



**Generation Interconnection
Feasibility Study Report
for
Queue Project AF1-221
COLLEGE CORNER-DREWERSBURG 138 KV
138.4 MW Capacity / 180 MW Energy**

January, 2020

Table of Contents

1	Preface.....	4
2	General.....	6
2.1	Point of Interconnection	7
2.2	Cost Summary.....	7
3	Transmission Owner Scope of Work.....	8
4	Attachment Facilities	8
5	Direct Connection Cost Estimate.....	8
6	Non-Direct Connection Cost Estimate.....	8
7	Incremental Capacity Transfer Rights (ICTRs)	9
8	Schedule.....	9
9	Transmission Owner Analysis.....	9
10	Interconnection Customer Requirements.....	9
11	Revenue Metering and SCADA Requirements	10
11.1	PJM Requirements	10
11.2	AEP Requirements.....	10
12	Network Impacts.....	11
13	Generation Deliverability	13
14	Multiple Facility Contingency	13
15	Contribution to Previously Identified Overloads	13
16	Potential Congestion due to Local Energy Deliverability.....	14
17	System Reinforcements.....	15
18	Flow Gate Details	17
18.1	Index 1	18
18.2	Index 2	19
18.3	Index 3	20
18.4	Index 4.....	21
18.5	Index 5.....	22
18.6	Index 6.....	25
18.7	Index 7	26
19	Affected Systems	28
19.1	LG&E.....	28

19.2	MISO	28
19.3	TVA.....	28
19.4	Duke Energy Progress.....	28
19.5	NYISO	28
20	Contingency Descriptions.....	29
21	Short Circuit.....	33
22	Network Impacts – Option 2	34
23	Generation Deliverability	36
24	Multiple Facility Contingency	36
25	Contribution to Previously Identified Overloads	36
26	Potential Congestion due to Local Energy Deliverability.....	36
27	Flow Gate Details	38
27.1	Index 1	39
27.2	Index 2	42
28	Affected Systems	46
28.1	LG&E.....	46
28.2	MISO	46
28.3	TVA.....	46
28.4	Duke Energy Progress.....	46
28.5	NYISO	46
29	Contingency Descriptions.....	47
30	Short Circuit.....	49
31	Single Line Diagram	Error! Bookmark not defined.

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 Franklin County, IN. The installed facilities will have a total capability of 180 MW with 138.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 6/1/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF1-221
Project Name	COLLEGE CORNER-DREWERSBURG 138 KV
State	Indiana
County	Franklin
Transmission Owner	AEP
MFO	180
MWE	180
MWC	138.4
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-221 will interconnect with the AEP transmission system tapping the College Corner to Drewersburg 138 kV line.

To accommodate the interconnection on the College Corner to Drewersburg 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	\$ 6,000,000
Non Direct Connection Network Upgrades	\$ 1,500,000
Total Costs	\$ 7,750,000

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

Description	Total Cost
System Upgrades	\$64,700,345

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
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
138kV Transmission Line Cut In	\$ 1,000,000
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	\$1,500,000

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 Transmission Owner Analysis

An AEP supplemental project will rebuild the College Corner- Jay 138kV line with the current projected ISD is 12/1/2023. PJM has assigned this project number S2014. A summary of this project is available at <https://www.pjm.com/-/media/committees-groups/committees/srrtep-w/20190520/20190520-reliability-analysis-update.ashx>. Determination of allocation of cost for the scope of S2014 to AE2-090 (if any) or other queue positions will occur during the System Impact Study.

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 AEP's 138kV 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.

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

The Queue Project AF1-221 was evaluated as a 180.0 MW (Capacity 138.4 MW) injection tapping the College Corner to Drewersburg 138 kV line in the AEP area. Project AF1-221 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-221 was studied with a commercial probability of 0.53. 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADING %	POST PROJE CT LOADING %	AC DC	MW IMPACT
41034053	250001	08COLINV	138.0	DEO&K	250144	08HUSTRC	138.0	DEO&K	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	178.0	82.79	101.32	DC	32.98
41632376	250001	08COLINV	138.0	DEO&K	250144	08HUSTRC	138.0	DEO&K	1	AEP_P4_#10527_05BLUFFP138_B2	breaker	178.0	86.35	105.31	DC	33.74
41034055	250144	08HUSTRC	138.0	DEO&K	250116	08TRENT1	138.0	DEO&K	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	178.0	81.72	100.25	DC	32.98
41632392	250144	08HUSTRC	138.0	DEO&K	250116	08TRENT1	138.0	DEO&K	1	AEP_P4_#10527_05BLUFFP138_B2	breaker	178.0	85.28	104.24	DC	33.74
43912239	934960	AD1-128 TAP	138.0	AEP	243278	05DESO TO	138.0	AEP	1	AEP_SUBT_P4_#1101_05BLUFFPNT 69.0_A	breaker	185.0	94.66	104.78	DC	18.73

