Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-202

KEYSTONE-DESOTO 345 KV

34 MW Capacity / 200 MW Energy

January, 2020

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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 Wind generating facility located in Blackford County, IN. The installed facilities will have a total capability of 200 MW with 34 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 12/31/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-202**
Project Name	KEYSTONE-DESOTO 345 KV
State	Indiana
County	Blackford
Transmission Owner	AEP
MFO	200
MWE	200
MWC	34
Fuel	Wind
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-202 will interconnect with the AEP transmission system tapping the Keystone to Desoto 345 kV line.

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

2.2 Cost Summary

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$350,000
Direct Connection Network Upgrade	$8,000,000
Non Direct Connection Network Upgrades	$1,900,000
Total Costs	$10,250,000

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

Description	Total Cost
System Upgrades	$125,000

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
345 kV Revenue Metering	$350,000
Total Attachment Facility Costs	$350,000

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 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus (See Figure 1). Installation of associated protection and control equipment, 345 kV line risers and SCADA will also be required.	$8,000,000
Total Direct Connection Facility Costs	$8,000,000

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 345kV remote end Substation #1	$350,000
Upgrade line protections & Controls at the 345kV remote end Substation #2	$350,000
345 kV Transmission Line Cut In	$1,200,000
Total Non-Direct Connection Facility Costs	$1,900,000

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 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 AEP's 345kV Facilities 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 AF1-202 was evaluated as a 200.0 MW (Capacity 34.0 MW) injection tapping the Keystone to Desoto 345 kV line in the AEP area. Project AF1-202 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-202 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)

None

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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4275770 5	248001	06DEARB1	345.0	OVEC	248013	06PIERCE	345.0	OVEC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	119.11	121.29	DC	21.14

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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4352303 7	243218	05DESOTO	345.0	AEP	944830	AF1-148 TAP	345.0	AEP	2	AEP_P1-2_#4817	operation	971.0	112.36	117.38	DC	48.8
4352311 7	243225	05KEYSTN	345.0	AEP	243232	05SORENS	345.0	AEP	1	AEP_P1-2_#8702-C	operation	1301.0	100.81	106.97	DC	80.15
4352311 8	243225	05KEYSTN	345.0	AEP	243232	05SORENS	345.0	AEP	1	Base Case	operation	897.0	98.11	106.14	DC	72.01
4352291 4	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	2	AEP_P1-2_#4817	operation	971.0	143.15	148.18	DC	48.8
4352291 9	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	2	Base Case	operation	971.0	103.3	105.64	DC	22.7

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4352950	944540	AF1-119 TAP	345.0	AEP	243225	05KEYSTN	345.0	AEP	1	AEP_P1-2_#8702-C	operation	897.0	124.57	133.54	DC	80.4
4352988	944830	AF1-148 TAP	345.0	AEP	944530	AF1-118 TAP	345.0	AEP	2	AEP_P1-2_#4817	operation	971.0	121.47	126.5	DC	48.8
4352009	945370	AF1-202 TAP	345.0	AEP	944540	AF1-119 TAP	345.0	AEP	1	AEP_P1-2_#8702-C	operation	897.0	114.83	123.79	DC	80.4

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
42757705	1	06DEARB1 345.0 kV - 06PIERCE 345.0 kV Ckt 1	OVEC0001a (1567) : Perform a sag study. OVECs cost estimate for performing the sag study is $125K. Project Type : FAC Cost : $125,000 Time Estimate : 6-12 Months	$125,000
			TOTAL COST	$125,000

17 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, 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
4275770 5	248001	06DEARB 1	OVEC	248013	06PIERCE	OVEC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	119.11	121.29	DC	21.14

