Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-072

EAST LEIPSIC-RICHLAND 138 KV

90 MW Capacity / 150 MW Energy

October, 2019

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1 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 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.

2 General

The Interconnection Customer has proposed to install PJM project # AE2-072, a Solar generating facility located in Putnam County, Ohio (See Figure 2). The installed facilities will have a total capability of 150 MW with 90 MW of this output being recognized by PJM as Capacity. The Point of Interconnection will be to AEP owned section of the East Leipsic – Richland 138 kV line (See Figure 1).

The proposed in-service date for this project is December 31, 2021. This study does not imply AEP's commitment to this in-service date.

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 for maintaining the reliability of the AEP transmission system.

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.

Queue Number	AE2-072
Project Name	EAST LEIPSIC-RICHLAND 138 KV
State	Ohio
County	Putnam
Transmission Owner	AEP
MFO	150
MWE	150
MWC	90
Fuel	Solar
Base case Study Year	2022

2.1 Point of Interconnection

AE2-072 will interconnect with the AEP transmission system via a new station cut into the AEP owned section of East Leipsic – Richland 138 kV line.

To accommodate the interconnection on the AEP owned section of the East Leipsic – Richland138 kV line, a new three (3) circuit breaker 138 kV 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, 138 kV line risers, SCADA, and 138 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.

2.2 Cost Summary

The AE2-072 project will be responsible for the following costs:

Based upon the results of this System Impact Study, the construction of the 150 MW (90 MW Capacity) Solar generating facility of the Interconnection Customer (PJM Project # AE2-072) will require the following additional interconnection charges. This plan of service will interconnect the proposed Solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Interconnection Customer generating facility.

Description	Total Cost
Attachment Facilities	$250,000
Direct Connection Network Upgrade	$6,000,000
Non Direct Connection Network Upgrades	$1,250,000*
Total Costs	$7,500,000

*Note: The Richland remote end estimate will have to be provided by ATSI/FE.

In addition, the AE2-072 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$90,757,500

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

3 Transmission Owner Scope of Work

4 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
138 kV Revenue Metering	$250,000
Total Attachment Facility Costs	$250,000

5 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
Construct a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus. Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required.	$6,000,000
Total Direct Connection Facility Costs	$6,000,000

6 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 East Leipsic 138 kV substation	$250,000
East Leipsic – Richland 138 kV T-Line Cut In	$1,000,000
Total Non-Direct Connection Facility Costs	**$1,250,000**

Note: The Richland remote end estimate will have to be provided by ATSI/FE.

7 Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

8 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 signing Agreement execution.

9 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 East Leipsic – Richland 138 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.

10 Revenue Metering and SCADA Requirements

10.1 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.

10.2 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

11 Network Impacts

The Queue Project AE2-072 was evaluated as a 150 MW (Capacity 90 MW) injection at the East Leipsic – Richland 138 kV line in the AEP area. Project AE2-072 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-072 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

12 Generation Deliverability

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

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
8667121	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	single	194.0	90.41	100.11	DC	18.82

13 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
2156374	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-008	breaker	194.0	98.78	114.95	DC	31.35
2156375	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-006	breaker	194.0	97.75	113.92	DC	31.35
1391381	243080	05RILEYC	AEP	243083	05CAMPSS	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	53.77	121.03	DC	150.0
1391391	243083	05CAMPSS	AEP	242989	05E LIMA	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	53.14	120.4	DC	150.0
1391359	247000	05YELLWC	AEP	243080	05RILEYC	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	56.82	124.08	DC	150.0

14 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
2156444	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1742.0	105.92	106.42	DC	18.97
2156994	238569	02BEAVER	ATSI	238607	02CARLIL	ATSI	1	ATSI-P7-1-OEC-345-001	tower	1243.0	105.77	106.31	DC	14.77
2156373	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-009	breaker	194.0	100.49	116.52	DC	31.09
8667012	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	single	179.0	101.84	112.35	DC	18.82
2156966	239728	02BLKRVR	ATSI	239734	02USSTEEL	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	659.0	101.41	101.95	DC	7.85

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
2156942	239734	02USSTEEL	ATSI	238915	02LRN Q2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	593.0	108.28	108.88	DC	7.85