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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJE CT LOADING %	POST PROJE CT LOADING %	AC DC	MW IMPACT
41033835	243262	05COLLCO	138.0	AEP	250001	08COLINV	138.0	DEO&K	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	167.0	123.16	142.91	DC	32.98
41631942	243262	05COLLCO	138.0	AEP	250001	08COLINV	138.0	DEO&K	1	AEP_P4_#10527_05BLUFFP138_B2	breaker	167.0	126.89	147.09	DC	33.74
41631943	243262	05COLLCO	138.0	AEP	250001	08COLINV	138.0	DEO&K	1	DEOK_P2-3_C2 1403_MIAMIFORT	breaker	167.0	118.16	137.57	DC	32.41
42767785	248001	06DEARB1	345.0	OVEC	248013	06PIERCE	345.0	OVEC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	121.29	123.76	DC	23.83
43912238	934960	AD1-128 TAP	138.0	AEP	243278	05DESO TO	138.0	AEP	1	AEP_P4_#10527_05BLUFFP138_B2	breaker	185.0	105.48	115.61	DC	18.74
43912210	942070	AE2-219 TAP	138.0	AEP	243253	05BLUFFP	138.0	AEP	1	AEP_P4_#6923_05COLLCO138_C2	breaker	255.0	110.67	118.16	DC	19.08
43912211	942070	AE2-219 TAP	138.0	AEP	243253	05BLUFFP	138.0	AEP	1	AEP_SUBT_P4_#1285_05RANDOLPH 69.0_F	breaker	255.0	111.7	114.0	DC	13.03
43912967	942070	AE2-219 TAP	138.0	AEP	243253	05BLUFFP	138.0	AEP	1	DEOK_P7-1_C5 CIRCUIT3281&13803	tower	255.0	110.75	118.23	DC	19.08
43912237	942790	AE2-297 TAP	138.0	AEP	243333	05MADISO	138.0	AEP	1	AEP_P4_#10610_05COLLCO138_B	breaker	223.0	113.14	115.56	DC	12.01

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	kV	FRO M BUS ARE A	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Ratin g MVA	PRE PROJEC T LOADIN G %	POST PROJEC T LOADIN G %	AC D C	MW IMPA CT
435404 07	24321 8	05DESOT O	345. 0	AEP	94483 0	AF1-148 TAP	345. 0	AEP	2	AEP_P1-2_#4817	operati on	971.0	117.38	118.21	DC	17.8
435404 33	24321 8	05DESOT O	345. 0	AEP	94537 0	AF1-202 TAP	345. 0	AEP	1	AEP_P1- 2_#8702-C	operati on	897.0	114.82	115.72	DC	17.77
435404 87	24322 5	05KEYST N	345. 0	AEP	24323 2	05SORE NS	345. 0	AEP	1	AEP_P1- 2_#8702-C	operati on	1301. 0	106.97	107.58	DC	17.54
435404 88	24322 5	05KEYST N	345. 0	AEP	24323 2	05SORE NS	345. 0	AEP	1	Base Case	operati on	897.0	106.14	106.79	DC	12.83
439126 04	24325 3	05BLUFF P	138. 0	AEP	24331 9	05JAY	138. 0	AEP	1	Base Case	operati on	205.0	125.89	128.19	DC	10.48
439126 05	24325 3	05BLUFF P	138. 0	AEP	24331 9	05JAY	138. 0	AEP	1	AEP_SUBT_P1- 3_#1457_05BLUF FP 138_1	operati on	284.0	112.54	114.44	DC	12.0
413133 07	24326 2	05COLLC O	138. 0	AEP	25000 1	08COLIN V	138. 0	DEO& K	1	AEP_SUBT_P1- 3_#786_05JAY 138_1-C	operati on	167.0	115.46	135.28	DC	33.09
413133 12	24326 2	05COLLC O	138. 0	AEP	25000 1	08COLIN V	138. 0	DEO& K	1	Base Case	operati on	167.0	87.63	106.63	DC	31.73
439127 84	93496 0	AD1-128 TAP	138. 0	AEP	24327 8	05DESOT O	138. 0	AEP	1	AEP_P1- 2_#10526-A	operati on	185.0	94.58	104.71	DC	18.74
425407 18	94151 0	AE2-148 TAP	345. 0	DAY	94563 0	AF1-228 TAP	345. 0	DAY	1	DAY_P1-2_#762	operati on	1374. 0	105.62	106.13	DC	15.49
439126 53	94207 0	AE2-219 TAP	138. 0	AEP	24325 3	05BLUFF P	138. 0	AEP	1	Base Case	operati on	205.0	120.17	122.91	DC	12.46
439126 54	94207 0	AE2-219 TAP	138. 0	AEP	24325 3	05BLUFF P	138. 0	AEP	1	AEP_SUBT_P1- 3_#1010_05RAN DOL 138_1	operati on	255.0	111.66	113.96	DC	13.03
435402 84	94453 0	AF1-118 TAP	345. 0	AEP	24323 2	05SORE NS	345. 0	AEP	2	AEP_P1-2_#4817	operati on	971.0	148.18	149.0	DC	17.8
435402 89	94453 0	AF1-118 TAP	345. 0	AEP	24323 2	05SORE NS	345. 0	AEP	2	Base Case	operati on	971.0	105.64	106.25	DC	13.15
435403 20	94454 0	AF1-119 TAP	345. 0	AEP	24322 5	05KEYST N	345. 0	AEP	1	AEP_P1- 2_#8702-C	operati on	897.0	133.54	134.43	DC	17.77
435403 58	94483 0	AF1-148 TAP	345. 0	AEP	94453 0	AF1-118 TAP	345. 0	AEP	2	AEP_P1-2_#4817	operati on	971.0	126.5	127.33	DC	17.8
435403 79	94537 0	AF1-202 TAP	345. 0	AEP	94454 0	AF1-119 TAP	345. 0	AEP	1	AEP_P1- 2_#8702-C	operati on	897.0	123.79	124.69	DC	17.77
413134 14	94563 0	AF1-228 TAP	345. 0	DAY	24345 3	05BEATT Y	345. 0	AEP	1	DAY_P1-2_#762	operati on	1374. 0	105.11	105.62	DC	15.49