Bus #	Bus	MW Impact
243795	05HDWTR1G C	0.5638
247264	05LAWG1A	6.9447
247265	05LAWG1B	6.9447
247266	05LAWG1S	11.0896
247267	05LAWG2A	6.9447
247268	05LAWG2B	6.9447
247269	05LAWG2S	11.0896
247543	V3-007 C	0.5638
247929	S-071 E	7.3628
247935	V3-007 E	27.0326
247958	05WLD G2 E	14.0135
247963	05HDWTR1G E	27.0326
247968	Z2-115 E	0.0797
250163	Y3-099 BAT	0.1991
250167	Y3-100 BAT	0.1991
251823	Z1-065 BAT	0.3770
913222	Y1-054 E	-1.2692
920501	AA2-148 C OP	3.5431
920502	AA2-148 E OP	23.7114
923881	AB2-028 C	2.9094
923882	AB2-028 E	19.4706
925243	**AB2-178 BAT (Withdrawn : 12/10/2019)**	**1.9713**
926691	AC1-152	2.1908
926851	AC1-172	2.1908
926881	AC1-175 C	11.8074
926882	AC1-175 E	19.2646
926951	AC1-182	-1.0684
932461	AC2-066 C	-1.4937
932462	AC2-066 E	-2.4371
932681	AC2-090 C	5.9037
932682	AC2-090 E	9.6323
932841	AC2-111 C O1	2.4266
932842	AC2-111 E O1	3.9592
933591	AC2-176 C O1	1.2906
933592	AC2-176 E O1	8.6368
933601	AC2-177 C O1	4.0394
933602	AC2-177 E O1	27.0326
934161	AD1-043 C O1	3.8136
934162	AD1-043 E O1	6.2222
934961	AD1-128 C	6.0990
934962	AD1-128 E	9.9510

Bus #	Bus	MW Impact
936561	AD2-071 C	5.0680
936562	AD2-071 E	2.4962
936681	**AD2-087 C O1 (Withdrawn : 12/09/2019)**	**2.7553**
936682	**AD2-087 E O1 (Withdrawn : 12/09/2019)**	**12.9000**
939761	AE1-207 C	5.0346
939762	AE1-207 E	6.9525
939771	AE1-208 C	4.5170
939772	AE1-208 E	6.1595
939781	AE1-209 C O1	1.6097
939782	AE1-209 E O1	10.7723
939791	AE1-210 C O1	1.6097
939792	AE1-210 E O1	10.7723
939811	AE1-217 C O1	6.6709
939812	AE1-217 E O1	9.2122
940981	AE2-089 C O1	3.2713
940982	AE2-089 E O1	2.1809
940991	AE2-090 C	3.5926
940992	AE2-090 E	2.3951
941691	AE2-169	1.4364
941701	AE2-170 O1	2.1194
941711	AE2-171	1.3297
941721	AE2-172	1.5883
942071	AE2-219 C	1.7281
942072	AE2-219 E	2.3864
942081	AE2-220 C	8.1564
942082	AE2-220 E	11.2636
942221	AE2-234 C O1	1.5343
942222	AE2-234 E O1	0.6939
942791	AE2-297 C O1	13.9226
942792	AE2-297 E O1	9.2818
943772	AF1-045 BAT	3.3100
944031	AF1-071 C	0.3215
944032	AF1-071 E	0.5246
944121	AF1-080	0.8537
944531	AF1-118 C O1	10.0303
944532	AF1-118 E O1	3.0251
944541	AF1-119 C O1	15.6572
944542	AF1-119 E O1	4.6768
944831	AF1-148 C O1	3.6914
944832	AF1-148 E O1	2.4609
945371	AF1-202 C O1	3.5938
945372	AF1-202 E O1	17.5462
945561	AF1-221 C O1	18.3200
945562	AF1-221 E O1	5.5066
945581	AF1-223 C O1	3.6499
945582	AF1-223 E O1	2.4332
946031	AF1-268 C O1	5.9576
946032	AF1-268 E O1	2.7175
946341	AF1-298 C	10.4009
946342	AF1-298 E	14.3631
946491	AF1-313 C O1	2.5757
946492	AF1-313 E O1	1.7171

Bus #	Bus	MW Impact
955491	J1031 C	1.4641
955492	J1031 E	7.9214
956561	J1152	12.1300
LGEE	LGEE	0.9088
WEC	WEC	1.1491
CBM-W2	CBM-W2	25.0368
NY	NY	0.4927
CBM-W1	CBM-W1	36.6293
TVA	TVA	1.8354
O-066	O-066	6.0278
CBM-S1	CBM-S1	11.6128
G-007	G-007	0.9329
MADISON	MADISON	20.2527
MEC	MEC	5.2993
CATAWBA	CATAWBA	0.0805

