 240706 CKT 1 /* 02TANGY 138 02NATIONAL 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 3 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 4 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 5 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 1 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 2 /* 02TANGY 138 02TANGY 69 REMOVE LOAD R FROM BUS 239264 /* 02DBP 138 DISCONNECT BUS 239134 /* 02TANGY 138 DISCONNECT BUS 239264 /* 02DBP 138 END

Contingency Name	Contingency Definition
AEP_P4_#8094_05BIXBY 345_C	CONTINGENCY 'AEP_P4_#8094_05BIXBY 345_C' OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453 05BEATTY 345 243454 05BIXBY 345 1 OPEN BRANCH FROM BUS 941520 TO BUS 243454 CKT 1 / 941520 AE2-149 TAP 345 243454 05BIXBY 345 1 /* CONTINGENCY LINE ADDED FOR AE2 BUILD END
ATSI-P2-3-OES-138-010A	CONTINGENCY 'ATSI-P2-3-OES-138-010A' /* TANGY B-155 FAILURE TO TRIP DISCONNECT BRANCH FROM BUS 239134 TO BUS 239264 CKT 1 /* 02TANGY 138 02DBP 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239218 CKT 1 /* 02TANGY 138 02SSCIOT 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 238574 CKT 1 /* 02TANGY 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 238964 TO BUS 238574 CKT 1 /* 02MLCRK+ 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 240706 CKT 1 /* 02TANGY 138 02NATIONAL 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 3 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 4 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 5 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 1 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 2 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 937240 TO BUS 238964 CKT 1 /* AD2-163 TAP 138 02MLCRK+ 138 /* CONTINGENCY LINE ADDED FOR AE1 BUILD REMOVE LOAD O FROM BUS 238574 /* 02BELPT+ 138 REMOVE LOAD O FROM BUS 238964 /* 02MLCRK+ 138 DISCONNECT BUS 239134 /* 02TANGY 138 DISCONNECT BUS 238964 /* 02MLCRK+ 138 DISCONNECT BUS 238574 /* 02BELPT+ 138 END
AEP_P1-2_#10137	CONTINGENCY 'AEP_P1-2_#10137' OPEN BRANCH FROM BUS 243453 TO BUS 244022 CKT 1 / 243453 05BEATTY 345 244022 05COLE 345 1 END
Base Case	
AEP_P4_#10715_05COLE 345_C	CONTINGENCY 'AEP_P4_#10715_05COLE 345_C' OPEN BRANCH FROM BUS 244022 TO BUS 243457 CKT 1 / 244022 05COLE 345 243457 05HAYDEN 345 1 OPEN BRANCH FROM BUS 244022 TO BUS 244023 CKT 1 / 244022 05COLE 345 244023 05COLE 138 1 END
DAY_P7_BEATTY-S. CHARLESTON 34542_1-B	CONTINGENCY 'DAY_P7_BEATTY-S. CHARLESTON 34542_1-B' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 941510 TO BUS 253248 CKT 1 / 941510 AE2-148 TAP 345 253248 09SCHARL 345 1 END
DAY_P7_BEATTY-S. CHARLESTON 34542_1-A	CONTINGENCY 'DAY_P7_BEATTY-S. CHARLESTON 34542_1-A' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 941510 CKT 1 / 243453 05BEATTY 345 941510 AE2-148 TAP 345 1 END

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Contingency Name	Contingency Definition
ATSI-P7-1-OES-138-066A-A	CONTINGENCY 'ATSI-P7-1-OES-138-066A-A' /* E. SPFD-LONDON 1&2 COMMON TOWER DISCONNECT BRANCH FROM BUS 942050 TO BUS 238703 CKT 1 /* AE2-217 TAP 138 02ESPRNG 138 DISCONNECT BRANCH FROM BUS 238703 TO BUS 238908 CKT 2 /* 02ESPRNG 138 02LONDON 138 END
AEP_P4_#3196_05BEATTY 345_302E	CONTINGENCY 'AEP_P4_#3196_05BEATTY 345_302E' OPEN BRANCH FROM BUS 243453 TO BUS 244022 CKT 1 / 243453 05BEATTY 345 244022 05COLE 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 243468 CKT 4 / 243453 05BEATTY 345 243468 05BEATTX 138 4 END
AEP_P1-2_#713	CONTINGENCY 'AEP_P1-2_#713' OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453 05BEATTY 345 243454 05BIXBY 345 1 END

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Short Circuit

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13.9 Short Circuit

The following Breakers are overduty:

None

14 Attachment 1 – One Line Diagram

15 Attachment 2 – Project Location