17 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
41034053,41632376	1	08COLINV 138.0 kV - 08HUSTRC 138.0 kV Ckt 1	<u>DEOK</u> r3281b (2550) : Rebuild the line Project Type : FAC Cost : \$5,631,405 Time Estimate : 22.0 Months	\$5,631,405
43912237	7	AE2-297 TAP 138.0 kV - 05MADISO 138.0 kV Ckt 1	<u>AEP</u> AEPI0018a (246) : A Sag Study will be required on the 24 miles section of ACSR ~ 636 ~ 26/7 ~ GROSBEAK line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between \$96,000 (no remediations required just sag study) and \$36 million (complete line reconductor/rebuild required) Project Type : FAC Cost : \$96,000 Time Estimate : Sag study : 6-12 months Months AEPI0018b (247) : Replace Madison Sub cond 500 MCM CU 37 Str Project Type : FAC Cost : \$100,000 Time Estimate : 12-18 months Months	\$196,000
41033835,41631942, 41631943	4	05COLLCO 138.0 kV - 08COLINV 138.0 kV Ckt 1	<u>AEP</u> AEPI0005a (147) : A Sag Study will be required on the 0.15 mile section of line to mitigate the overload . New Rating after the Sag Study : S/N: 167 MVA S/E: 245 MVA. Depending on the sag study results, cost for this upgrade is expected to be between \$600 (no remediations required just sag study) and \$0.3 million (complete line reconductor/rebuild required). Time Estimate: a) Sag Study: 6-12 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 : \$600 Time Estimate : 6-12 Months AEPI0005b (148) : 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 Months <u>DEOK</u> r3281 (2549) : Rebuild the line Project Type : FAC Cost : \$24,163,861 Time Estimate : 36.0 Months	\$24,389,461

ID	Index	Facility	Upgrade Description	Cost
43912967,43912210, 43912211	6	AE2-219 TAP 138.0 kV - 05BLUFFP 138.0 kV Ckt 1	<u>AEP</u> AEPI0017a (245) : Reconductor/rebuild 7 miles of ACSR ~ 556.5 ~ 26/7 ~ DOVE conductor sec 1 Project Type : FAC Cost : \$10,500,000 Time Estimate : 24-36 months Months	\$10,500,000
43912238,43912239	3	AD1-128 TAP 138.0 kV - 05DESOTO 138.0 kV Ckt 1	<u>AEP</u> AEPI0021a (262) : A Sag Study will be required on the 10 miles section of ACSR ~ 477 ~ 26/7 ~ HAWK line to mitigate the overload. New Ratings afetr the sag study S/N : 185MVA S/E: 257MVA.Dependng on the sag study results, cost for this upgrade is expected to be between \$40,000 (no remediations required just sag study) and \$15 million (complete line reconductor/rebuild required) Project Type : FAC Cost : \$40,000 Time Estimate : sag study : 6-12 months Months	\$40,000
42767785	5	06DEARB1 345.0 kV - 06PIERCE 345.0 kV Ckt 1	<u>OVEC</u> OVEC0001a (793) : 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 OVEC0001b (795) : Replace 2 1600 A switches at Dearborn 345 kV Project Type : FAC Cost : \$1,500,000 Time Estimate : 12 -18 months Months OVEC0001c (796) : Replace 4 switches at Pierce 345kV Project Type : FAC Cost : \$6,000,000 Time Estimate : 12 -18 months Months	\$7,625,000
41632392,41034055	2	08HUSTRC 138.0 kV - 08TRENTO 138.0 kV Ckt 1	<u>DEOK</u> r3281c (2551) : 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	\$64,700,345

18 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.