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
Base Case	
DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	CONTINGENCY 'DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FORT 345 1 OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1 / 243233 05TANNER 345 249565 08EBEND
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_#8702-C	CONTINGENCY 'AEP_P1-2_#8702-C' OPEN BRANCH FROM BUS 944530 TO BUS 243232 CKT 2 / 944530 AF1-118 TAP 345 243232 05SORENS 345 2 END

Short Circuit

20 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue

21 Network Impacts – Option 2

The Queue Project AF1-202 was evaluated as a 200.0 MW (Capacity 34.0 MW) injection tapping the Sorenson to Desoto 345 kV line in the AEP area. Project AF1-202 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-202 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

22 Generation Deliverability

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

None

23 Multiple Facility Contingency

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

None

24 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4275705	248001	06DEARB1	345.0	OVEC	248013	06PIERCE	345.0	OVEC	1	DEOK_P7-1_C54504MFTANNERS4512EBTANNERS	tower	972.0	119.51	121.7	DC	21.15

25 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.

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51921810	243218	05DESOTO	345.0	AEP	945580	AF1-223 TAP	345.0	AEP	1	AEP_P1-2_#8702-D	operation	897.0	106.54	111.95	DC	48.46
51921857	243225	05KEYSTN	345.0	AEP	944530	AF1-118 TAP	345.0	AEP	1	Base Case	operation	897.0	99.94	102.42	DC	22.26
51921721	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	1	Base Case	operation	897.0	122.58	125.06	DC	22.26
51921722	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	1	AEP_P1-2_#8702-D	operation	1301.0	111.31	115.02	DC	48.21

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
5192167 4	944540	AF1-119 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	129.07	137.36	DC	80.42
5192169 9	945370	AF1-202 TAP	345.0	AEP	944540	AF1-119 TAP	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	119.85	128.13	DC	80.42
5192176 7	945580	AF1-223 TAP	345.0	AEP	243225	05KEYSTN	345.0	AEP	1	AEP_P1-2_#8702-D	operation	897.0	106.54	111.94	DC	48.46

26 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, 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.

26.1 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
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Bus #	Bus	MW Impact
243795	05HDWTR1G C	0.5638
247264	05LAWG1A	6.9447
247265	05LAWG1B	6.9447
247266	05LAWG1S	11.0896
247267	05LAWG2A	6.9447
247268	05LAWG2B	6.9447
247269	05LAWG2S	11.0896
247543	V3-007 C	0.5638
247929	S-071 E	7.3628
247935	V3-007 E	27.0326
247958	05WLD G2 E	14.0135
247963	05HDWTR1G E	27.0326
247968	Z2-115 E	0.0797
250163	Y3-099 BAT	0.1991
250167	Y3-100 BAT	0.1991
251823	Z1-065 BAT	0.3770
913222	Y1-054 E	-1.2692
920501	AA2-148 C OP	3.5431
920502	AA2-148 E OP	23.7114
923881	AB2-028 C	2.9094
923882	AB2-028 E	19.4706
925243	**AB2-178 BAT (Withdrawn : 12/10/2019)**	**1.9713**
926691	AC1-152	2.1908
926851	AC1-172	2.1908
926881	AC1-175 C	11.8074
926882	AC1-175 E	19.2646
926951	AC1-182	-1.0684
932461	AC2-066 C	-1.4937
932462	AC2-066 E	-2.4371
932681	AC2-090 C	5.9037
932682	AC2-090 E	9.6323
932841	AC2-111 C O1	2.4266
932842	AC2-111 E O1	3.9592
933591	AC2-176 C O1	1.2906
933592	AC2-176 E O1	8.6368
933601	AC2-177 C O1	4.0394
933602	AC2-177 E O1	27.0326
934161	AD1-043 C O1	3.8136
934162	AD1-043 E O1	6.2222
934961	AD1-128 C	6.0990
934962	AD1-128 E	9.9510

