Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-322

MARK CENTER 69 KV

40.3 MW Capacity / 60 MW Energy

October, 2019

Table of Contents

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.

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 # AE2-322, a Solar generating facility located in Defiance County, Ohio (See Figure 2). The installed facilities will have a total capability of 60 MW with 40.3 MW of this output being recognized by PJM as Capacity. The Primary Point of Interconnection will be a direct connection to Mark Center 69 kV substation (See Figure 1).

The Secondary Point of Interconnection will be behind previous PJM project # AC1-167 and will share the generator lead, main transformer and other facilities with AC1-167 in addition to the POI (See Figure 3). AC1-167 is a 49.9 MW (33.6 MW Capacity) solar generating facility connecting to Mark Center 69 kV.

The proposed in-service date for this project is December 1, 2021. This study does not imply AEP's commitment to this in-service date.

Queue Number	**AE2-322**
Project Name	MARK CENTER 69 KV
State	Ohio
County	Defiance
Transmission Owner	AEP
MFO	60
MWE	60
MWC	40.3
Fuel	Solar
Base case Study Year	2022

2.1 Point of Interconnection

AE2-322 will interconnect with the AEP transmission system at Mark Center 69 kV substation.

To accommodate the interconnection at the Mark Center 69 kV substation, the substation will have to be expanded requiring the installation of one (1) 69 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required. Additionally, review and update of adjacent substation's protection and control equipment may be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Note: The Interconnection Customer may be required to go offline for routine circuit breaker maintenance.

2.2 Cost Summary

The AE2-322 project will be responsible for the following costs:

Based upon the results of this Feasibility Study, the construction of the 60 MW (40.3 MW Capacity) solar generating facility of the Interconnection Customer (PJM Project #AE2-322) will require the following additional interconnection charges. This plan of service will interconnect the proposed 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	$200,000
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$800,000
Total Costs	$1,000,000

In addition, the AE2-322 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$70,362,400

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
69 kV Revenue Metering	$200,000
Total Attachment Facility Costs	$200,000

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
	$0
Total Direct Connection Facility Costs	$0

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
Expand the Mark Center 69 kV substation: Install one (1) additional 69 kV circuit breaker. Installation of associated protection and control equipment, 69 kV line risers and SCADA will also be required.	$800,000
Total Non-Direct Connection Facility Costs	$800,000

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 Transmission Owner Analysis

During modeled summer peak load conditions, N-1 Contingencies of the Mark Center 69 kV outlets, when the AC1-167 and AE2-322 facilities are operating at the combined MFO, heavily load the remaining outlets. The most severe contingency would be the outage of the circuit to S. Hicksville, which would load the exit to N. Cecil Switch to approximately its SE rating. These results apply to both Primary and Alternate POI.

Refer to Section 16 for additional information regarding the process to address potential congestion due to local energy deliverability.

10 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 Mark Center 69 kV substation 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.2 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

12 Network Impacts – Option 1

The Queue Project AE2-322 was evaluated as a 60 MW (Capacity 40.3 MW) injection at Mark Center 69kV substation in the AEP area. Project AE2-322 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-322 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

13 Generation Deliverability

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

None

14 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
7435048	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P4_#6533_05E LIMA 138_A	breaker	332.0	99.57	104.32	DC	15.79

15 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
8988112	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	single	194.0	100.11	101.35	DC	2.41
8987533	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-009	breaker	194.0	116.52	117.35	DC	3.56
8987534	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-008	breaker	194.0	114.95	115.79	DC	3.59
8987535	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-006	breaker	194.0	113.92	114.76	DC	3.59
8988003	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	single	179.0	112.35	113.7	DC	2.41
7435065	243051	05NDELPH	AEP	242991	05E SIDE	AEP	1	AEP_P4_#10140_05ALLEN 138_H	breaker	167.0	110.61	112.17	DC	5.76
7436407	243051	05NDELPH	AEP	242991	05E SIDE	AEP	1	AEP_P7-1_#11065	tower	167.0	110.61	112.17	DC	5.76
7436408	243051	05NDELPH	AEP	242991	05E SIDE	AEP	1	AEP_P7-1_#10895	tower	167.0	110.56	112.12	DC	5.77
7434322	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P2-2_#10084_05HAVILN 138_1	bus	332.0	108.83	113.22	DC	14.58
7435047	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P4_#10084_05HAVILN 138_I	breaker	332.0	108.83	113.22	DC	14.58
7436489	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P7-1_#6676	tower	332.0	101.11	105.94	DC	16.07

16 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
8988111	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	operation	194.0	117.42	118.26	DC	3.59
8988002	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	operation	179.0	131.12	132.02	DC	3.59
7435582	243017	05HAVILN	AEP	242989	05E LIMA	AEP	1	AEP_P1-2_#7501	operation	220.0	135.55	141.73	DC	13.59
7435583	243017	05HAVILN	AEP	242989	05E LIMA	AEP	1	Base Case	operation	167.0	107.36	111.65	DC	7.16
7436091	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P1-2_#5227	operation	332.0	99.48	104.21	DC	15.69

17 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
7434322,7436489,7435047,7435048	1	05TIMBSS 138.0 kV - 05TILLMA 138.0 kV Ckt 1	AEP AEPO0011a (208) : Upgrade "Sub Cond 1-1233.6 KCM ACSR/TW (38/19)" riser at Timber Switch Project Type : FAC Cost : $100,000 Time Estimate : 12-18 Months	$100,000
8987535,8987534,8987533	3	02RICHLD 138.0 kV - 02NAOMI 138.0 kV Ckt 1	ATSI TE-004A (408) : 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
8988003	4	02RICHLD 138.0 kV - 02RDGVL 138.0 kV Ckt 1	ATSI TE-003B (407) : 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
7436408,7435065,7436407	5	05NDELPH 138.0 kV - 05E SIDE 138.0 kV Ckt 1	AEP AEP_AE1_REF_r0028 (142) : A sag study will be required on the 15.6 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between $62,400 (no remediation required, just sag study) and $23.4 million (complete line reconductor/rebuild).New rating after sag study: S/N: 167 S/E: 245. Time Estimate: a) Sag Study: 12-18 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. Project Type : FAC Cost : $62,400 Time Estimate : 6-12 Months	$62,400
8988112	2	02RDGVL 138.0 kV - 02RDGVL+ 138.0 kV Ckt 1	ATSI TE-005A (409) : 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
			TOTAL COST	$70,362,400

18 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.

18.1 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
7435047	246950	05TIMBSS	AEP	243383	05TILLMA	AEP	1	AEP_P4_#10084_05HAVILN 138_I	breaker	332.0	108.83	113.22	DC	14.58

Bus #	Bus	MW Impact
246953	05TIMB G C	3.18
247607	V1-011 C	1.26
247911	05TIMB G E	105.07
247959	V1-011 E	69.15
926811	AC1-167 C O1	8.17
926812	AC1-167 E O1	3.96
926901	AC1-176 C	6.61
926902	AC1-176 E	44.45
934741	AD1-101 C O1	2.16
934742	AD1-101 E O1	3.53
934901	AD1-119 C O1	3.73
934902	AD1-119 E O1	6.09
940031	AE1-245 C	15.5
940032	AE1-245 E	103.72
942801	AE2-298 C O1	8.0
942802	AE2-298 E O1	5.34
943181	AE2-322 C	9.79
943182	AE2-322 E	4.79
BLUEG	BLUEG	0.46
CALDERWOOD	CALDERWOOD	0.03
CANNELTON	CANNELTON	0.03
CATAWBA	CATAWBA	0.01
CBM-N	CBM-N	0.02
CHEOAH	CHEOAH	0.03
CHILHOWEE	CHILHOWEE	0.01
COFFEEN	COFFEEN	0.07
COTTONWOOD	COTTONWOOD	0.19
DUCKCREEK	DUCKCREEK	0.17
EDWARDS	EDWARDS	0.08
ELMERSMITH	ELMERSMITH	0.05
FARMERCITY	FARMERCITY	0.05
G-007A	G-007A	0.04
GIBSON	GIBSON	0.03
HAMLET	HAMLET	0.02
MECS	MECS	0.19
NEWTON	NEWTON	0.18
NYISO	NYISO	0.07
PRAIRIE	PRAIRIE	0.32
SANTEETLA	SANTEETLA	0.01
SMITHLAND	SMITHLAND	0.02

Bus #	Bus	MW Impact
TATANKA	TATANKA	0.09
TILTON	TILTON	0.09
TRIMBLE	TRIMBLE	0.05
TVA	TVA	0.14
UNIONPOWER	UNIONPOWER	0.06
VFT	VFT	0.1

18.2 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
8988112	239060	02RDGVL	ATSI	239061	02RDGVL+	ATSI	1	ATSI-P1-2-TE-138-001	single	194.0	100.11	101.35	DC	2.41

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

18.3 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
8987533	239070	02RICHLD	ATSI	238521	02NAOMI	ATSI	1	ATSI-P2-3-TE-138-009	breaker	194.0	116.52	117.35	DC	3.56

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

18.4 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
8988003	239070	02RICHLD	ATSI	239060	02RDGVL	ATSI	1	ATSI-P1-2-TE-138-001	single	179.0	112.35	113.7	DC	2.41

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

18.5 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
7436408	243051	05NDELPH	AEP	242991	05E SIDE	AEP	1	AEP_P7-1_#10895	tower	167.0	110.56	112.12	DC	5.77

Bus #	Bus	MW Impact
247521	T-131 C	2.68
247911	05TIMB G E	11.0
247925	T-131 E	88.09
247959	V1-011 E	7.92
926811	AC1-167 C O1	3.23
926812	AC1-167 E O1	1.57
926861	AC1-173 C	7.27
926862	AC1-173 E	48.45
926901	AC1-176 C	0.69
926902	AC1-176 E	4.65
934741	AD1-101 C O1	4.14
934742	AD1-101 E O1	6.76
934901	AD1-119 C O1	2.04
934902	AD1-119 E O1	3.32
940031	AE1-245 C	1.78
940032	AE1-245 E	11.88
942801	AE2-298 C O1	4.61
942802	AE2-298 E O1	3.07
943181	AE2-322 C	3.87
943182	AE2-322 E	1.89
BLUEG	BLUEG	0.09
CALDERWOOD	CALDERWOOD	0.01
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-W1	CBM-W1	0.5
CBM-W2	CBM-W2	0.47
CHEOAH	CHEOAH	0.01
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	0.07
G-007	G-007	0.04
HAMLET	HAMLET	0.02
IPL	IPL	0.04
MEC	MEC	0.26
MECS	MECS	0.45
O-066	O-066	0.25
RENSSELAER	RENSSELAER	0.01
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.01
TVA	TVA	0.01
WEC	WEC	0.05

Affected Systems

19 Affected Systems

19.1 LG&E

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

19.2 MISO

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

19.3 TVA

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

19.4 Duke Energy Progress

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

19.5 NYISO

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

20 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P2-2_#10084_05HAVILN 138_1	CONTINGENCY 'AEP_P2-2_#10084_05HAVILN 138_1' OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1 OPEN BRANCH FROM BUS 243017 TO BUS 243168 CKT 1 / 243017 05HAVILN 138 243168 05HAVILND1 69.0 1 END
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
AEP_P7-1_#6676	CONTINGENCY 'AEP_P7-1_#6676' /(MODIFIED) OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1 OPEN BRANCH FROM BUS 242991 TO BUS 243051 CKT 1 / 242991 05E SIDE 138 243051 05NDELPH 138 1 OPEN BRANCH FROM BUS 242991 TO BUS 243108 CKT 1 / 242991 05E SIDE 138 243108 05STRLN1 138 1 END
AEP_P1-2_#7501	CONTINGENCY 'AEP_P1-2_#7501' OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 247877 CKT 1 / 246264 05ST R14 8 34.5 247877 05ST.RD14 SS34.5 1 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

Contingency Name	Contingency Definition
AEP_P4_#10140_05ALLEN 138_H	CONTINGENCY 'AEP_P4_#10140_05ALLEN 138_H' OPEN BRANCH FROM BUS 243242 TO BUS 247864 CKT 1 / 243242 05ALLEN 138 247864 05LOGTOWN 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 247877 CKT 1 / 246264 05ST R14 8 34.5 247877 05ST.RD14 SS34.5 1 END
AEP_P7-1_#10895	CONTINGENCY 'AEP_P7-1_#10895' OPEN BRANCH FROM BUS 243242 TO BUS 243877 CKT 1 / 243242 05ALLEN 138 243877 05DAWKNS 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 243330 CKT 1 / 243242 05ALLEN 138 243330 05LINCOL 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 247864 CKT 1 / 243242 05ALLEN 138 247864 05LOGTOWN 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243877 TO BUS 243342 CKT 1 / 243877 05DAWKNS 138 243342 05MILAN 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 END
AEP_P1-2_#5227	CONTINGENCY 'AEP_P1-2_#5227' OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1 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_#10084_05HAVILN 138_I	CONTINGENCY 'AEP_P4_#10084_05HAVILN 138_I' OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1 OPEN BRANCH FROM BUS 243017 TO BUS 243168 CKT 1 / 243017 05HAVILN 138 243168 05HAVILND1 69.0 1 END

Contingency Name	Contingency Definition
AEP_P4_#6533_05E LIMA 138_A	CONTINGENCY 'AEP_P4_#6533_05E LIMA 138_A' OPEN BRANCH FROM BUS 245771 TO BUS 243059 CKT 1 / 245771 05NFIND EQ 999 243059 05NFINDL 138 1 OPEN BRANCH FROM BUS 245775 TO BUS 243067 CKT 1 / 245775 05NWOODCEQ 999 243067 05NWOODC 138 1 OPEN BRANCH FROM BUS 245771 TO BUS 245764 CKT Z1 / 245771 05NFIND EQ 999 245764 05N FINDLA 69.0 Z1 OPEN BRANCH FROM BUS 245775 TO BUS 245766 CKT 1 / 245775 05NWOODCEQ 999 245766 05N WOODCK 69.0 1 OPEN BRANCH FROM BUS 245771 TO BUS 245772 CKT 1 / 245771 05NFIND EQ 999 245772 05NFINDLY1 34.5 1 OPEN BRANCH FROM BUS 245775 TO BUS 245765 CKT 1 / 245775 05NWOODCEQ 999 245765 05N WOODCK 34.5 1 OPEN BRANCH FROM BUS 242989 TO BUS 243017 CKT 1 / 242989 05E LIMA 138 243017 05HAVILN 138 1 OPEN BRANCH FROM BUS 242989 TO BUS 243067 CKT 1 / 242989 05E LIMA 138 243067 05NWOODC 138 1 OPEN BRANCH FROM BUS 243059 TO BUS 243067 CKT 1 / 243059 05NFINDL 138 243067 05NWOODC 138 1 OPEN BRANCH FROM BUS 245763 TO BUS 245766 CKT 1 / 245763 05N BLUFFT 69.0 245766 05N WOODCK 69.0 1 OPEN BRANCH FROM BUS 245738 TO BUS 245772 CKT 1 / 245738 05DOWCHEM2 34.5 245772 05NFINDLY1 34.5 1 OPEN BRANCH FROM BUS 245788 TO BUS 245765 CKT 1 / 245788 05DTR 34.5 245765 05N WOODCK 34.5 1 OPEN BRANCH FROM BUS 245726 TO BUS 245772 CKT 1 / 245726 05GRIFTHSS 34.5 245772 05NFINDLY1 34.5 1 REMOVE SWSHUNT FROM BUS 245772 / 245772 05NFINDLY1 34.5 END
AEP_P7-1_#11065	CONTINGENCY 'AEP_P7-1_#11065' OPEN BRANCH FROM BUS 243242 TO BUS 247864 CKT 1 / 243242 05ALLEN 138 247864 05LOGTOWN 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 END

Short Circuit

21 Short Circuit

The following Breakers are over-duty

None

22 Secondary Point of Interconnection

AE2-322 will interconnect with the AEP transmission system at Mark Center 69 kV substation behind previous PJM project # AC1-167 and will share the generator lead, main transformer and other facilities with AC1-167 in addition to the POI (See Figure 3).

Note: It is assumed that the 69 kV revenue metering system, gen lead and Protection & Control Equipment that will be installed for #AC1-167 will be adequate for the additional generation requested in AE2-322. Depending on the timing of the completion of the AC1-167 interconnection construction relative to the AE2-322 completion, there may (or may not) be a need to separately review and revise relay settings for the increased generation of AE2-322.

23 Network Impacts – Option 2

The Queue Project AE2-322 was evaluated as a 60.0 MW (Capacity 40.3 MW) injection at Mark Center 69 kV in the AEP area. Project AE2-322 was evaluated for compliance with applicable reliability planning criteria

(PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-322 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

The analysis results for the Primary and Secondary POI are the same.