18.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
41632376	250001	08COLIN V	DEO& K	250144	08HUSTR C	DEO& K	1	AEP_P4_#10527_05BLUFF 138_B2	breaker	178.0	86.35	105.31	DC	33.74

Bus #	Bus	MW Impact
243415	05WWVSTA	2.1959
247288	05RICHG1	0.7178
247289	05RICHG2	0.7178
247536	05BLUFF P WF	0.6169
247929	S-071 E	17.6774
932841	AC2-111 C O1	7.0853
932842	AC2-111 E O1	11.5603
934961	AD1-128 C	3.8372
934962	AD1-128 E	6.2608
936681	AD2-087 C O1 (Withdrawn : 12/09/2019)	6.4814
936682	AD2-087 E O1 (Withdrawn : 12/09/2019)	30.3446
940991	AE2-090 C	16.4229
940992	AE2-090 E	10.9486
942071	AE2-219 C	7.7335
942072	AE2-219 E	10.6795
944031	AF1-071 C	1.7713
944032	AF1-071 E	2.8901
945561	AF1-221 C O1	25.9458
945562	AF1-221 E O1	7.7988
WEC	WEC	0.1342
CBM-W2	CBM-W2	2.2277
NY	NY	0.0321
CBM-W1	CBM-W1	4.4035
TVA	TVA	0.1162
O-066	O-066	0.3898
CHEOAH	CHEOAH	0.0020
CBM-S1	CBM-S1	0.5027
G-007	G-007	0.0603
MADISON	MADISON	6.5641
MEC	MEC	0.5673
CALDERWOOD	CALDERWOOD	0.0015
BLUEG	BLUEG	0.0330
TRIMBLE	TRIMBLE	0.0228
CATAWBA	CATAWBA	0.0133

18.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
4163239 2	25014 4	08HUSTR C	DEO& K	25011 6	08TRENT 1	DEO& K	1	AEP_P4_#10527_05BLUF FP 138_B2	breaker	178.0	85.28	104.24	DC	33.74

Bus #	Bus	MW Impact
243415	05WWVSTA	2.1959
247288	05RICHG1	0.7178
247289	05RICHG2	0.7178
247536	05BLUFF P WF	0.6169
247929	S-071 E	17.6774
932841	AC2-111 C O1	7.0853
932842	AC2-111 E O1	11.5603
934961	AD1-128 C	3.8372
934962	AD1-128 E	6.2608
936681	AD2-087 C O1 (Withdrawn : 12/09/2019)	6.4814
936682	AD2-087 E O1 (Withdrawn : 12/09/2019)	30.3446
940991	AE2-090 C	16.4229
940992	AE2-090 E	10.9486
942071	AE2-219 C	7.7335
942072	AE2-219 E	10.6795
944031	AF1-071 C	1.7713
944032	AF1-071 E	2.8901
945561	AF1-221 C O1	25.9458
945562	AF1-221 E O1	7.7988
WEC	WEC	0.1342
CBM-W2	CBM-W2	2.2277
NY	NY	0.0321
CBM-W1	CBM-W1	4.4035
TVA	TVA	0.1162
O-066	O-066	0.3898
CHEOAH	CHEOAH	0.0020
CBM-S1	CBM-S1	0.5027
G-007	G-007	0.0603
MADISON	MADISON	6.5641
MEC	MEC	0.5673
CALDERWOOD	CALDERWOOD	0.0015
BLUEG	BLUEG	0.0330
TRIMBLE	TRIMBLE	0.0228
CATAWBA	CATAWBA	0.0133

18.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
43912238	934960	AD1-128 TAP	AEP	243278	05DESOTO	AEP	1	AEP_P4_#10527_05BLUFF P 138_B2	breaker	185.0	105.48	115.61	DC	18.74

Bus #	Bus	MW Impact
243415	05WWWSTA	1.7664
247288	05RICHG1	0.6738
247289	05RICHG2	0.6738
247536	05BLUFF P WF	0.5531
247929	S-071 E	15.8506
932841	AC2-111 C O1	3.9183
932842	AC2-111 E O1	6.3929
934961	AD1-128 C	40.4597
934962	AD1-128 E	66.0133
936681	AD2-087 C O1 (Withdrawn : 12/09/2019)	5.8119
936682	AD2-087 E O1 (Withdrawn : 12/09/2019)	27.2101
940991	AE2-090 C	13.6979
940992	AE2-090 E	9.1319
942071	AE2-219 C	6.9346
942072	AE2-219 E	9.5764
944031	AF1-071 C	0.9796
944032	AF1-071 E	1.5982
945561	AF1-221 C O1	14.4061
945562	AF1-221 E O1	4.3301
DUCKCREEK	DUCKCREEK	0.4007
LGEE	LGEE	0.1015
NEWTON	NEWTON	0.2622
CPLE	CPLE	0.0212
FARMERCITY	FARMERCITY	0.0148
G-007A	G-007A	0.0647
VFT	VFT	0.1677
PRAIRIE	PRAIRIE	0.5476
COFFEEN	COFFEEN	0.1438
CBM-S2	CBM-S2	0.1561
EDWARDS	EDWARDS	0.1274
CBM-S1	CBM-S1	0.0256
TILTON	TILTON	0.2155
GIBSON	GIBSON	0.1048

18.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC DC	MW IMPACT
4163194 2	24326 2	05COLLC O	AEP	25000 1	08COLIN V	DEO& K	1	AEP_P4_#10527_05BLUF FP 138_B2	breaker	167.0	126.89	147.09	DC	33.74

Bus #	Bus	MW Impact
243415	05WWVSTA	2.1959
247288	05RICHG1	0.7178
247289	05RICHG2	0.7178
247536	05BLUFF P WF	0.6169
247929	S-071 E	17.6774
932841	AC2-111 C O1	7.0853
932842	AC2-111 E O1	11.5603
934961	AD1-128 C	3.8372
934962	AD1-128 E	6.2608
936681	AD2-087 C O1 (Withdrawn : 12/09/2019)	6.4814
936682	AD2-087 E O1 (Withdrawn : 12/09/2019)	30.3446
940991	AE2-090 C	16.4229
940992	AE2-090 E	10.9486
942071	AE2-219 C	7.7335
942072	AE2-219 E	10.6795
944031	AF1-071 C	1.7713
944032	AF1-071 E	2.8901
945561	AF1-221 C O1	25.9458
945562	AF1-221 E O1	7.7988
WEC	WEC	0.1342
CBM-W2	CBM-W2	2.2277
NY	NY	0.0321
CBM-W1	CBM-W1	4.4035
TVA	TVA	0.1162
O-066	O-066	0.3898
CHEOAH	CHEOAH	0.0020
CBM-S1	CBM-S1	0.5027
G-007	G-007	0.0603
MADISON	MADISON	6.5641
MEC	MEC	0.5673
CALDERWOOD	CALDERWOOD	0.0015
BLUEG	BLUEG	0.0330
TRIMBLE	TRIMBLE	0.0228
CATAWBA	CATAWBA	0.0133

18.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC/D C	MW IMPACT
42767785	248001	06DEARB1	OVEC	248013	06PIERC E	OVEC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	121.29	123.76	DC	23.83

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

18.6 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
43912967	942070	AE2-219 TAP	AEP	243253	05BLUFP	AEP	1	DEOK_P7-1_C5 CIRCUIT3281&13803	tower	255.0	110.75	118.23	DC	19.08

Bus #	Bus	MW Impact
243415	05WWWSTA	1.7744
247288	05RICHG1	0.5412
247289	05RICHG2	0.5412
932841	AC2-111 C O1	3.9736
932842	AC2-111 E O1	6.4832
933591	AC2-176 C O1	-1.4109
933592	AC2-176 E O1	-9.4424
936681	AD2-087 C O1 (Withdrawn : 12/09/2019)	19.3702
936682	AD2-087 E O1 (Withdrawn : 12/09/2019)	90.6878
940991	AE2-090 C	40.8180
940992	AE2-090 E	27.2120
942071	AE2-219 C	26.3857
942072	AE2-219 E	36.4373
944031	AF1-071 C	0.9934
944032	AF1-071 E	1.6208
945561	AF1-221 C O1	14.6690
945562	AF1-221 E O1	4.4092
DUCKCREEK	DUCKCREEK	0.0818
LGEE	LGEE	0.1466
CPL	CPL	0.0245
FARMERCITY	FARMERCITY	0.0015
CBM-W2	CBM-W2	0.4996
NY	NY	0.0066
TVA	TVA	0.1008
O-066	O-066	0.0739
CBM-S2	CBM-S2	0.2659
EDWARDS	EDWARDS	0.0290
CBM-S1	CBM-S1	0.9116
G-007	G-007	0.0114

18.7 Index 7

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC DC	MW IMPACT
43912237	942790	AE2-297 TAP	AEP	243333	05MADISO	AEP	1	AEP_P4_#10610_05COLLC O 138_B	breaker	223.0	113.14	115.56	DC	12.01

Bus #	Bus	MW Impact
920501	AA2-148 C OP	15.1681
920502	AA2-148 E OP	101.5096
942791	AE2-297 C O1	63.1194
942792	AE2-297 E O1	42.0796
945561	AF1-221 C O1	4.1593
945562	AF1-221 E O1	1.2502
DUCKCREEK	DUCKCREEK	0.3270
LGEE	LGEE	0.0262
NEWTON	NEWTON	0.2987
CPL	CPL	0.0079
FARMERCITY	FARMERCITY	0.0131
G-007A	G-007A	0.0695
VFT	VFT	0.1870
PRAIRIE	PRAIRIE	0.5915
COFFEEN	COFFEEN	0.1464
CBM-S2	CBM-S2	0.0116
EDWARDS	EDWARDS	0.1011
CHEOAH	CHEOAH	0.0110
TILTON	TILTON	0.2312
GIBSON	GIBSON	0.1878
CALDERWOOD	CALDERWOOD	0.0114