Bus #	Bus	MW Impact
936561	AD2-071 C	5.0680
936562	AD2-071 E	2.4962
936681	**AD2-087 C O1 (Withdrawn : 12/09/2019)**	**2.7553**
936682	**AD2-087 E O1 (Withdrawn : 12/09/2019)**	**12.9000**
939761	AE1-207 C	5.0346
939762	AE1-207 E	6.9525
939771	AE1-208 C	4.5170
939772	AE1-208 E	6.1595
939781	AE1-209 C O1	1.6097
939782	AE1-209 E O1	10.7723
939791	AE1-210 C O1	1.6097
939792	AE1-210 E O1	10.7723
939811	AE1-217 C O1	6.6709
939812	AE1-217 E O1	9.2122
940981	AE2-089 C O1	3.2713
940982	AE2-089 E O1	2.1809
940991	AE2-090 C	3.5926
940992	AE2-090 E	2.3951
941691	AE2-169	1.4364
941701	AE2-170 O1	2.1194
941711	AE2-171	1.3297
941721	AE2-172	1.5883
942071	AE2-219 C	1.7281
942072	AE2-219 E	2.3864
942081	AE2-220 C	8.1564
942082	AE2-220 E	11.2636
942221	AE2-234 C O1	1.5343
942222	AE2-234 E O1	0.6939
942791	AE2-297 C O1	13.9226
942792	AE2-297 E O1	9.2818
943772	AF1-045 BAT	3.3100
944031	AF1-071 C	0.3215
944032	AF1-071 E	0.5246
944121	AF1-080	0.8537
944241	AF1-092 C O2	3.1867
944242	AF1-092 E O2	0.9699
944531	AF1-118 C O2	10.1212
944532	AF1-118 E O2	3.0525
944541	AF1-119 C O2	15.4755
944542	AF1-119 E O2	4.6225
944831	AF1-148 C O2	3.7575
944832	AF1-148 E O2	2.5050
945371	AF1-202 C O2	3.5962
945372	AF1-202 E O2	17.5578
945561	AF1-221 C O2	35.4567
945562	AF1-221 E O2	10.6575
945581	AF1-223 C O2	9.6228
945582	AF1-223 E O2	6.4152
946031	AF1-268 C O2	6.6622
946032	AF1-268 E O2	3.0389
946341	AF1-298 C	10.4009
946342	AF1-298 E	14.3631

Bus #	Bus	MW Impact
946491	AF1-313 C O2	2.6196
946492	AF1-313 E O2	1.7464
955491	J1031 C	1.4641
955492	J1031 E	7.9214
956561	J1152	12.1300
LGEE	LGEE	0.9088
WEC	WEC	1.1491
CBM-W2	CBM-W2	25.0368
NY	NY	0.4927
CBM-W1	CBM-W1	36.6293
TVA	TVA	1.8354
O-066	O-066	6.0278
CBM-S1	CBM-S1	11.6128
G-007	G-007	0.9329
MADISON	MADISON	20.2527
MEC	MEC	5.2993
CATAWBA	CATAWBA	0.0805

Affected Systems

27 Affected Systems

27.1 LG&E

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

27.2 MISO

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

27.3 TVA

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

27.4 Duke Energy Progress

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

27.5 NYISO

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

28 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
AEP_P1-2_#8702-D	CONTINGENCY 'AEP_P1-2_#8702-D' OPEN BRANCH FROM BUS 944540 TO BUS 243232 CKT 2 / 944540 AF1-119 TAP 345 243232 05SORENS 345 2 END
DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	CONTINGENCY 'DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FORT 345 1 OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1 / 243233 05TANNER 345 249565 08EBEND
AEP_P1-2_#4817-B	CONTINGENCY 'AEP_P1-2_#4817-B' OPEN BRANCH FROM BUS 944530 TO BUS 243232 CKT 1 / 944530 AF1-118 TAP 345 243232 05SORENS 345 1 END

Short Circuit

29 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue