Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-219

BLUFF POINT-RANDOLPH 138 KV

42 MW Capacity / 100 MW Energy

December, 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 (IC), has proposed a Solar generating facility located in Randolph County, Indiana. The installed facilities will have a total capability of 100 MW with 42 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 10.31.2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AE2-219
Project Name	BLUFF POINT-RANDOLPH 138 KV
State	Indiana
County	Randolph
Transmission Owner	AEP
MFO	100
MWE	100
MWC	42
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-219 will interconnect with the AEP transmission system tap of the Bluff Point to Randolph 138 kV line.

To accommodate the interconnection on the Delaware to Van Buren 138kV Circuit, a new three (3) circuit breaker 138kV 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

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 250,000
Direct Connection Network Upgrade	$ 7,000,000
Non Direct Connection Network Upgrades	$ 500,000
Total Costs	$ 7,750,000

In addition, this project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$46,338,745 + TBD – See Pg. 15-17

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
138kV 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 (See Figure 1). Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required.	$6,000,000
138kV Transmission Line Cut In	$ 1,000,000
Total Direct Connection Facility Costs	$7,000,000

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 protections & Controls at the 138kV Remote end Substation #1	$ 250,000
Upgrade line protections & Controls at the 138kV Remote end Substation #2	$ 250,000
Total Non-Direct Connection Facility Costs	$500,000

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 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 AEP Transmission circuit 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 AE2-219 was evaluated as a 100.0 MW (Capacity 42.0 MW) injection tapping the Bluff Point to Randolph 138 kV line in the AEP area. Project AE2-219 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-219 was studied with a commercial probability of 0.53. 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)

None

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
7205794	243310	05HODGIN	AEP	243262	05COLLCO	AEP	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	284.0	99.34	120.73	DC	60.75
7205995	243362	05RANDOL	AEP	940990	AE2-090 TAP	AEP	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	284.0	78.61	105.6	DC	76.66
8848987	250001	08COLINV	DEO&K	250144	08HUSTRC	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	178.0	97.27	108.79	DC	20.52
8848994	250144	08HUSTRC	DEO&K	250116	08TRENTO	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	178.0	96.2	107.73	DC	20.52
7205705	942070	AE2-219 TAP	AEP	243253	05BLUFFP	AEP	1	AEP_P4_#6924_05COLLCO 138_C	breaker	284.0	95.48	125.61	DC	85.57

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
7205645	243253	05BLUFFP	AEP	243319	05JAY	AEP	1	AEP_P4_#6924_05COLLCO 138_C	breaker	284.0	104.66	130.71	DC	73.97
7205460	243262	05COLLCO	AEP	250001	08COLINV	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	167.0	138.7	150.99	DC	20.52
7207286	940980	AE2-089 TAP	AEP	243237	05ADAM	AEP	1	AEP_P7-1_#11019	tower	205.0	106.04	108.2	DC	9.82
7205501	940990	AE2-090 TAP	AEP	243310	05HODGIN	AEP	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	284.0	119.41	146.4	DC	76.66

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
7206922	243218	05DESOTO	AEP	243232	05SORENS	AEP	2	AEP_P1-2_#4817	operation	971.0	97.45	98.67	DC	12.01
7206516	243253	05BLUFFP	AEP	243319	05JAY	AEP	1	Base Case	operation	205.0	104.81	130.78	DC	53.23
7206517	243253	05BLUFFP	AEP	243319	05JAY	AEP	1	AEP_P1-2_#10142-A	operation	284.0	104.14	130.17	DC	73.94
7206444	243262	05COLLCO	AEP	250001	08COLINV	DEO&K	1	AEP_P1-2_#6372A	operation	167.0	131.76	138.06	DC	10.51
7206445	243262	05COLLCO	AEP	250001	08COLINV	DEO&K	1	.138.DEO&K-AEP-DAY.B2 TODHUNTER JCT 138	operation	167.0	131.76	138.06	DC	10.51
7206449	243262	05COLLCO	AEP	250001	08COLINV	DEO&K	1	Base Case	operation	167.0	100.1	102.52	DC	8.96
7206883	940980	AE2-089 TAP	AEP	243237	05ADAM	AEP	1	AEP_P1-2_#5598	operation	205.0	96.41	106.76	DC	21.22
7206763	940990	AE2-090 TAP	AEP	243310	05HODGIN	AEP	1	AEP_P1-2_#10526-A	operation	284.0	87.1	114.09	DC	76.67
7206542	942070	AE2-219 TAP	AEP	243253	05BLUFFP	AEP	1	Base Case	operation	205.0	98.91	128.97	DC	61.61
7206543	942070	AE2-219 TAP	AEP	243253	05BLUFFP	AEP	1	AEP_P1-2_#10142-A	operation	284.0	94.75	124.86	DC	85.53

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
7205705	5	AE2-219 TAP 138.0 kV - 05BLUFFP 138.0 kV Ckt 1	**AEP** **b3103.1 : PJM Baseline Upgrade b3103.1. Install a 138/69 kV transformer at Royerton station. Install a 69 kV bus with one 69 kV breaker toward Bosman station. Rebuild the 138 kV portion into a ring bus configuration built for future breaker and a half with four 138 kV breakers.** **b3103.2 : PJM Baseline Upgrade b3103.2. Rebuild the Bosman/Strawboard station in the clear across the road to move it out of the flood plain and bring it up to 69kV standards.** **b3103.3 : PJM Baseline Upgrade b3103.3. Retire 138 kV breaker L at Delaware station and re-purpose 138 kV breaker M for the Jay line.** **b3103.4 : PJM Baseline Upgrade b3103.4. Retire all 34.5 kV equipment at Hartford City station. Re-purpose breaker M for the Bosman line 69 kV exit.** **b3103.5 : PJM Baseline Upgrade b3103.5. Rebuild the 138 kV portion of Jay station as a 6 breaker, breaker and a half station re-using the existing breakers "A", "B" and "G". Rebuild the 69 kV portion of this station as a 6 breaker ring bus re-using the 2 existing 69 kV breakers. Install a new 138/69kV transformer.** **b3103.6 : PJM Baseline Upgrade b3103.6. Rebuild the 69 kV Hartford City – Armstrong Cork line but instead of terminating it into Armstrong Cork, terminate it into Jay station.** **b3103.7 : PJM Baseline Upgrade b3103.7. Build a new 69 kV line from Armstrong Cork – Jay station.** **b3103.8 : PJM Baseline Upgrade b3103.8. Rebuild the 34.5 kV Delaware – Bosman line as the 69 kV Royerton – Strawboard line. Retire the line section from Royerton to Delaware stations.** **B3103 Raises limit to 284 MVA. The baseline projects have a projected in-service date of 06/01/2022.** **Project Type : CON** **Cost : $0** **Time Estimate : N/A** **AEP** **(sXXXX): Jay - College Corner Rebuild raises limit to 359 MVA (waiting for a Supplemental ID# for this project). Note: This queue project may have a cost responsibility for upgrading the overloaded element if the supplemental project is not approved. Further information will be provided during the Impact Study Phase.** **Project Type : FAC** **Cost : TBD** **Time Estimate : TBD** **An AEP supplemental project may rebuild a portion or all of this line. PJM is in the process of assigning this project a Supplemental ID number. Determination of allocation of cost for the scope of SXXXX to AE2-219 (if any) or other queue positions will occur during the System Impact Study.**	**TBD**

ID	Index	Facility	Upgrade Description	Cost
8848987	3	08COLINV 138.0 kV - 08HUSTRC 138.0 kV Ckt 1	**DEOK** **r3281b (499) : Rebuild the line** **Project Type : FAC** **Cost : $5,631,405** **Time Estimate : 22.0 Months**	$5,631,405
7205645	6	05BLUFFP 138.0 kV - 05JAY 138.0 kV Ckt 1	**AEP** **(sXXXX): Jay - College Corner Rebuild raises limit to 359 MVA (waiting for a Supplemental ID# for this project). Note: This queue project may have a cost responsibility for upgrading the overloaded element if the supplemental project is not approved. Further information will be provided during the Impact Study Phase.** **Project Type : FAC** **Cost : TBD** **Time Estimate : TBD** **An AEP supplemental project may rebuild a portion or all of this line. PJM is in the process of assigning this project a Supplemental ID number. Determination of allocation of cost for the scope of SXXXX to AE2-219 (if any) or other queue positions will occur during the System Impact Study.**	**TBD**
7205794	1	05HODGIN 138.0 kV - 05COLLCO 138.0 kV Ckt 1		
7207286	8	AE2-089 TAP 138.0 kV - 05ADAM 138.0 kV Ckt 1	**AEP** **b3119 (99) : PJM Baseline Upgrade b3119. Rebuild the 138kV Jay Pennville line as double circuit 138/69kV. Build a new 9.8 mile single circuit 69 kV line from near Pennville station to North Portland station. The baseline project has an projected in-service date of 06/17/2019.** **Additionally, the Jay- Allen project (PJM has not asigned S number yet) will be required to mitigate the identified overloads.** **Project Type : FAC** **Cost : $0** **Time Estimate : N/A Months**	$0
7205501	9	AE2-090 TAP 138.0 kV - 05HODGIN 138.0 kV Ckt 1	**AEP** **AEPI0007a : Replace Hodgin Sub Cond 795 AAC 37 Str** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12-18 Months** **AEPI0007b : Adding 138kV breaker at bluff point will mitigate the overload. This upgrade will be tested during System Impact studies. If not adequate additional mitigations may be required.** **Project Type : FAC** **Cost : $1,000,000** **Time Estimate : 12-18 Months**	$1,100,000

ID	Index	Facility	Upgrade Description	Cost
7205995	2	05RANDOL 138.0 kV - AE2-090 TAP 138.0 kV Ckt 1	**AEP** **sXXXX : Jay - College Corner rebuild raises limit to 359 MVA (waiting for a Supplemental ID# for this project) Note: This queue project may have a cost responsibility for upgrading the overloaded element if the supplemental project is not approved. Further information will be provided during the Impact Study Phase.** **Project Type : FAC** **Cost : TBD** **Time Estimate : TBD** **An AEP supplemental project may rebuild a portion or all of this line. PJM is in the process of assigning this project a Supplemental ID number. Determination of allocation of cost for the scope of SXXXX to AE2-219 (if any) or other queue positions will occur during the System Impact Study.**	**TBD**
7205460	7	05COLLCO 138.0 kV - 08COLINV 138.0 kV Ckt 1	**AEP** **AEPI0005b (262) : Reconductor/Rebuild the 0.15 mile section of ACSR~397.5~30/7~ LARK** **Project Type : FAC** **Cost : $225,000** **Time Estimate : 24-36 Months** **DEOK** **r3281 (495) : Rebuild the line** **Project Type : FAC** **Cost : $24,163,861** **Time Estimate : 36.0 Months**	$24,388,861
8848994	4	08HUSTRC 138.0 kV - 08TRENTO 138.0 kV Ckt 1	**DEOK** **r3281c (500) : Rebuild the line and Substation Bus Conductor at Trenton** **Project Type : FAC** **Cost : $16,318,479** **Time Estimate : 27.0 Months**	$16,318,479
			TOTAL COST	**$46,338,745 + TBD**

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
7205794	243310	05HODGIN	AEP	243262	05COLLCO	AEP	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	284.0	99.34	120.73	DC	60.75

Bus #	Bus	MW Impact
243415	05WWVSTA	2.71
247288	05RICHG1	0.68
247289	05RICHG2	0.68
247536	S-071 C	1.78
247929	S-071 E	58.32
936681	AD2-087 C O1	21.38
936682	AD2-087 E O1	100.11
940991	AE2-090 C	55.08
940992	AE2-090 E	36.72
942071	AE2-219 C	25.51
942072	AE2-219 E	35.23
CARR	CARR	0.02
CATAWBA	CATAWBA	0.01
CBM-S1	CBM-S1	0.11
CBM-W1	CBM-W1	0.56
CBM-W2	CBM-W2	2.38
CIN	CIN	0.52
G-007	G-007	0.05
HAMLET	HAMLET	0.01
IPL	IPL	0.39
LGEE	LGEE	0.02
MEC	MEC	0.52
MECS	MECS	0.22
O-066	O-066	0.31
RENSSELAER	RENSSELAER	0.01
WEC	WEC	0.08

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
7205995	243362	05RANDOL	AEP	940990	AE2-090 TAP	AEP	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	284.0	78.61	105.6	DC	76.66

Bus #	Bus	MW Impact
247536	S-071 C	2.24
247929	S-071 E	73.59
936681	AD2-087 C O1	26.98
936682	AD2-087 E O1	126.33
942071	AE2-219 C	32.2
942072	AE2-219 E	44.46
BLUEG	BLUEG	0.18
CALDERWOOD	CALDERWOOD	0.01
CANNELTON	CANNELTON	0.0
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-W1	CBM-W1	0.28
CBM-W2	CBM-W2	0.52
CHEOAH	CHEOAH	0.01
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	0.11
ELMERSMITH	ELMERSMITH	0.0
G-007	G-007	0.02
HAMLET	HAMLET	0.01
IPL	IPL	0.08
MEC	MEC	0.21
MECS	MECS	0.16
O-066	O-066	0.11
RENSSELAER	RENSSELAER	0.0
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.02
TVA	TVA	0.0
WEC	WEC	0.04

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
8848987	250001	08COLINV	DEO&K	250144	08HUSTRC	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	178.0	97.27	108.79	DC	20.52

Bus #	Bus	MW Impact
243415	05WWVSTA	2.13
247288	05RICHG1	0.7
247289	05RICHG2	0.7
247536	S-071 C	0.6
247929	S-071 E	19.7
932841	AC2-111 C O1	7.51
932842	AC2-111 E O1	12.26
934961	AD1-128 C O1	6.2
934962	AD1-128 E O1	10.12
936681	AD2-087 C O1	7.22
936682	AD2-087 E O1	33.81
938061	AE1-008 C	1.88
938062	AE1-008 E	3.07
939781	AE1-209 C O1	1.41
939782	AE1-209 E O1	9.47
940991	AE2-090 C	18.14
940992	AE2-090 E	12.1
942071	AE2-219 C	8.62
942072	AE2-219 E	11.9
BLUEG	BLUEG	0.11
CALDERWOOD	CALDERWOOD	0.0
CARR	CARR	0.03
CATAWBA	CATAWBA	0.02
CBM-S1	CBM-S1	0.17
CBM-W1	CBM-W1	1.99
CBM-W2	CBM-W2	6.44
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	1.28
G-007	G-007	0.07
HAMLET	HAMLET	0.03
IPL	IPL	1.07
MEC	MEC	1.64
MECS	MECS	1.02
O-066	O-066	0.48
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.03
WEC	WEC	0.28

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
8848994	250144	08HUSTRC	DEO&K	250116	08TRENTO	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	178.0	96.2	107.73	DC	20.52

Bus #	Bus	MW Impact
243415	05WWVSTA	2.13
247288	05RICHG1	0.7
247289	05RICHG2	0.7
247536	S-071 C	0.6
247929	S-071 E	19.7
932841	AC2-111 C O1	7.51
932842	AC2-111 E O1	12.26
934961	AD1-128 C O1	6.2
934962	AD1-128 E O1	10.12
936681	AD2-087 C O1	7.22
936682	AD2-087 E O1	33.81
938061	AE1-008 C	1.88
938062	AE1-008 E	3.07
939781	AE1-209 C O1	1.41
939782	AE1-209 E O1	9.47
940991	AE2-090 C	18.14
940992	AE2-090 E	12.1
942071	AE2-219 C	8.62
942072	AE2-219 E	11.9
BLUEG	BLUEG	0.11
CALDERWOOD	CALDERWOOD	0.0
CARR	CARR	0.03
CATAWBA	CATAWBA	0.02
CBM-S1	CBM-S1	0.17
CBM-W1	CBM-W1	1.99
CBM-W2	CBM-W2	6.44
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	1.28
G-007	G-007	0.07
HAMLET	HAMLET	0.03
IPL	IPL	1.07
MEC	MEC	1.64
MECS	MECS	1.02
O-066	O-066	0.48
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.03
WEC	WEC	0.28

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
7205705	942070	AE2-219 TAP	AEP	243253	05BLUFFP	AEP	1	AEP_P4_#6924_05COLLCO 138_C	breaker	284.0	95.48	125.61	DC	85.57

Bus #	Bus	MW Impact
936681	AD2-087 C O1	29.06
936682	AD2-087 E O1	136.04
940991	AE2-090 C	71.32
940992	AE2-090 E	47.55
942071	AE2-219 C	35.94
942072	AE2-219 E	49.63
CARR	CARR	0.0
CBM-S1	CBM-S1	0.12
CBM-S2	CBM-S2	0.03
CBM-W2	CBM-W2	0.59
CIN	CIN	0.13
CPLE	CPLE	0.01
DUCKCREEK	DUCKCREEK	0.02
EDWARDS	EDWARDS	0.01
FARMERCITY	FARMERCITY	0.0
G-007	G-007	0.0
IPL	IPL	0.11
LGEE	LGEE	0.06
O-066	O-066	0.01
RENSSELAER	RENSSELAER	0.0
TATANKA	TATANKA	0.01

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
7205645	243253	05BLUFFP	AEP	243319	05JAY	AEP	1	AEP_P4_#6924_05COLLCO 138_C	breaker	284.0	104.66	130.71	DC	73.97

Bus #	Bus	MW Impact
247536	S-071 C	2.27
247621	Y3-024	0.2
247929	S-071 E	74.6
936681	AD2-087 C O1	25.12
936682	AD2-087 E O1	117.6
940991	AE2-090 C	61.65
940992	AE2-090 E	41.1
942071	AE2-219 C	31.07
942072	AE2-219 E	42.9
CALDERWOOD	CALDERWOOD	0.0
CARR	CARR	0.01
CATAWBA	CATAWBA	0.0
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
COFFEEN	COFFEEN	0.0
COTTONWOOD	COTTONWOOD	0.01
DUCKCREEK	DUCKCREEK	0.01
EDWARDS	EDWARDS	0.01
FARMERCITY	FARMERCITY	0.0
G-007	G-007	0.02
GIBSON	GIBSON	0.0
HAMLET	HAMLET	0.01
LGEE	LGEE	0.01
NEWTON	NEWTON	0.01
O-066	O-066	0.11
PRAIRIE	PRAIRIE	0.02
RENSSELAER	RENSSELAER	0.0
SANTEETLA	SANTEETLA	0.0
SMITHLAND	SMITHLAND	0.0
TATANKA	TATANKA	0.01
TILTON	TILTON	0.01
TVA	TVA	0.01
UNIONPOWER	UNIONPOWER	0.0

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
7205460	243262	05COLLCO	AEP	250001	08COLINV	DEO&K	1	AEP_P4_#10527_05BLUFFP 138_E2	breaker	167.0	138.7	150.99	DC	20.52

Bus #	Bus	MW Impact
243415	05WWVSTA	2.13
247288	05RICHG1	0.7
247289	05RICHG2	0.7
247536	S-071 C	0.6
247929	S-071 E	19.7
932841	AC2-111 C O1	7.51
932842	AC2-111 E O1	12.26
934961	AD1-128 C O1	6.2
934962	AD1-128 E O1	10.12
936681	AD2-087 C O1	7.22
936682	AD2-087 E O1	33.81
938061	AE1-008 C	1.88
938062	AE1-008 E	3.07
939781	AE1-209 C O1	1.41
939782	AE1-209 E O1	9.47
940991	AE2-090 C	18.14
940992	AE2-090 E	12.1
942071	AE2-219 C	8.62
942072	AE2-219 E	11.9
BLUEG	BLUEG	0.11
CALDERWOOD	CALDERWOOD	0.0
CARR	CARR	0.03
CATAWBA	CATAWBA	0.02
CBM-S1	CBM-S1	0.17
CBM-W1	CBM-W1	1.99
CBM-W2	CBM-W2	6.44
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	1.28
G-007	G-007	0.07
HAMLET	HAMLET	0.03
IPL	IPL	1.07
MEC	MEC	1.64
MECS	MECS	1.02
O-066	O-066	0.48
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.03
WEC	WEC	0.28

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
7207286	940980	AE2-089 TAP	AEP	243237	05ADAM	AEP	1	AEP_P7-1_#11019	tower	205.0	106.04	108.2	DC	9.82

Bus #	Bus	MW Impact
247536	S-071 C	0.33
247929	S-071 E	10.76
933591	AC2-176 C O1	2.64
933592	AC2-176 E O1	17.7
936681	AD2-087 C O1	3.11
936682	AD2-087 E O1	14.58
940981	AE2-089 C O1	37.91
940982	AE2-089 E O1	25.27
940991	AE2-090 C	6.73
940992	AE2-090 E	4.49
942071	AE2-219 C	4.12
942072	AE2-219 E	5.7
CARR	CARR	0.01
CBM-S1	CBM-S1	1.3
CBM-S2	CBM-S2	0.31
CBM-W2	CBM-W2	8.49
CIN	CIN	2.11
CPLE	CPLE	0.1
DUCKCREEK	DUCKCREEK	0.2
EDWARDS	EDWARDS	0.12
FARMERCITY	FARMERCITY	0.0
G-007	G-007	0.01
IPL	IPL	1.88
LGEE	LGEE	0.55
O-066	O-066	0.05
RENSSELAER	RENSSELAER	0.01
TATANKA	TATANKA	0.08

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
7205501	940990	AE2-090 TAP	AEP	243310	05HODGIN	AEP	1	AEP_P4_#10527_05BLUFF P 138_E2	breaker	284.0	119.41	146.4	DC	76.66

Bus #	Bus	MW Impact
247536	S-071 C	2.24
247929	S-071 E	73.59
936681	AD2-087 C O1	26.98
936682	AD2-087 E O1	126.33
940991	AE2-090 C	69.59
940992	AE2-090 E	46.39
942071	AE2-219 C	32.2
942072	AE2-219 E	44.46
BLUEG	BLUEG	0.18
CALDERWOOD	CALDERWOOD	0.01
CANNELTON	CANNELTON	0.0
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-W1	CBM-W1	0.28
CBM-W2	CBM-W2	0.52
CHEOAH	CHEOAH	0.01
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	0.11
ELMERSMITH	ELMERSMITH	0.0
G-007	G-007	0.02
HAMLET	HAMLET	0.01
IPL	IPL	0.08
MEC	MEC	0.21
MECS	MECS	0.16
O-066	O-066	0.11
RENSSELAER	RENSSELAER	0.0
SANTEETLA	SANTEETLA	0.0
TRIMBLE	TRIMBLE	0.02
TVA	TVA	0.0
WEC	WEC	0.04

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
AEP_P1-2_#6372A	CONTINGENCY 'AEP_P1-2_#6372A' OPEN BRANCH FROM BUS 243262 TO BUS 250106 CKT 1 / 243262 05COLLCO 138 250106 08TODHJT 138 1 END
AEP_P4_#10527_05BLUFFP 138_E2	CONTINGENCY 'AEP_P4_#10527_05BLUFFP 138_E2' OPEN BRANCH FROM BUS 243253 TO BUS 243319 CKT 1 / 243253 05BLUFFP 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 243253 TO BUS 246014 CKT 1 / 243253 05BLUFFP 138 246014 05BLUFFPNT 69.0 1 END
AEP_P1-2_#10526-A	CONTINGENCY 'AEP_P1-2_#10526-A' OPEN BRANCH FROM BUS 243253 TO BUS 942070 CKT 1 / 243253 05BLUFFP 138 942070 AE2-219 TAP 138 1 END
AEP_P4_#6924_05COLLCO 138_C	CONTINGENCY 'AEP_P4_#6924_05COLLCO 138_C' OPEN BRANCH FROM BUS 243262 TO BUS 243310 CKT 1 / 243262 05COLLCO 138 243310 05HODGIN 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 250106 CKT 1 / 243262 05COLLCO 138 250106 08TODHJT 138 1 OPEN BRANCH FROM BUS 243310 TO BUS 940990 CKT 1 / 243310 05HODGIN 138 940990 AE2-090 TAP 138 1 /* CONTINGENCY LINE ADDED FOR AE2 BUILD OPEN BRANCH FROM BUS 243310 TO BUS 243400 CKT 1 / 243310 05HODGIN 138 243400 05HODGIN 69.0 1 END
AEP_P1-2_#4817	CONTINGENCY 'AEP_P1-2_#4817' OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END
AEP_P1-2_#10142-A	CONTINGENCY 'AEP_P1-2_#10142-A' OPEN BRANCH FROM BUS 243262 TO BUS 243310 CKT 1 / 243262 05COLLCO 138 243310 05HODGIN 138 1 OPEN BRANCH FROM BUS 243310 TO BUS 940990 CKT 1 / 243310 05HODGIN 138 940990 AE2-090 TAP 138 1 OPEN BRANCH FROM BUS 243310 TO BUS 243400 CKT 1 / 243310 05HODGIN 138 243400 05HODGIN 69.0 1 END
AEP_P1-2_#5598	CONTINGENCY 'AEP_P1-2_#5598' OPEN BRANCH FROM BUS 243278 TO BUS 243319 CKT 1 / 243278 05DESOTO 138 243319 05JAY 138 1 END
.138.DEO&K-AEP-DAY.B2 TODHUNTER JCT 138	CONTINGENCY '.138.DEO&K-AEP-DAY.B2 TODHUNTER JCT 138' OPEN BUS 250106 END

Contingency Name	Contingency Definition
Base Case	
AEP_P7-1_#11019	CONTINGENCY 'AEP_P7-1_#11019' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END

Short Circuit

20 Short Circuit

The following Breakers are overduty

None.