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_SUBT_P1-3_#1457_05BLUFFP 138_1	CONTINGENCY 'AEP_SUBT_P1-3_#1457_05BLUFFP 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_SUBT_P1-3_#1010_05RANDOL 138_1	CONTINGENCY 'AEP_SUBT_P1-3_#1010_05RANDOL 138_1' OPEN BRANCH FROM BUS 246086 TO BUS 243362 CKT 1 / 246086 05RANOLEQ 999 243362 05RANDOL 138 1 OPEN BRANCH FROM BUS 246086 TO BUS 246087 CKT 1 / 246086 05RANOLEQ 999 246087 05RANDOLPH 69.0 1 OPEN BRANCH FROM BUS 246086 TO BUS 246089 CKT 1 / 246086 05RANOLEQ 999 246089 05RANDOL1L 12.0 1 OPEN BRANCH FROM BUS 246079 TO BUS 246087 CKT 1 / 246079 05PRICE 69.0 246087 05RANDOLPH 69.0 1 REMOVE SWSHUNT FROM BUS 246087 / 246087 05RANDOLPH 69.0 END
AEP_SUBT_P4_#1101_05BLUFFPNT 69.0_A	CONTINGENCY 'AEP_SUBT_P4_#1101_05BLUFFPNT 69.0_A' OPEN BRANCH FROM BUS 243253 TO BUS 243319 CKT 1 / 243253 05BLUFFP 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 243253 TO BUS 942070 CKT 1 / 243253 05BLUFFP 138 942070 AE2- 219 TAP 138 1 OPEN BRANCH FROM BUS 243253 TO BUS 246014 CKT 1 / 243253 05BLUFFP 138 246014 05BLUFFPNT 69.0 1 OPEN BRANCH FROM BUS 246014 TO BUS 246022 CKT 1 / 246014 05BLUFFPNT 69.0 246022 05PORTLAND 69.0 1 OPEN BRANCH FROM BUS 246020 TO BUS 246022 CKT 1 / 246020 05N PORTLN 69.0 246022 05PORTLAND 69.0 1 END
DAY_P1-2_#762	CONTINGENCY 'DAY_P1-2_#762' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 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_#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

Contingency Name	Contingency Definition
DEOK_P2-3_C2 1403_MIAMIFORT	CONTINGENCY 'DEOK_P2-3_C2 1403_MIAMIFORT' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FORT 345 1 OPEN BRANCH FROM BUS 249567 TO BUS 251950 CKT 7 / 249567 08M.FORT 345 251950 08M.FRT7 22.0 7 END
AEP_SUBT_P1-3_#786_05JAY 138_1-C	CONTINGENCY 'AEP_SUBT_P1-3_#786_05JAY 138_1-C' OPEN BRANCH FROM BUS 246018 TO BUS 243319 CKT 1 / 246018 05JAY EQ 999 243319 05JAY 138 1 OPEN BRANCH FROM BUS 246018 TO BUS 246016 CKT 1 / 246018 05JAY EQ 999 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246018 TO BUS 246015 CKT 1 / 246018 05JAY EQ 999 246015 05JAY 34.5 1 OPEN BRANCH FROM BUS 243253 TO BUS 243319 CKT 1 / 243253 05BLUFFP 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 253250 TO BUS 243319 CKT 1 / 253250 09FTRECV 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 945580 TO BUS 243319 CKT 1 / 945580 AF1-223 TAP 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 243319 TO BUS 243358 CKT 1 / 243319 05JAY 138 243358 05PENNV 138 1 REMOVE SWSHUNT FROM BUS 243319 / 243319 05JAY 138 OPEN BRANCH FROM BUS 246013 TO BUS 246016 CKT 1 / 246013 05ARMSTRON 69.0 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246024 TO BUS 246016 CKT 1 / 246024 05GREEN SW 69.0 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246026 TO BUS 246015 CKT 1 / 246026 05BARLEY 34.5 246015 05JAY 34.5 1 END
AEP_P4_#10610_05COLLCO 138_B	CONTINGENCY 'AEP_P4_#10610_05COLLCO 138_B' OPEN BRANCH FROM BUS 243259 TO BUS 243262 CKT 1 / 243259 05CNTRVL 138 243262 05COLLCO 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 945560 CKT 1 / 243262 05COLLCO 138 945560 AF1- 221 TAP 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 243310 CKT 1 / 243262 05COLLCO 138 243310 05HODGIN 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 243364 CKT 1 / 243262 05COLLCO 138 243364 05RICHMO 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 246963 CKT 1 / 243262 05COLLCO 138 246963 05WESLSS 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 250001 CKT 1 / 243262 05COLLCO 138 250001 08COLINV 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 250168 CKT 1 / 243262 05COLLCO 138 250168 08TRENT2 138 1 END
AEP_P4_#10527_05BLUFFP 138_B2	CONTINGENCY 'AEP_P4_#10527_05BLUFFP 138_B2' 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
Base Case	

Contingency Name	Contingency Definition
AEP_SUBT_P4_#1285_05RANDOLPH 69.0_F	CONTINGENCY 'AEP_SUBT_P4_#1285_05RANDOLPH 69.0_F' OPEN BRANCH FROM BUS 246086 TO BUS 243362 CKT 1 / 246086 05RANDOLEQ 999 243362 05RANDOL 138 1 OPEN BRANCH FROM BUS 246086 TO BUS 246087 CKT 1 / 246086 05RANDOLEQ 999 246087 05RANDOLPH 69.0 1 OPEN BRANCH FROM BUS 246086 TO BUS 246089 CKT 1 / 246086 05RANDOLEQ 999 246089 05RANDOL1L 12.0 1 OPEN BRANCH FROM BUS 246076 TO BUS 246079 CKT 1 / 246076 05ANCHORHO 69.0 246079 05PRICE 69.0 1 OPEN BRANCH FROM BUS 246079 TO BUS 246087 CKT 1 / 246079 05PRICE 69.0 246087 05RANDOLPH 69.0 1 REMOVE SWSHUNT FROM BUS 246087 / 246087 05RANDOLPH 69.0 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
DEOK_P7-1_C5 CIRCUIT3281&13803	CONTINGENCY 'DEOK_P7-1_C5 CIRCUIT3281&13803' OPEN BRANCH FROM BUS 250001 TO BUS 250144 CKT 1 / 250001 08COLINV 138 250144 08HUSTRC 138 1 OPEN BRANCH FROM BUS 250116 TO BUS 250144 CKT 1 / 250116 08TRENTO 138 250144 08HUSTRC 138 1 OPEN BRANCH FROM BUS 250001 TO BUS 251296 CKT 1 / 250001 08COLINV 138 251296 08COLINV 69.0 1 OPEN BRANCH FROM BUS 243262 TO BUS 250001 CKT 1 / 243262 05COLLCO 138 250001 08COLINV 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 250168 CKT 1 / 243262 05COLLCO 138 250168 08TRENT2 138 1 OPEN BRANCH FROM BUS 250106 TO BUS 250168 CKT 1 / 250106 08TODHJT 138 253057 08TRENT2 138 1 OPEN BRANCH FROM BUS 250106 TO BUS 253057 CKT 1 / 250106 08TODHJT 138 253057 09OHH 138 1 END
AEP_P4_#6923_05COLLCO 138_C2	CONTINGENCY 'AEP_P4_#6923_05COLLCO 138_C2' OPEN BRANCH FROM BUS 243262 TO BUS 250001 CKT 1 / 243262 05COLLCO 138 250001 08COLINV 138 1 OPEN BRANCH FROM BUS 243262 TO BUS 250168 CKT 1 / 243262 05COLLCO 138 250168 08TRENT2 138 1 OPEN BRANCH FROM BUS 250168 TO BUS 250106 CKT 1 / 250168 08TRENT2 138 250106 08TODHJT 138 1 END

Short Circuit

21 Short Circuit

The following Breakers are overduty

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

22 Network Impacts – Option 2

The Queue Project AF1-221 was evaluated as a 180.0 MW (Capacity 138.4 MW) injection tapping the Desoto to Tanners Creek 345 kV line in the AEP area. Project AF1-221 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-221 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

23 Generation Deliverability

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

None

24 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
41632454	243233	05TANNER	345.0	AEP	249567	08M.FORT	345.0	DEO&K	1	DEOK_P2-3_C2 1307_TERMINAL	breaker	2151.0	97.75	100.43	DC	59.25

25 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
42767785	248001	06DEARB1	345.0	OVENC	248013	06PIERCE	345.0	OVENC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	121.7	126.46	DC	46.11

26 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPACT
51941287	243218	05DESOTO	345.0	AEP	946030	AF1-268 TAP	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	119.88	122.24	DC	22.87

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
51941358	243218	05DESOTO	345.0	AEP	945580	AF1-223 TAP	345.0	AEP	1	AEP_P1-2_#8702-D	operation	897.0	111.95	114.49	DC	22.8
51941405	243225	05KEYSTN	345.0	AEP	944530	AF1-118 TAP	345.0	AEP	1	Base Case	operation	897.0	102.42	103.25	DC	16.51
51941406	243225	05KEYSTN	345.0	AEP	944530	AF1-118 TAP	345.0	AEP	1	AEP_P1-2_#8702-D	operation	1301.0	99.09	100.83	DC	22.56
51941269	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	1	Base Case	operation	897.0	125.06	125.89	DC	16.51
51941270	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	1	AEP_P1-2_#8702-D	operation	1301.0	115.02	116.75	DC	22.56
51941222	944540	AF1-119 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	137.36	139.71	DC	22.87
51941247	945370	AF1-202 TAP	345.0	AEP	944540	AF1-119 TAP	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	128.13	130.49	DC	22.87
51941315	945580	AF1-223 TAP	345.0	AEP	243225	05KEYSTN	345.0	AEP	1	AEP_P1-2_#8702-D	operation	897.0	111.94	114.48	DC	22.8
51941275	946030	AF1-268 TAP	345.0	AEP	945370	AF1-202 TAP	345.0	AEP	2	AEP_P1-2_#4817-B	operation	971.0	119.87	122.23	DC	22.87

27 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.

27.1 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
41632454	243233	05TANNER	AEP	249567	08M.FORT	DEO&K	1	DEOK_P2-3_C2 1307_TERMINAL	breaker	2151.0	97.75	100.43	DC	59.25

Bus #	Bus	MW Impact
243795	05HDWTR1G C	0.7074
246991	05WLD G1 C	0.2053
247255	05WLD G2 C	0.2155
247264	05LAWG1A	8.9834
247265	05LAWG1B	8.9834
247266	05LAWG1S	14.3452
247267	05LAWG2A	8.9834
247268	05LAWG2B	8.9834
247269	05LAWG2S	14.3452
247543	V3-007 C	0.7074
247929	S-071 E	7.7846
247935	V3-007 E	33.9143
247958	05WLD G2 E	20.1840
247963	05HDWTR1G E	33.9143
250163	Y3-099 BAT	0.2422
250167	Y3-100 BAT	0.2422
251823	Z1-065 BAT	1.4076
251831	Z1-080 BAT	0.8363
251947	08EBND2	25.0424
913222	Y1-054 E	-3.2708
918802	AA1-099 E	-0.4739
918803	AA1-099 BAT	0.5575
920501	AA2-148 C OP	4.3735
920502	AA2-148 E OP	29.2685
923881	AB2-028 C	3.5784
923882	AB2-028 E	23.9476
925243	AB2-178 BAT (Withdrawn : 12/10/2019)	2.3974
926691	AC1-152	2.8339
926851	AC1-172	2.8339
926881	AC1-175 C	14.8132
926882	AC1-175 E	24.1688
926951	AC1-182	-3.0637
932461	AC2-066 C	-3.4128
932462	AC2-066 E	-5.5683
932481	AC2-068 C	-2.6989
932482	AC2-068 E	-4.4202
932681	AC2-090 C	7.4066
932682	AC2-090 E	12.0844
933591	AC2-176 C O1	1.4151
933592	AC2-176 E O1	9.4703
933601	AC2-177 C O1	5.0677
933602	AC2-177 E O1	33.9143

Bus #	Bus	MW Impact
934161	AD1-043 C O1	5.4848
934162	AD1-043 E O1	8.9488
934961	AD1-128 C	6.8183
934962	AD1-128 E	11.1247
936561	AD2-071 C	6.2343
936562	AD2-071 E	3.0706
939761	AE1-207 C	6.1587
939762	AE1-207 E	8.5048
939771	AE1-208 C	6.3833
939772	AE1-208 E	8.7045
939781	AE1-209 C O1	1.9876
939782	AE1-209 E O1	13.3014
939791	AE1-210 C O1	1.9876
939792	AE1-210 E O1	13.3014
939811	AE1-217 C O1	8.1175
939812	AE1-217 E O1	11.2098
941691	AE2-169	3.8300
941701	AE2-170 O1	2.5775
941711	AE2-171	3.6084
941721	AE2-172	1.9429
942081	AE2-220 C	10.2328
942082	AE2-220 E	14.1310
942791	AE2-297 C O1	17.1681
942792	AE2-297 E O1	11.4454
943772	AF1-045 BAT	8.0336
944121	AF1-080	2.3200
944531	AF1-118 C O2	12.3599
944532	AF1-118 E O2	3.7277
944541	AF1-119 C O2	19.0082
944542	AF1-119 E O2	5.6778
944831	AF1-148 C O2	4.5956
944832	AF1-148 E O2	3.0637
945371	AF1-202 C O2	4.4234
945372	AF1-202 E O2	21.5966
945561	AF1-221 C O2	45.5599
945562	AF1-221 E O2	13.6943
945581	AF1-223 C O2	11.8395
945582	AF1-223 E O2	7.8930
946031	AF1-268 C O2	8.2148
946032	AF1-268 E O2	3.7471
946341	AF1-298 C	12.8428
946342	AF1-298 E	17.7352
946491	AF1-313 C O2	3.1459
946492	AF1-313 E O2	2.0973
LGEE	LGEE	1.0708
CPL	CPL	0.0212
WEC	WEC	1.5051
CBM-W2	CBM-W2	33.1777
NY	NY	0.4258
CBM-W1	CBM-W1	47.0001
TVA	TVA	2.6250
O-066	O-066	5.3357

Bus #	Bus	MW Impact
CBM-S2	CBM-S2	1.5664
CBM-S1	CBM-S1	15.9750
G-007	G-007	0.8247
MADISON	MADISON	59.2422
MEC	MEC	7.0281

27.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
42767785	248001	06DEARB1	OVEC	248013	06PIERC E	OVEC	1	DEOK_P7-1_C5 4504MFTANNERS4512EBTANNERS	tower	972.0	121.7	126.46	DC	46.11

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

28 Affected Systems

28.1 LG&E

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

28.2 MISO

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

28.3 TVA

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

28.4 Duke Energy Progress

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

28.5 NYISO

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

29 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
DEOK_P2-3_C2 1307_TERMINAL	CONTINGENCY 'DEOK_P2-3_C2 1307_TERMINAL' OPEN BRANCH FROM BUS 249575 TO BUS 250118 CKT 1 / 249575 08TERMNL 345 250118 08TRMNL2 138 1 OPEN BRANCH FROM BUS 249565 TO BUS 249575 CKT 1 / 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
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

Short Circuit

30 Short Circuit

The following Breakers are overduty

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