15 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
8667120	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	operation	194.0	101.24	117.42	DC	31.36
2156819	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	Base Case	operation	152.0	93.44	107.89	DC	21.96
8667011	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	operation	179.0	113.58	131.12	DC	31.36

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
2156373,2156375,2156374	2	02RICHLD 138.0 kV - 02NAOMI 138.0 kV Ckt 1	ATSI TE-004A : Reconductor the transmission line conductor (existing 336 ACSR) with 336 ACSS. Project Type : Facility Cost : $40,950,000 Time Estimate : 36.0 Months	$40,950,000
1391381	3	05RILEYC 138.0 kV - 05CAMPSS 138.0 kV Ckt 1	AEP AEPO0013a : Perform Sag Study on 8.6 miles of line with ACSR 636 26/7 Grosbeak conductor. Project Type : FAC Cost : $34,400 Time Estimate : 6-12 Months	$34,400
8667121	1	02RDGVL 138.0 kV - 02RDGVL+ 138.0 kV Ckt 1	ATSI TE-005A : Reconductor the existing section of the 336 ACSR 30/7 with with 336 ACSS. The existing line has mixed 1336 ACSR 30/7 and 636 AA 37 conductors. The sections of 636 AA 37 conductors does not need to be reconductored. Project Type : Facility Cost : $ 9,750,000 Time Estimate : 24.0 Months	$9,750,000
2156994	7	02BEAVER 345.0 kV - 02CARLIL 345.0 kV Ckt 1	ATSI ATSI Rating Correction: [Rate A: 1380, Rate B: 1646, Rate C: 1730]	$0
2156966	9	02BLKRVR 138.0 kV - 02USSTEEL 138.0 kV Ckt 1	ATSI OEC-002A : Build a new 138 kV line from Black River to Astor substation Project Type : Facility Cost : $20,152,700 Time Estimate : 30.0 Months	$20,152,700
2156942	10	02USSTEEL 138.0 kV - 02LRN Q2 138.0 kV Ckt 1		
2156444	6	02BEAVER 345.0 kV - 02LAKEAVE 345.0 kV Ckt 2	ATSI ATSI Rating Correction: [Rate A: 1534, Rate B: 1878, Rate C: 2120]	$0
8667012	8	02RICHLD 138.0 kV - 02RDGVL 138.0 kV Ckt 1	ATSI TE-003B : Reconductor the transmission line conductor (existing 336 ACSR) with 336 ACSS 26/7. Reconductor substation conductor (existing 336 ACSR) at Richland with 556 26/7 ACSR. Replace the existing 800 Amp wave trap with a 1,200 Amp wave trap. Project Type : Facility Cost : $19,500,000 Time Estimate : 30.0 Months	$19,500,000

ID	Index	Facility	Upgrade Description	Cost
1391359	5	05YELLWC 138.0 kV - 05RILEYC 138.0 kV Ckt 1	AEP AEPO0012a (209) : Perform Sag Study on 3.5 miles of line with ACSR 636 26/7 Grosbeak conductor. Project Type : FAC Cost : $20,000 Time Estimate : 6-12 Months AEPO0012b (210) : Perform Sag Study on 7 miles of line with ACSR 795 45/7 Tern conductor. Project Type : FAC Cost : $28,000 Time Estimate : 6-12 Months	$48,000
1391391	4	05CAMPSS 138.0 kV - 05E LIMA 138.0 kV Ckt 1	AEP AEPO0014a (212) : Perform Sag Study on 5.6 miles of line with ACSR 636 26/7 Grosbeak conductor. Project Type : FAC Cost : $22,400 Time Estimate : 6-12 Months AEPO0014b (213) : Upgrade threee "Sub cond 795 AAC 37 Str." risers at East Lima Project Type : FAC Cost : $300,000 Time Estimate : 12-18 Months	$322,400
			TOTAL COST	$90,757,500

17 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.

17.1 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
8667121	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	single	194.0	90.41	100.11	DC	18.82

Bus #	Bus	MW Impact
239064	02RICHG1	0.47
239065	02RICHG2&3	0.92
239067	02RICHG4	5.01
239068	02RICHG5	5.01
239069	02RICHG6	5.01
247567	V2-006 C	2.64
926811	AC1-167 C O1	2.01
926941	AC1-181	0.21
934901	AD1-119 C O1	1.01
940841	AE2-072 C	18.82
943181	AE2-322 C	2.41
CARR	CARR	0.12
CBM-S1	CBM-S1	0.99
CBM-S2	CBM-S2	0.17
CBM-W2	CBM-W2	9.29
CIN	CIN	1.25
CPLE	CPLE	0.04
IPL	IPL	0.83
LGEE	LGEE	0.28
MEC	MEC	2.2
RENSSELAER	RENSSELAER	0.09
WEC	WEC	0.35

17.2 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
2156373	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-009	breaker	194.0	100.49	116.52	DC	31.09

Bus #	Bus	MW Impact
239064	02RICHG1	0.46
239065	02RICHG2&3	0.91
239067	02RICHG4	4.97
239068	02RICHG5	4.97
239069	02RICHG6	4.97
247567	V2-006 C	2.61
247961	V2-006 E	17.49
926811	AC1-167 C O1	1.99
926812	AC1-167 E O1	0.97
926941	AC1-181	0.21
934901	AD1-119 C O1	1.01
934902	AD1-119 E O1	1.64
940841	AE2-072 C	18.65
940842	AE2-072 E	12.44
943181	AE2-322 C	2.39
943182	AE2-322 E	1.17
CARR	CARR	0.12
CBM-S1	CBM-S1	0.99
CBM-S2	CBM-S2	0.17
CBM-W2	CBM-W2	9.24
CIN	CIN	1.24
CPLE	CPLE	0.04
G-007	G-007	0.28
IPL	IPL	0.83
LGEE	LGEE	0.28
MEC	MEC	2.19
O-066	O-066	1.84
RENSSELAER	RENSSELAER	0.1
WEC	WEC	0.35

17.3 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
1391381	243080	05RILEYC	AEP	243083	05CAMPSS	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	53.77	121.03	DC	150.0

Bus #	Bus	MW Impact
247567	V2-006 C	19.5
247961	V2-006 E	130.5
940841	AE2-072 C	90.0
940842	AE2-072 E	60.0

17.4 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
1391391	243083	05CAMPSS	AEP	242989	05E LIMA	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	53.14	120.4	DC	150.0

Bus #	Bus	MW Impact
247567	V2-006 C	19.5
247961	V2-006 E	130.5
940841	AE2-072 C	90.0
940842	AE2-072 E	60.0

17.5 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
1391359	247000	05YELLWC	AEP	243080	05RILEYC	AEP	1	AEP_P4_#6817_05E.LPSC 138_B	breaker	223.0	56.82	124.08	DC	150.0

Bus #	Bus	MW Impact
247567	V2-006 C	19.5
247961	V2-006 E	130.5
940841	AE2-072 C	90.0
940842	AE2-072 E	60.0

17.6 Index 6

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
2156444	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1742.0	105.92	106.42	DC	18.97

Bus #	Bus	MW Impact
238564	02BAYSG1	3.86
238670	02DVBSG1	246.72
238979	02NAPMUN	6.72
239171	02WLORG-2	4.45
239172	02WLORG-3	4.52
239173	02WLORG-4	4.53
239174	02WLORG-5	4.55
239293	02BS-PKR	0.34
240968	02BG2 GEN	1.4
240969	02BG4 G1	0.35
240973	02BG6 AMPO	5.46
240975	02PGE GEN	7.21
241902	Y1-069 GE	22.19
247548	V4-010 C	4.22
247567	V2-006 C	2.24
247940	U4-028 E	12.38
247941	U4-029 E	12.38
247947	V4-010 E	28.22
247961	V2-006 E	15.02
900041	V4-011	0.44
925751	AC1-051 C	0.88
925752	AC1-051 E	5.89
931951	AB1-107 1	55.01
931961	AB1-107 2	127.69
932051	AC2-015 C	6.11
932052	AC2-015 E	7.24
932791	AC2-103 C	14.44
932792	AC2-103 E	96.62
934251	AD1-052 C1	2.31
934261	AD1-052 C2	2.31
934461	AD1-070 C O1	5.41
934462	AD1-070 E O1	25.39
934761	AD1-103 C O1	24.27
934762	AD1-103 E O1	162.43
934891	AD1-118	14.45
937021	AD2-136 C O1	6.66
937022	AD2-136 E O1	44.58
937381	AD2-191 C	3.15
937382	AD2-191 E	21.05
938911	AE1-119	113.52

Bus #	Bus	MW Impact
939161	AE1-146 C O1	11.4
939162	AE1-146 E O1	5.42
940841	AE2-072 C	11.38
940842	AE2-072 E	7.59
941741	AE2-174 C	5.65
941742	AE2-174 E	26.46
941761	AE2-176 C	15.5
941762	AE2-176 E	10.33
941781	AE2-181 C	5.32
941782	AE2-181 E	3.55
942661	AE2-282 C O1	7.94
942662	AE2-282 E O1	4.18
CARR	CARR	1.57
CBM-S1	CBM-S1	11.05
CBM-S2	CBM-S2	2.24
CBM-W1	CBM-W1	49.77
CBM-W2	CBM-W2	99.7
CIN	CIN	12.26
CPLE	CPLE	0.54
G-007	G-007	3.48
IPL	IPL	7.85
LGEE	LGEE	2.97
MEC	MEC	24.54
MECS	MECS	52.64
O-066	O-066	22.51
RENSSELAER	RENSSELAER	1.23
WEC	WEC	4.0
Z1-043	Z1-043	15.41

17.7 Index 7

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
2156994	238569	02BEAVER	ATSI	238607	02CARLIL	ATSI	1	ATSI-P7-1-OEC-345-001	tower	1243.0	105.77	106.31	DC	14.77

Bus #	Bus	MW Impact
238572	02BEAVGB	1.21
238670	02DVBSG1	194.55
238979	02NAPMUN	5.29
239171	02WLORG-2	3.49
239172	02WLORG-3	3.55
239173	02WLORG-4	3.56
239174	02WLORG-5	3.57
239175	02WLORG-6	1.83
240968	02BG2 GEN	1.11
240969	02BG4 G1	0.28
240973	02BG6 AMPO	4.32
240975	02PGE GEN	5.7
247548	V4-010 C	3.38
247567	V2-006 C	1.74
247940	U4-028 E	9.85
247941	U4-029 E	9.85
247947	V4-010 E	22.63
247961	V2-006 E	11.65
900041	V4-011	0.34
925751	AC1-051 C	0.7
925752	AC1-051 E	4.67
931951	AB1-107 1	43.58
931961	AB1-107 2	100.67
932051	AC2-015 C	4.85
932052	AC2-015 E	5.74
932791	AC2-103 C	11.36
932792	AC2-103 E	76.02
934251	AD1-052 C1	1.87
934261	AD1-052 C2	1.87
934461	AD1-070 C O1	4.26
934462	AD1-070 E O1	19.98
934761	AD1-103 C O1	19.1
934762	AD1-103 E O1	127.79
934891	AD1-118	11.39
937021	AD2-136 C O1	5.3
937022	AD2-136 E O1	35.46
937381	AD2-191 C	2.5
937382	AD2-191 E	16.74
938911	AE1-119	89.46
939161	AE1-146 C O1	8.94
939162	AE1-146 E O1	4.26

Bus #	Bus	MW Impact
940841	AE2-072 C	8.86
940842	AE2-072 E	5.91
941741	AE2-174 C	4.53
941742	AE2-174 E	21.22
941761	AE2-176 C	12.78
941762	AE2-176 E	8.52
941781	AE2-181 C	4.19
941782	AE2-181 E	2.79
942661	AE2-282 C O1	6.25
942662	AE2-282 E O1	3.29
950241	J419	8.28
953321	J799	15.58
953781	J833	8.28
CARR	CARR	1.08
CBM-S1	CBM-S1	7.8
CBM-S2	CBM-S2	1.34
CBM-W1	CBM-W1	37.97
CBM-W2	CBM-W2	72.04
CIN	CIN	8.97
CPLE	CPLE	0.27
G-007	G-007	2.64
IPL	IPL	5.74
LGEE	LGEE	2.13
MEC	MEC	18.1
MECS	MECS	41.13
O-066	O-066	17.07
RENSSELAER	RENSSELAER	0.86
WEC	WEC	2.98
Z1-043	Z1-043	11.45

17.8 Index 8

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
8667012	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	single	179.0	101.84	112.35	DC	18.82

Bus #	Bus	MW Impact
239064	02RICHG1	0.47
239065	02RICHG2&3	0.92
239067	02RICHG4	5.01
239068	02RICHG5	5.01
239069	02RICHG6	5.01
247567	V2-006 C	2.64
926811	AC1-167 C O1	2.01
926941	AC1-181	0.21
934901	AD1-119 C O1	1.01
940841	AE2-072 C	18.82
943181	AE2-322 C	2.41
CARR	CARR	0.12
CBM-S1	CBM-S1	0.99
CBM-S2	CBM-S2	0.17
CBM-W2	CBM-W2	9.29
CIN	CIN	1.25
CPLE	CPLE	0.04
IPL	IPL	0.83
LGEE	LGEE	0.28
MEC	MEC	2.2
RENSSELAER	RENSSELAER	0.09
WEC	WEC	0.35

17.9 Index 9

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
2156966	239728	02BLKRVR	ATSI	239734	02USSTEEL	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	659.0	101.41	101.95	DC	7.85

Bus #	Bus	MW Impact
238571	02BEAVGA	1.2
238572	02BEAVGB	1.22
238670	02DVBSG1	89.84
238979	02NAPMUN	2.71
239174	02WLORG-5	1.43
239175	02WLORG-6	1.85
240968	02BG2 GEN	0.57
240969	02BG4 G1	0.14
240973	02BG6 AMPO	2.25
240975	02PGE GEN	2.96
241908	02LLF_W4-004	0.4
247548	V4-010 C	2.07
247940	U4-028 E	6.02
247941	U4-029 E	6.02
247947	V4-010 E	13.88
900041	V4-011	0.19
925751	AC1-051 C	0.47
925752	AC1-051 E	3.12
931951	AB1-107 1	22.49
931961	AB1-107 2	49.34
932051	AC2-015 C	3.24
932052	AC2-015 E	3.84
932791	AC2-103 C	4.81
932792	AC2-103 E	32.21
934251	AD1-052 C1	1.16
934261	AD1-052 C2	1.16
934461	AD1-070 C O1	2.33
934462	AD1-070 E O1	10.94
934761	AD1-103 C O1	8.09
934762	AD1-103 E O1	54.14
934891	AD1-118	5.63
937021	AD2-136 C O1	3.24
937022	AD2-136 E O1	21.67
937381	AD2-191 C	1.53
937382	AD2-191 E	10.23
938911	AE1-119	44.28
939161	AE1-146 C O1	4.9
939162	AE1-146 E O1	2.33
940841	AE2-072 C	4.71
940842	AE2-072 E	3.14

Bus #	Bus	MW Impact
941741	AE2-174 C	2.78
941742	AE2-174 E	13.01
941761	AE2-176 C	8.91
941762	AE2-176 E	5.94
941781	AE2-181 C	2.14
941782	AE2-181 E	1.43
942661	AE2-282 C O1	3.19
942662	AE2-282 E O1	1.68
942813	AE2-299 BAT	4.33
CARR	CARR	0.77
CBM-S1	CBM-S1	5.02
CBM-S2	CBM-S2	1.13
CBM-W1	CBM-W1	20.54
CBM-W2	CBM-W2	44.21
CIN	CIN	5.39
CPLE	CPLE	0.3
G-007	G-007	1.57
IPL	IPL	3.46
LGEE	LGEE	1.34
MEC	MEC	10.64
MECS	MECS	20.91
O-066	O-066	10.16
RENSSELAER	RENSSELAER	0.6
WEC	WEC	1.72

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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
2156942	239734	02USSTEEL	ATSI	238915	02LRN Q2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	593.0	108.28	108.88	DC	7.85

Bus #	Bus	MW Impact
238571	02BEAVGA	1.2
238572	02BEAVGB	1.22
238670	02DVBSG1	89.84
238979	02NAPMUN	2.71
239174	02WLORG-5	1.43
239175	02WLORG-6	1.85
240968	02BG2 GEN	0.57
240969	02BG4 G1	0.14
240973	02BG6 AMPO	2.25
240975	02PGE GEN	2.96
241908	02LLF_W4-004	0.4
247548	V4-010 C	2.07
247940	U4-028 E	6.02
247941	U4-029 E	6.02
247947	V4-010 E	13.88
900041	V4-011	0.19
925751	AC1-051 C	0.47
925752	AC1-051 E	3.12
931951	AB1-107 1	22.49
931961	AB1-107 2	49.34
932051	AC2-015 C	3.24
932052	AC2-015 E	3.84
932791	AC2-103 C	4.81
932792	AC2-103 E	32.21
934251	AD1-052 C1	1.16
934261	AD1-052 C2	1.16
934461	AD1-070 C O1	2.33
934462	AD1-070 E O1	10.94
934761	AD1-103 C O1	8.09
934762	AD1-103 E O1	54.14
934891	AD1-118	5.63
937021	AD2-136 C O1	3.24
937022	AD2-136 E O1	21.67
937381	AD2-191 C	1.53
937382	AD2-191 E	10.23
938911	AE1-119	44.28
939161	AE1-146 C O1	4.9
939162	AE1-146 E O1	2.33
940841	AE2-072 C	4.71
940842	AE2-072 E	3.14

Bus #	Bus	MW Impact
941741	AE2-174 C	2.78
941742	AE2-174 E	13.01
941761	AE2-176 C	8.91
941762	AE2-176 E	5.94
941781	AE2-181 C	2.14
941782	AE2-181 E	1.43
942661	AE2-282 C O1	3.19
942662	AE2-282 E O1	1.68
942813	AE2-299 BAT	4.33
CARR	CARR	0.77
CBM-S1	CBM-S1	5.02
CBM-S2	CBM-S2	1.13
CBM-W1	CBM-W1	20.54
CBM-W2	CBM-W2	44.21
CIN	CIN	5.39
CPLE	CPLE	0.3
G-007	G-007	1.57
IPL	IPL	3.46
LGEE	LGEE	1.34
MEC	MEC	10.64
MECS	MECS	20.91
O-066	O-066	10.16
RENSSELAER	RENSSELAER	0.6
WEC	WEC	1.72

Affected Systems

18 Affected Systems

18.1 LG&E

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

18.2 MISO

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

18.3 TVA

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

18.4 Duke Energy Progress

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

18.5 NYISO

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

19 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P2-3-TE-138-006	CONTINGENCY 'ATSI-P2-3-TE-138-006' /* NAP MUNI 138 B1 BREAKER DISCONNECT BUS 238979 /* 02NAPMUN 138 DISCONNECT BUS 239061 /* 02RDGVL+ 138 DISCONNECT BUS 239060 /* 02RDGVL 138 END
ATSI-P2-3-TE-138-008	CONTINGENCY 'ATSI-P2-3-TE-138-008' /* NAP MUNI 138 B2 BREAKER DISCONNECT BUS 239061 /* 02RDGVL+ 138 DISCONNECT BUS 239060 /* 02RDGVL 138 END
ATSI-P2-3-TE-138-009	CONTINGENCY 'ATSI-P2-3-TE-138-009' /* STRYKER 13222 BREAKER DISCONNECT BUS 239127 /* 02STRYKE 138 REMOVE MACHINE 1 FROM BUS 239202 /* 02STRYCT 13 DISCONNECT BUS 239202 /* 02STRYCT 13 DISCONNECT BUS 239061 /* 02RDGVL+ 138 DISCONNECT BUS 239060 /* 02RDGVL 138 END
ATSI-P7-1-CEI-345-001-A	CONTINGENCY 'ATSI-P7-1-CEI-345-001-A' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END
Base Case	
ATSI-P1-2-TE-138-001	CONTINGENCY 'ATSI-P1-2-TE-138-001' /* 3-TERMINAL LINE MIDWAY-RICHLAND-WAUSEON 138 DISCONNECT BRANCH FROM BUS 238960 TO BUS 238521 CKT 1 /* 02MIDW K 138 02NAOMI 138 DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1 /* 02RICHLD 138 02NAOMI 138 DISCONNECT BRANCH FROM BUS 238521 TO BUS 239165 CKT 1 /* 02NAOMI 138 02WAUSEO 138 END
AEP_P4_#6817_05E.LPSC 138_B	CONTINGENCY 'AEP_P4_#6817_05E.LPSC 138_B' OPEN BRANCH FROM BUS 239269 TO BUS 940840 CKT 1 / 239269 02RICHLJ 138 940840 AE2-072 TAP 1 OPEN BRANCH FROM BUS 242993 TO BUS 245792 CKT 1 / 242993 05E.LPSC 138 245792 05E.LEIPSC 69.0 1 END
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Contingency Name	Contingency Definition
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END

Short Circuit

20 Short Circuit

The following Breakers are over-duty

None