Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-433

DESOTO-KEYSTONE 345 KV

17.6 MW Capacity / 100 MW Energy

Wind Project

January 2021

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 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.

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.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

3 General

The Interconnection Customer (IC) has proposed an uprate to a planned/existing Wind generating facility located in Blackford, Indiana. This project is an increase to the Interconnection Customer's AF2-388 project, which will share the same point of interconnection. The AG1-433 queue position is a 100 MW uprate (17.6 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 300 MW with 52.8 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this uprate project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-433
Project Name	DESOTO-KEYSTONE 345 KV
State	Indiana
County	Blackford
Transmission Owner	AEP
MFO	300
MWE	100
MWC	17.6
Fuel	Wind
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AG1-433 will interconnect with the AEP transmission system via a direct connection to the AF2-388 proposed 345 kV switching station as an uprate to the PJM project AF2-388. The proposed AF2-388 switching station will be cut into Keystone – Desoto 345kV circuit.

Note: It is assumed that the existing 345 kV revenue metering system, generation lead and Protection & Control Equipment that will be installed for AF2-388 will be adequate for the increased generation of AG1-433.Depending on the timing of the completion of the AF2-388 interconnection construction relative to the AG1-433 completion, there may (or may not) be a need to review and revise the relay settings for the increased generation of AG1-433.

5 Cost Summary

The AG1-433 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$45,000
Total System Network Upgrade Costs	$10,697,000
Total Costs	**$10,742,000**

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

6.1 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
None	$ 0
Total Attachment Facility Costs	$ 0

6.2 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
None	$ 0
Total Direct Connection Facility Costs	**$ 0**

6.3 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
Review line protection and control settings at the AF2-388 proposed 345 kV switching station	$ 45,000
Total Non-Direct Connection Facility Costs	**$ 45,000**

7 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.

8 Transmission Owner Analysis

No violations were identified in the Sub-Transmission load flow analysis and the short circuit analysis for the Sub-Transmission will be conducted in the System Impact Study phase.

9 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner 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.

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 Meteorological Data Reporting Requirements

The wind generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Wind speed (meters/second) - (Required)
- Wind direction (decimal degrees from true north) - (Required)
- Ambient air temperature (Fahrenheit) - (Required)
- Air Pressure (Hectopascals) - (Required)
- Humidity (Percent) (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-433 was evaluated as a 100.0 MW (Capacity 17.6 MW) injection tapping the Desoto to Keystone 345 kV line in the AEP area. Project AG1-433 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-433 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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
16183047 1	243218	05DESOTO	345.0	AEP	923880	AB2-028 TAP	345.0	AEP	1	AEP_P7-1_#11019-D	tower	1318.0	106.27	109.09	DC	37.11
16183047 2	243218	05DESOTO	345.0	AEP	923880	AB2-028 TAP	345.0	AEP	1	AEP_P7-1_#11087-H	tower	1318.0	100.35	103.17	DC	37.16
16743802 4	243218	05DESOTO	345.0	AEP	243278	05DESOTO	138.0	AEP	1	AEP_P4_#4814_05DESOTO	breaker	692.0	106.29	107.89	DC	11.1
16183035 0	243233	05TANNER	345.0	AEP	248001	06DEARB1	345.0	OVEC	Z1	DEOK_P7_4504MFTANNERS4512EBTANNERS	tower	1204.0	158.52	159.82	DC	16.29
16465605 3	243233	05TANNER	345.0	AEP	248001	06DEARB1	345.0	OVEC	Z1	AEP_P4_#14920_05TANNER 345_T	breaker	1204.0	158.52	159.82	DC	16.29
16465605 4	243233	05TANNER	345.0	AEP	248001	06DEARB1	345.0	OVEC	Z1	DEOK_P2-3_1401_MIAMIFORT	breaker	1204.0	114.9	115.33	DC	12.53
16183039 4	243792	05LOSANTVILL	345.0	AEP	243233	05TANNER	345.0	AEP	2	AEP_P7-1_#11019-D	tower	648.0	125.26	127.98	DC	17.61
16183039 5	243792	05LOSANTVILL	345.0	AEP	243233	05TANNER	345.0	AEP	2	AEP_P7-1_#11087-H	tower	648.0	119.51	122.24	DC	17.63
16465605 8	248001	06DEARB1	345.0	OVEC	248013	06PIERCE	345.0	OVEC	1	AEP_P4_#14920_05TANNER 345_T	breaker	971.0	153.89	154.35	DC	9.84
16465702 8	248001	06DEARB1	345.0	OVEC	248013	06PIERCE	345.0	OVEC	1	DEOK_P7_4504MFTANNERS4512EBTANNERS	tower	971.0	153.89	154.35	DC	9.84
16183042 6	923880	AB2-028 TAP	345.0	AEP	243222	05FALLC	345.0	AEP	1	AEP_P7-1_#11019-D	tower	1318.0	115.41	118.22	DC	37.11
16183042 7	923880	AB2-028 TAP	345.0	AEP	243222	05FALLC	345.0	AEP	1	AEP_P7-1_#11087-H	tower	1318.0	109.5	112.32	DC	37.16

11.4 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
168237215	243218	05DESOTO	345.0	AEP	958860	AF2-177 TAP	345.0	AEP	2	AEP_P1-2_#4817_6341	operation	971.0	118.4	120.95	DC	24.68
168237325	243218	05DESOTO	345.0	AEP	243278	05DESOTO	138.0	AEP	1	AEP_P1-3_#6854_05DESOTO 345_2	operation	692.0	106.46	107.09	DC	9.65
168237335	243218	05DESOTO	345.0	AEP	243278	05DESOTO	138.0	AEP	2	AEP_P1-3_#674_05DESOTO 345_1	operation	692.0	105.01	105.63	DC	9.52
168237191	243225	05KEYSTN	345.0	AEP	243232	05SORENS	345.0	AEP	1	Base Case	operation	897.0	119.02	123.97	DC	44.34
168237192	243225	05KEYSTN	345.0	AEP	243232	05SORENS	345.0	AEP	1	AEP_P1-2_#8702_2543-C	operation	1301.0	118.82	122.42	DC	47.41
168237363	243232	05SORENS	345.0	AEP	243231	05ROBPK	345.0	AEP	1	AEP_P1-2_#7441_100545-A	operation	1203.0	99.17	100.35	DC	14.13
164656507	243233	05TANNER	345.0	AEP	248001	06DEARB1	345.0	OVEC	Z1	AEP_P1-2_#144_1696	operation	1204.0	114.72	115.15	DC	12.53
168237063	944530	AF1-118 TAP	345.0	AEP	243232	05SORENS	345.0	AEP	2	AEP_P1-2_#4817_6341	operation	971.0	163.04	165.54	DC	24.68
169749690	944830	AF1-148 TAP	345.0	AEP	944530	AF1-118 TAP	345.0	AEP	2	AEP_P1-2_#4817_6341	operation	971.0	141.23	143.74	DC	24.68
168237189	945370	AF1-202 TAP	345.0	AEP	243218	05DESOTO	345.0	AEP	1	AEP_P1-2_#4817_6341	operation	897.0	114.81	125.94	DC	99.88
169749763	958860	AF2-177 TAP	345.0	AEP	944830	AF1-148 TAP	345.0	AEP	2	AEP_P1-2_#4817_6341	operation	971.0	131.78	134.28	DC	24.68
168237083	960970	AF2-388 TAP	345.0	AEP	243225	05KEYSTN	345.0	AEP	1	AEP_P1-2_#8702_2543-C	operation	897.0	153.15	158.39	DC	47.54
168237085	960970	AF2-388 TAP	345.0	AEP	243225	05KEYSTN	345.0	AEP	1	Base Case	operation	897.0	97.34	102.3	DC	44.46

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
161830471,161830472	1	05DESOTO 345.0 kV - AB2-028 TAP 345.0 kV Ckt 1	**AEP** **AEPI0026a (222) : Replace 10 345 kV Desoto Risers (Sub Cond 22156 ACSR 84/19 STD)** **Project Type : FAC** **Cost : $1,000,000** **Time Estimate : 12-18 Months** **AEPI0026b (223) : A Sag Study will be required on the ~18 mile section of ACSR ~954 ~45/7 ~ RAIL line to mitigate the overload . New Rating after the Sag Study : S/N: 1410 MVA S/E: 1888 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $72,000 (No remediations required just sag study) and $54 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 : $72,000** **Time Estimate : 6-12 Months**	$1,072,000
161830394,161830395	4	05LOSANTVILL 345.0 kV - 05TANNER 345.0 kV Ckt 2	**AEP** **AEPI0061a (465) : An engineering study will need to be conducted to determine if the Tanner Relay Thermal limit 1118 Amps settings can be adjusted to mitigate the overload.** **Project Type : FAC** **Cost : $25,000** **Time Estimate : 12-18 Months**	$25,000
161830426,161830427	6	AB2-028 TAP 345.0 kV - 05FALL C 345.0 kV Ckt 1	**AEP** **Not a violation for AEP portion (471) : Not a violation for AEP portion** **Project Type : FAC** **Cost : $0** **Time Estimate : 0.0 Months** **IPL** **NonPJMArea (425) : The external (i.e. Non-PJM) Transmission Owner, IPL, will not evaluate this violation until the impact study phase.** **Project Type : FAC** **Cost : $0** **Time Estimate : 0.0 Months**	$0
167438024	2	05DESOTO 345.0 kV - 05DESOTO 138.0 kV Ckt 1	**AEP** **AEPI0063a (466) : Replace the Desoto 138 kV bus 3' AL tubular** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12-18 Months**	$100,000

ID	Idx	Facility	Upgrade Description	Cost
164656054,164656053,161830350	3	05TANNER 345.0 kV - 06DEARB1 345.0 kV Ckt Z1	AEP AEPI0024a (9) : Replace Tanner's Creek 345 kV Riser (Sub Cond 2870 MCM ACSR) Project Type : FAC Cost : $100,000 Time Estimate : 12-18 Months	$100,000
164656058,164657028	5	06DEARB1 345.0 kV - 06PIERCE 345.0 kV Ckt 1	OVEC OVEC0001a (1) : 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 (2) : Replace 2 1600 A switches at Dearborn 345 kV and 4 1600 A switches at Pierce 345kV Project Type : FAC Cost : $9,000,000 Time Estimate : 12 -18 Months OVEC0001c (3) : Replace 2156 KCM ACSR risers at Dearborn 345 kV Project Type : FAC Cost : $175,000 Time Estimate : 12 -18 Months OVEC0001d (4) : Replace/issue new settings for Dearborn line relays. Project Type : FAC Cost : $100,000 Time Estimate : 12-18 Months	$9,400,000
			TOTAL COST	$10,697,000

11.6 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

11.6.1 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
161830471	243218	05DESOTO	AEP	923880	AB2-028 TAP	AEP	1	AEP_P7-1_#11019-D	tower	1318.0	106.27	109.09	DC	37.11

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	1.3143	50/50	1.3143
247292	05KEY G1	3.3844	50/50	3.3844
247293	05KEY G2	3.4019	50/50	3.4019
247294	05KEY G3	3.4956	50/50	3.4956
247295	05KEY G4	3.5073	50/50	3.5073
247536	05BLUFF P WF	0.5695	50/50	0.5695
247543	V3-007 C	1.3143	50/50	1.3143
247621	Y3-024	0.0507	50/50	0.0507
247929	S-071 E	14.4384	50/50	14.4384
247935	V3-007 E	55.7513	50/50	55.7513
247963	05HDWTR1G E	55.7513	50/50	55.7513
926881	AC1-175 C	24.3512	50/50	24.3512
926882	AC1-175 E	39.7308	50/50	39.7308
932681	AC2-090 C	12.1756	50/50	12.1756
932682	AC2-090 E	19.8654	50/50	19.8654
932841	AC2-111 C O1	2.4845	Adder	2.92
932842	AC2-111 E O1	4.0537	Adder	4.77
933594	AC2-176 C	0.4291	50/50	0.4291
933596	AC2-176 E	18.2023	50/50	18.2023
934961	AD1-128 C	12.0869	50/50	12.0869
934962	AD1-128 E	19.7207	50/50	19.7207
939761	AE1-207 C	8.5841	50/50	8.5841
939762	AE1-207 E	11.8543	50/50	11.8543
939771	AE1-208 C	6.8024	50/50	6.8024
939772	AE1-208 E	9.2760	50/50	9.2760
939781	AE1-209 C O1	4.8248	50/50	4.8248
939782	AE1-209 E O1	32.2892	50/50	32.2892
939791	AE1-210 C O1	4.8248	50/50	4.8248
939792	AE1-210 E O1	32.2892	50/50	32.2892
940981	AE2-089 C O1	11.2521	50/50	11.2521
940982	AE2-089 E O1	7.5014	50/50	7.5014
941691	AE2-169	4.0814	50/50	4.0814
941721	AE2-172	5.1096	50/50	5.1096
942071	AE2-219 C	6.1156	50/50	6.1156
942072	AE2-219 E	8.4454	50/50	8.4454
942081	AE2-220 C	16.8215	50/50	16.8215
942082	AE2-220 E	23.2297	50/50	23.2297
942221	AE2-234 C O1	1.8295	Adder	2.15
942222	AE2-234 E O1	0.8275	Adder	0.97
944031	AF1-071 C	0.6211	Adder	0.73
944032	AF1-071 E	1.0134	Adder	1.19

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944531	AF1-118 C O1	99.7969	50/50	99.7969
944532	AF1-118 E O1	30.0986	50/50	30.0986
944541	AF1-119 C O1	51.9582	50/50	51.9582
944542	AF1-119 E O1	22.2678	50/50	22.2678
944831	AF1-148 C O1	35.4058	50/50	35.4058
944832	AF1-148 E O1	23.6039	50/50	23.6039
945371	AF1-202 C O1	12.6184	50/50	12.6184
945372	AF1-202 E O1	61.6076	50/50	61.6076
945561	AF1-221 C O1	9.9512	Adder	11.71
945562	AF1-221 E O1	2.9911	Adder	3.52
945581	AF1-223 C O1	33.4017	50/50	33.4017
945582	AF1-223 E O1	22.2678	50/50	22.2678
946031	AF1-268 C O1	13.7794	50/50	13.7794
946032	AF1-268 E O1	6.2502	50/50	6.2502
957741	AF2-068 C O1	14.4846	50/50	14.4846
957742	AF2-068 E O1	9.6564	50/50	9.6564
958711	AF2-162 C	11.1339	50/50	11.1339
958712	AF2-162 E	5.5670	50/50	5.5670
958821	AF2-173 C	31.1758	50/50	31.1758
958822	AF2-173 E	43.0522	50/50	43.0522
958861	AF2-177 C O1	9.6494	50/50	9.6494
958862	AF2-177 E O1	64.5766	50/50	64.5766
959201	AF2-211 C	4.9037	Adder	5.77
959202	AF2-211 E	3.2691	Adder	3.85
960441	AF2-335 C	10.8810	50/50	10.8810
960442	AF2-335 E	3.6270	50/50	3.6270
960791	AF2-370	3.6270	50/50	3.6270
960971	AF2-388 C	13.0638	50/50	13.0638
960972	AF2-388 E	61.1622	50/50	61.1622
961162	AF2-407 BAT	92.1750	50/50	92.1750
961172	AF2-408 BAT	13.2912	50/50	13.2912
961761	AG1-017 C	0.4716	50/50	0.4716
961762	AG1-017 E	2.2065	50/50	2.2065
962031	AG1-047 C	9.6564	50/50	9.6564
962032	AG1-047 E	6.4376	50/50	6.4376
962051	AG1-049	0.7624	Adder	1.69
963731	AG1-225 C	8.8749	Adder	19.7
963732	AG1-225 E	5.9595	Adder	13.23
964353	AG1-297 BAT	21.6346	Merchant Transmission	21.6346
964611	AG1-324 C O1	5.5925	50/50	5.5925
964612	AG1-324 E O1	2.3968	50/50	2.3968
965031	AG1-367 C	22.2684	50/50	22.2684
965032	AG1-367 E	14.8456	50/50	14.8456
965101	AG1-375 C	22.2678	50/50	22.2678
965102	AG1-375 E	14.8452	50/50	14.8452
965111	AG1-376 C	4.4536	50/50	4.4536
965112	AG1-376 E	6.6803	50/50	6.6803
965461	AG1-414 C O1	1.8038	Adder	4.0
965462	AG1-414 E O1	1.2026	Adder	2.67
965651	AG1-433 C	6.5319	50/50	6.5319
965652	AG1-433 E	30.5811	50/50	30.5811
G-007A	G-007A	0.4771	Confirmed LTF	0.4771

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
VFT	VFT	1.2900	Confirmed LTF	1.2900
CALDERWOOD	CALDERWOOD	0.6222	Confirmed LTF	0.6222
PRAIRIE	PRAIRIE	8.6195	Confirmed LTF	8.6195
CHEOAH	CHEOAH	0.6166	Confirmed LTF	0.6166
CBM-N	CBM-N	0.2412	Confirmed LTF	0.2412
COTTONWOOD	COTTONWOOD	4.5381	Confirmed LTF	4.5381
HAMLET	HAMLET	0.3101	Confirmed LTF	0.3101
GIBSON	GIBSON	3.8804	Confirmed LTF	3.8804
BLUEG	BLUEG	3.2394	Confirmed LTF	3.2394
TRIMBLE	TRIMBLE	0.8826	Confirmed LTF	0.8826
CATAWBA	CATAWBA	0.2222	Confirmed LTF	0.2222

11.6.2 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
167438024	243218	05DESOTO	AEP	243278	05DESOTO	AEP	1	AEP_P4_#4814_05DESOTO	breaker	692.0	106.29	107.89	DC	11.1

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	0.5976	50/50	0.5976
247543	V3-007 C	0.5976	50/50	0.5976
247935	V3-007 E	25.3501	50/50	25.3501
247963	05HDWTR1G E	25.3501	50/50	25.3501
923881	AB2-028 C	1.8458	Adder	2.17
923882	AB2-028 E	12.3526	Adder	14.53
926881	AC1-175 C	11.0724	50/50	11.0724
926882	AC1-175 E	18.0656	50/50	18.0656
932681	AC2-090 C	5.5362	50/50	5.5362
932682	AC2-090 E	9.0328	50/50	9.0328
939781	AE1-209 C O1	2.2090	50/50	2.2090
939782	AE1-209 E O1	14.7830	50/50	14.7830
939791	AE1-210 C O1	2.2090	50/50	2.2090
939792	AE1-210 E O1	14.7830	50/50	14.7830
941692	AE2-169 BAT	10.0247	50/50	10.0247
941712	AE2-171 BAT	5.0043	50/50	5.0043
941722	AE2-172 BAT	11.8648	50/50	11.8648
942081	AE2-220 C	7.6487	50/50	7.6487
942082	AE2-220 E	10.5625	50/50	10.5625
944541	AF1-119 C O1	16.8154	50/50	16.8154
944542	AF1-119 E O1	7.2066	50/50	7.2066
945371	AF1-202 C O1	4.3918	50/50	4.3918
945372	AF1-202 E O1	21.4422	50/50	21.4422
945581	AF1-223 C O1	11.6253	50/50	11.6253
945582	AF1-223 E O1	7.7502	50/50	7.7502
958711	AF2-162 C	3.6033	50/50	3.6033
958712	AF2-162 E	1.8017	50/50	1.8017
958821	AF2-173 C	14.2733	50/50	14.2733
958822	AF2-173 E	19.7107	50/50	19.7107
960971	AF2-388 C	3.9058	50/50	3.9058
960972	AF2-388 E	18.2862	50/50	18.2862
964613	AG1-324 BAT	15.5137	50/50	15.5137
965031	AG1-367 C	10.1952	50/50	10.1952
965032	AG1-367 E	6.7968	50/50	6.7968
965651	AG1-433 C	1.9529	50/50	1.9529
965652	AG1-433 E	9.1431	50/50	9.1431
LGEE	LGEE	0.3179	Confirmed LTF	0.3179
CPLE	CPLE	0.0710	Confirmed LTF	0.0710
CBM-W2	CBM-W2	3.3958	Confirmed LTF	3.3958
NY	NY	0.0094	Confirmed LTF	0.0094
TVA	TVA	0.3710	Confirmed LTF	0.3710
O-066	O-066	0.0673	Confirmed LTF	0.0673

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
SIGE	SIGE	0.0823	Confirmed LTF	0.0823
CBM-S2	CBM-S2	1.3676	Confirmed LTF	1.3676
CBM-S1	CBM-S1	0.1174	Confirmed LTF	0.1174
G-007	G-007	0.0095	Confirmed LTF	0.0095
MEC	MEC	0.1668	Confirmed LTF	0.1668
LAGN	LAGN	0.4147	Confirmed LTF	0.4147

11.6.3 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
164656053	243233	05TANNER	AEP	248001	06DEARB1	OVEC	Z1	AEP_P4_#14920_05TANNER 345_T	breaker	1204.0	158.52	159.82	DC	16.29

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243415	05WWVSTA	2.5309	50/50	2.5309
243795	05HDWTR1G C	1.0971	50/50	1.0971
247264	05LAWG1A	15.3783	50/50	15.3783
247265	05LAWG1B	15.3783	50/50	15.3783
247266	05LAWG1S	24.5616	50/50	24.5616
247267	05LAWG2A	15.3783	50/50	15.3783
247268	05LAWG2B	15.3783	50/50	15.3783
247269	05LAWG2S	24.5616	50/50	24.5616
247289	05RICHG2	0.8780	50/50	0.8780
247543	V3-007 C	1.0971	50/50	1.0971
247929	S-071 E	12.2686	Adder	14.43
247935	V3-007 E	46.5363	50/50	46.5363
247958	05WLD G2 E	23.1449	Adder	27.23
247963	05HDWTR1G E	46.5363	50/50	46.5363
247968	Z2-115 E	0.1239	Adder	0.15
920501	AA2-148 C O1	5.7544	50/50	5.7544
920502	AA2-148 E O1	38.5101	50/50	38.5101
923881	AB2-028 C	4.8142	50/50	4.8142
923882	AB2-028 E	32.2178	50/50	32.2178
926881	AC1-175 C	20.3262	50/50	20.3262
926882	AC1-175 E	33.1638	50/50	33.1638
932681	AC2-090 C	10.1631	50/50	10.1631
932682	AC2-090 E	16.5819	50/50	16.5819
932841	AC2-111 C O1	5.5489	50/50	5.5489
932842	AC2-111 E O1	9.0535	50/50	9.0535
933596	AC2-176 E	13.8780	Adder	16.33
934161	AD1-043 C O1	7.4209	50/50	7.4209
934162	AD1-043 E O1	12.1079	50/50	12.1079
934961	AD1-128 C	10.6487	50/50	10.6487
934962	AD1-128 E	17.3743	50/50	17.3743
936561	AD2-071 C	8.3990	Adder	9.88
936562	AD2-071 E	4.1368	Adder	4.87
939761	AE1-207 C	8.1939	Adder	9.64
939762	AE1-207 E	11.3153	Adder	13.31
939771	AE1-208 C	8.9105	50/50	8.9105
939772	AE1-208 E	12.1507	50/50	12.1507
939781	AE1-209 C O1	2.7387	50/50	2.7387
939782	AE1-209 E O1	18.3283	50/50	18.3283
939791	AE1-210 C O1	2.7387	50/50	2.7387
939792	AE1-210 E O1	18.3283	50/50	18.3283
940981	AE2-089 C O1	9.8560	Adder	11.6
940982	AE2-089 E O1	6.5706	Adder	7.73

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
941691	AE2-169	5.3463	50/50	5.3463
941711	AE2-171	4.8822	50/50	4.8822
941721	AE2-172	4.8773	Adder	5.74
942071	AE2-219 C	5.5578	Adder	6.54
942072	AE2-219 E	7.6750	Adder	9.03
942081	AE2-220 C	14.0411	50/50	14.0411
942082	AE2-220 E	19.3901	50/50	19.3901
942221	AE2-234 C O1	2.4758	Adder	2.91
942222	AE2-234 E O1	1.1198	Adder	1.32
942791	AE2-297 C O1	22.6554	50/50	22.6554
942792	AE2-297 E O1	15.1036	50/50	15.1036
944031	AF1-071 C	1.3872	50/50	1.3872
944032	AF1-071 E	2.2634	50/50	2.2634
944531	AF1-118 C O1	31.0803	Adder	36.57
944532	AF1-118 E O1	9.3738	Adder	11.03
944541	AF1-119 C O1	23.8476	50/50	23.8476
944542	AF1-119 E O1	10.2204	50/50	10.2204
944831	AF1-148 C O1	11.4832	Adder	13.51
944832	AF1-148 E O1	7.6554	Adder	9.01
945371	AF1-202 C O1	6.0411	50/50	6.0411
945372	AF1-202 E O1	29.4949	50/50	29.4949
945561	AF1-221 C O1	34.4242	50/50	34.4242
945562	AF1-221 E O1	10.3472	50/50	10.3472
945581	AF1-223 C O1	15.9912	50/50	15.9912
945582	AF1-223 E O1	10.6608	50/50	10.6608
946031	AF1-268 C O1	10.3711	50/50	10.3711
946032	AF1-268 E O1	4.7042	50/50	4.7042
953351	J805	18.8732	PJM External (MISO)	18.8732
954351	J903	9.6360	PJM External (MISO)	9.6360
955151	J993	19.1640	PJM External (MISO)	19.1640
956561	J1152	21.9860	PJM External (MISO)	21.9860
957741	AF2-068 C O1	11.0435	Adder	12.99
957742	AF2-068 E O1	7.3624	Adder	8.66
958711	AF2-162 C	5.1102	50/50	5.1102
958712	AF2-162 E	2.5551	50/50	2.5551
958821	AF2-173 C	17.6963	50/50	17.6963
958822	AF2-173 E	24.4377	50/50	24.4377
958861	AF2-177 C O1	4.3784	50/50	4.3784
958862	AF2-177 E O1	29.3016	50/50	29.3016
959131	AF2-204 C	7.6433	Adder	8.99
959132	AF2-204 E	4.0339	Adder	4.75
959201	AF2-211 C	10.9518	50/50	10.9518
959202	AF2-211 E	7.3012	50/50	7.3012
960441	AF2-335 C	10.8672	50/50	10.8672
960442	AF2-335 E	3.6224	50/50	3.6224
960791	AF2-370	3.6224	50/50	3.6224
960971	AF2-388 C	5.7355	50/50	5.7355
960972	AF2-388 E	26.8525	50/50	26.8525
961161	AF2-407	52.5750	50/50	52.5750
961171	AF2-408	14.3080	50/50	14.3080
961761	AG1-017 C	0.1906	Adder	0.42
961762	AG1-017 E	0.8916	Adder	1.98

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
962031	AG1-047 C	3.9021	Adder	8.66
962032	AG1-047 E	2.6014	Adder	5.77
962051	AG1-049	3.2125	50/50	3.2125
963721	AG1-224 C O1	39.1759	50/50	39.1759
963722	AG1-224 E O1	26.1173	50/50	26.1173
963731	AG1-225 C	10.4416	Adder	23.18
963732	AG1-225 E	7.0115	Adder	15.56
963791	AG1-232 C	3.4086	Adder	7.57
963792	AG1-232 E	2.2724	Adder	5.04
964351	AG1-297 C	55.6400	50/50	55.6400
964352	AG1-297 E	83.4600	50/50	83.4600
964611	AG1-324 C O1	2.1577	Adder	4.79
964612	AG1-324 E O1	0.9247	Adder	2.05
965031	AG1-367 C	12.6402	50/50	12.6402
965032	AG1-367 E	8.4268	50/50	8.4268
965101	AG1-375 C	10.1040	50/50	10.1040
965102	AG1-375 E	6.7360	50/50	6.7360
965111	AG1-376 C	2.0208	50/50	2.0208
965112	AG1-376 E	3.0312	50/50	3.0312
965461	AG1-414 C O1	2.6277	Adder	5.83
965462	AG1-414 E O1	1.7518	Adder	3.89
965651	AG1-433 C	2.8677	50/50	2.8677
965652	AG1-433 E	13.4263	50/50	13.4263
WEC	WEC	1.2880	Confirmed LTF	1.2880
CALDERWOOD	CALDERWOOD	0.1779	Confirmed LTF	0.1779
CBM-W2	CBM-W2	26.8710	Confirmed LTF	26.8710
NY	NY	0.5790	Confirmed LTF	0.5790
TVA	TVA	0.9828	Confirmed LTF	0.9828
O-066	O-066	7.3222	Confirmed LTF	7.3222
SIGE	SIGE	0.5410	Confirmed LTF	0.5410
CHEOAH	CHEOAH	0.1862	Confirmed LTF	0.1862
CBM-S1	CBM-S1	0.0262	Confirmed LTF	0.0262
G-007	G-007	1.1445	Confirmed LTF	1.1445
HAMLET	HAMLET	0.5290	Confirmed LTF	0.5290
MEC	MEC	5.5869	Confirmed LTF	5.5869
BLUEG	BLUEG	6.4232	Confirmed LTF	6.4232
TRIMBLE	TRIMBLE	2.4364	Confirmed LTF	2.4364
LAGN	LAGN	2.3030	Confirmed LTF	2.3030
CATAWBA	CATAWBA	0.3031	Confirmed LTF	0.3031
CBM-W1	CBM-W1	45.6211	Confirmed LTF	45.6211

11.6.4 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
161830394	243792	05LOSANTVILL	AEP	243233	05TANNER	AEP	2	AEP_P7-1_#11019-D	tower	648.0	125.26	127.98	DC	17.61

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	1.2302	50/50	1.2302
247292	05KEY G1	1.6056	50/50	1.6056
247293	05KEY G2	1.6139	50/50	1.6139
247294	05KEY G3	1.6584	50/50	1.6584
247295	05KEY G4	1.6639	50/50	1.6639
247543	V3-007 C	1.2302	50/50	1.2302
247929	S-071 E	6.4399	Adder	7.58
247935	V3-007 E	52.1826	50/50	52.1826
247958	05WLD G2 E	12.3053	Adder	14.48
247963	05HDWTR1G E	52.1826	50/50	52.1826
247968	Z2-115 E	0.0710	Adder	0.08
920501	AA2-148 C O1	1.2391	Adder	1.46
920502	AA2-148 E O1	8.2928	Adder	9.76
923881	AB2-028 C	3.1600	50/50	3.1600
923882	AB2-028 E	21.1480	50/50	21.1480
926881	AC1-175 C	22.7924	50/50	22.7924
926882	AC1-175 E	37.1876	50/50	37.1876
932681	AC2-090 C	11.3962	50/50	11.3962
932682	AC2-090 E	18.5938	50/50	18.5938
933596	AC2-176 E	8.3609	Adder	9.84
934161	AD1-043 C O1	3.2434	Adder	3.82
934162	AD1-043 E O1	5.2919	Adder	6.23
934961	AD1-128 C	6.2278	50/50	6.2278
934962	AD1-128 E	10.1612	50/50	10.1612
936561	AD2-071 C	4.5275	Adder	5.33
936562	AD2-071 E	2.2300	Adder	2.62
939761	AE1-207 C	5.3327	Adder	6.27
939762	AE1-207 E	7.3642	Adder	8.66
939771	AE1-208 C	4.6605	Adder	5.48
939772	AE1-208 E	6.3552	Adder	7.48
939781	AE1-209 C O1	2.2885	50/50	2.2885
939782	AE1-209 E O1	15.3155	50/50	15.3155
939791	AE1-210 C O1	2.2885	50/50	2.2885
939792	AE1-210 E O1	15.3155	50/50	15.3155
940981	AE2-089 C O1	5.4568	Adder	6.42
940982	AE2-089 E O1	3.6379	Adder	4.28
941691	AE2-169	2.7963	Adder	3.29
941711	AE2-171	2.1338	Adder	2.51
941721	AE2-172	3.1742	Adder	3.73
942071	AE2-219 C	2.6489	Adder	3.12
942072	AE2-219 E	3.6581	Adder	4.3

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
942081	AE2-220 C	15.7447	50/50	15.7447
942082	AE2-220 E	21.7427	50/50	21.7427
942221	AE2-234 C O1	1.3094	Adder	1.54
942222	AE2-234 E O1	0.5922	Adder	0.7
942791	AE2-297 C O1	5.1611	Adder	6.07
942792	AE2-297 E O1	3.4408	Adder	4.05
944531	AF1-118 C O1	47.3452	50/50	47.3452
944532	AF1-118 E O1	14.2793	50/50	14.2793
944541	AF1-119 C O1	24.6484	50/50	24.6484
944542	AF1-119 E O1	10.5636	50/50	10.5636
944831	AF1-148 C O1	16.7971	50/50	16.7971
944832	AF1-148 E O1	11.1981	50/50	11.1981
945371	AF1-202 C O1	5.9860	50/50	5.9860
945372	AF1-202 E O1	29.2260	50/50	29.2260
945581	AF1-223 C O1	15.8454	50/50	15.8454
945582	AF1-223 E O1	10.5636	50/50	10.5636
946031	AF1-268 C O1	7.3944	50/50	7.3944
946032	AF1-268 E O1	3.3540	50/50	3.3540
957741	AF2-068 C O1	6.6532	Adder	7.83
957742	AF2-068 E O1	4.4355	Adder	5.22
958711	AF2-162 C	5.2818	50/50	5.2818
958712	AF2-162 E	2.6409	50/50	2.6409
958821	AF2-173 C	14.7874	50/50	14.7874
958822	AF2-173 E	20.4206	50/50	20.4206
958861	AF2-177 C O1	4.5776	50/50	4.5776
958862	AF2-177 E O1	30.6344	50/50	30.6344
959131	AF2-204 C	3.9443	Adder	4.64
959132	AF2-204 E	2.0817	Adder	2.45
960441	AF2-335 C	7.3248	50/50	7.3248
960442	AF2-335 E	2.4416	50/50	2.4416
960791	AF2-370	2.4416	50/50	2.4416
960971	AF2-388 C	6.1973	50/50	6.1973
960972	AF2-388 E	29.0147	50/50	29.0147
961161	AF2-407	30.1050	50/50	30.1050
961171	AF2-408	6.2111	Adder	7.31
961761	AG1-017 C	0.1148	Adder	0.25
961762	AG1-017 E	0.5372	Adder	1.19
962031	AG1-047 C	2.3508	Adder	5.22
962032	AG1-047 E	1.5672	Adder	3.48
963731	AG1-225 C	5.3565	Adder	11.89
963732	AG1-225 E	3.5969	Adder	7.98
964611	AG1-324 C O1	1.3588	Adder	3.02
964612	AG1-324 E O1	0.5823	Adder	1.29
965031	AG1-367 C	10.5624	50/50	10.5624
965032	AG1-367 E	7.0416	50/50	7.0416
965101	AG1-375 C	10.5636	50/50	10.5636
965102	AG1-375 E	7.0424	50/50	7.0424
965111	AG1-376 C	2.1127	50/50	2.1127
965112	AG1-376 E	3.1691	50/50	3.1691
965461	AG1-414 C O1	1.6157	Adder	3.59
965462	AG1-414 E O1	1.0771	Adder	2.39
965651	AG1-433 C	3.0987	50/50	3.0987

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
965652	AG1-433 E	14.5073	50/50	14.5073
WEC	WEC	0.4167	Confirmed LTF	0.4167
CBM-W2	CBM-W2	10.6803	Confirmed LTF	10.6803
NY	NY	0.0896	Confirmed LTF	0.0896
TVA	TVA	0.7434	Confirmed LTF	0.7434
O-066	O-066	1.1172	Confirmed LTF	1.1172
SIGE	SIGE	0.1869	Confirmed LTF	0.1869
CBM-S2	CBM-S2	0.3550	Confirmed LTF	0.3550
CBM-S1	CBM-S1	0.1615	Confirmed LTF	0.1615
G-007	G-007	0.1743	Confirmed LTF	0.1743
HAMLET	HAMLET	0.0017	Confirmed LTF	0.0017
MEC	MEC	1.9640	Confirmed LTF	1.9640
BLUEG	BLUEG	0.1441	Confirmed LTF	0.1441
TRIMBLE	TRIMBLE	0.1180	Confirmed LTF	0.1180
LAGN	LAGN	1.2075	Confirmed LTF	1.2075
CBM-W1	CBM-W1	14.8752	Confirmed LTF	14.8752

11.6.5 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
164657028	248001	06DEARB1	OVEC	248013	06PIERCE	OVEC	1	DEOK_P7_4504MFTANNERS4512EBTANNERS	tower	971.0	153.89	154.35	DC	9.84

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	0.6377	50/50	0.6377
247264	05LAWG1A	8.6056	50/50	8.6056
247265	05LAWG1B	8.6056	50/50	8.6056
247266	05LAWG1S	13.7446	50/50	13.7446
247267	05LAWG2A	8.6056	50/50	8.6056
247268	05LAWG2B	8.6056	50/50	8.6056
247269	05LAWG2S	13.7446	50/50	13.7446
247543	V3-007 C	0.6377	50/50	0.6377
247929	S-071 E	6.9980	Adder	8.23
247935	V3-007 E	27.0500	50/50	27.0500
247958	05WLD G2 E	14.4291	Adder	16.98
247963	05HDWTR1G E	27.0500	50/50	27.0500
247968	Z2-115 E	0.0822	Adder	0.1
250163	Y3-099 BAT	0.1705	Merchant Transmission	0.1705
250167	08DEO_STUART	0.1664	Merchant Transmission	0.1664
251823	Z1-065 BAT	0.3601	Merchant Transmission	0.3601
913222	Y1-054 E	-1.2048	Adder	-1.42
920501	AA2-148 C O1	3.3681	50/50	3.3681
920502	AA2-148 E O1	22.5406	50/50	22.5406
923881	AB2-028 C	2.9424	50/50	2.9424
923882	AB2-028 E	19.6916	50/50	19.6916
926881	AC1-175 C	11.8150	50/50	11.8150
926882	AC1-175 E	19.2770	50/50	19.2770
932661	AC2-088 C O1	-2.4366	Adder	-2.87
932681	AC2-090 C	5.9075	50/50	5.9075
932682	AC2-090 E	9.6385	50/50	9.6385
932841	AC2-111 C O1	2.4465	Adder	2.88
932842	AC2-111 E O1	3.9917	Adder	4.7
933596	AC2-176 E	8.0465	Adder	9.47
934161	AD1-043 C O1	4.6001	50/50	4.6001
934162	AD1-043 E O1	7.5055	50/50	7.5055
934961	AD1-128 C	6.1098	50/50	6.1098
934962	AD1-128 E	9.9687	50/50	9.9687
935031	AD1-136 C	-0.3426	Adder	-0.4
936561	AD2-071 C	5.2964	Adder	6.23
936562	AD2-071 E	2.6087	Adder	3.07
939761	AE1-207 C	5.1591	Adder	6.07
939762	AE1-207 E	7.1244	Adder	8.38
939771	AE1-208 C	4.5824	Adder	5.39
939772	AE1-208 E	6.2488	Adder	7.35
939781	AE1-209 C O1	1.6223	50/50	1.6223

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
939782	AE1-209 E O1	10.8567	50/50	10.8567
939791	AE1-210 C O1	1.6223	50/50	1.6223
939792	AE1-210 E O1	10.8567	50/50	10.8567
940981	AE2-089 C O1	5.8205	Adder	6.85
940982	AE2-089 E O1	3.8803	Adder	4.57
941691	AE2-169	2.7495	Adder	3.23
941711	AE2-171	3.0264	50/50	3.0264
941721	AE2-172	3.0709	Adder	3.61
942071	AE2-219 C	3.1320	Adder	3.68
942072	AE2-219 E	4.3251	Adder	5.09
942081	AE2-220 C	8.1616	50/50	8.1616
942082	AE2-220 E	11.2709	50/50	11.2709
942221	AE2-234 C O1	1.5136	Adder	1.78
942222	AE2-234 E O1	0.6846	Adder	0.81
942791	AE2-297 C O1	13.2913	50/50	13.2913
942792	AE2-297 E O1	8.8609	50/50	8.8609
943773	AF1-045 BAT	3.5877	Merchant Transmission	3.5877
944031	AF1-071 C	0.6116	Adder	0.72
944032	AF1-071 E	0.9979	Adder	1.17
944531	AF1-118 C O1	19.0669	Adder	22.43
944532	AF1-118 E O1	5.7506	Adder	6.77
944541	AF1-119 C O1	14.3430	50/50	14.3430
944542	AF1-119 E O1	6.1470	50/50	6.1470
944831	AF1-148 C O1	7.0175	Adder	8.26
944832	AF1-148 E O1	4.6784	Adder	5.5
945371	AF1-202 C O1	3.6217	50/50	3.6217
945372	AF1-202 E O1	17.6823	50/50	17.6823
945561	AF1-221 C O1	18.4653	50/50	18.4653
945562	AF1-221 E O1	5.5503	50/50	5.5503
945581	AF1-223 C O1	9.5868	50/50	9.5868
945582	AF1-223 E O1	6.3912	50/50	6.3912
946031	AF1-268 C O1	6.1205	50/50	6.1205
946032	AF1-268 E O1	2.7762	50/50	2.7762
956561	J1152	12.4260	PJM External (MISO)	12.4260
957741	AF2-068 C O1	6.4031	Adder	7.53
957742	AF2-068 E O1	4.2687	Adder	5.02
958711	AF2-162 C	3.0735	50/50	3.0735
958712	AF2-162 E	1.5368	50/50	1.5368
958821	AF2-173 C	10.4824	50/50	10.4824
958822	AF2-173 E	14.4756	50/50	14.4756
958861	AF2-177 C O1	2.6359	50/50	2.6359
958862	AF2-177 E O1	17.6401	50/50	17.6401
959131	AF2-204 C	4.7350	Adder	5.57
959132	AF2-204 E	2.4991	Adder	2.94
959201	AF2-211 C	4.8287	Adder	5.68
959202	AF2-211 E	3.2191	Adder	3.79
960441	AF2-335 C	6.4992	50/50	6.4992
960442	AF2-335 E	2.1664	50/50	2.1664
960791	AF2-370	2.1664	50/50	2.1664
960971	AF2-388 C	2.9426	Adder	3.46
960972	AF2-388 E	13.7769	Adder	16.21
961161	AF2-407	32.5980	50/50	32.5980

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
961171	AF2-408	8.7872	50/50	8.7872
961761	AG1-017 C	0.1105	Adder	0.25
961762	AG1-017 E	0.5170	Adder	1.15
962031	AG1-047 C	2.2624	Adder	5.02
962032	AG1-047 E	1.5083	Adder	3.35
962051	AG1-049	0.7507	Adder	1.67
963721	AG1-224 C O1	22.4885	50/50	22.4885
963722	AG1-224 E O1	14.9923	50/50	14.9923
963731	AG1-225 C	6.2592	Adder	13.89
963732	AG1-225 E	4.2030	Adder	9.33
963791	AG1-232 C	2.0953	Adder	4.65
963792	AG1-232 E	1.3969	Adder	3.1
964351	AG1-297 C	33.0840	50/50	33.0840
964352	AG1-297 E	49.6260	50/50	49.6260
964611	AG1-324 C O1	1.2566	Adder	2.79
964612	AG1-324 E O1	0.5385	Adder	1.2
965031	AG1-367 C	7.4874	50/50	7.4874
965032	AG1-367 E	4.9916	50/50	4.9916
965101	AG1-375 C	6.0828	50/50	6.0828
965102	AG1-375 E	4.0552	50/50	4.0552
965111	AG1-376 C	1.2166	50/50	1.2166
965112	AG1-376 E	1.8248	50/50	1.8248
965461	AG1-414 C O1	1.6958	Adder	3.76
965462	AG1-414 E O1	1.1305	Adder	2.51
965651	AG1-433 C	0.7798	Adder	1.73
965652	AG1-433 E	3.6509	Adder	8.1
WEC	WEC	1.1564	Confirmed LTF	1.1564
LGEE	LGEE	1.0662	Confirmed LTF	1.0662
CBM-W2	CBM-W2	27.2205	Confirmed LTF	27.2205
NY	NY	0.4866	Confirmed LTF	0.4866
TVA	TVA	1.9796	Confirmed LTF	1.9796
O-066	O-066	6.0099	Confirmed LTF	6.0099
SIGE	SIGE	0.5611	Confirmed LTF	0.5611
CBM-S1	CBM-S1	0.5571	Confirmed LTF	0.5571
G-007	G-007	0.9376	Confirmed LTF	0.9376
HAMLET	HAMLET	0.1756	Confirmed LTF	0.1756
MEC	MEC	5.3454	Confirmed LTF	5.3454
LAGN	LAGN	3.1867	Confirmed LTF	3.1867
CATAWBA	CATAWBA	0.0735	Confirmed LTF	0.0735
CBM-W1	CBM-W1	41.7936	Confirmed LTF	41.7936

11.6.6 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
161830426	923880	AB2-028 TAP	AEP	243222	05FALL C	AEP	1	AEP_P7-1_#11019-D	tower	1318.0	115.41	118.22	DC	37.11

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	1.3143	50/50	1.3143
247292	05KEY G1	3.3844	50/50	3.3844
247293	05KEY G2	3.4019	50/50	3.4019
247294	05KEY G3	3.4956	50/50	3.4956
247295	05KEY G4	3.5073	50/50	3.5073
247536	05BLUFF P WF	0.5695	50/50	0.5695
247543	V3-007 C	1.3143	50/50	1.3143
247621	Y3-024	0.0507	50/50	0.0507
247929	S-071 E	14.4384	50/50	14.4384
247935	V3-007 E	55.7513	50/50	55.7513
247963	05HDWTR1G E	55.7513	50/50	55.7513
923881	AB2-028 C	15.6702	50/50	15.6702
923882	AB2-028 E	104.8698	50/50	104.8698
926881	AC1-175 C	24.3512	50/50	24.3512
926882	AC1-175 E	39.7308	50/50	39.7308
932681	AC2-090 C	12.1756	50/50	12.1756
932682	AC2-090 E	19.8654	50/50	19.8654
932841	AC2-111 C O1	2.4845	Adder	2.92
932842	AC2-111 E O1	4.0537	Adder	4.77
933594	AC2-176 C	0.4291	50/50	0.4291
933596	AC2-176 E	18.2023	50/50	18.2023
934961	AD1-128 C	12.0869	50/50	12.0869
934962	AD1-128 E	19.7207	50/50	19.7207
939761	AE1-207 C	8.5841	50/50	8.5841
939762	AE1-207 E	11.8543	50/50	11.8543
939771	AE1-208 C	6.8024	50/50	6.8024
939772	AE1-208 E	9.2760	50/50	9.2760
939781	AE1-209 C O1	4.8248	50/50	4.8248
939782	AE1-209 E O1	32.2892	50/50	32.2892
939791	AE1-210 C O1	4.8248	50/50	4.8248
939792	AE1-210 E O1	32.2892	50/50	32.2892
940981	AE2-089 C O1	11.2521	50/50	11.2521
940982	AE2-089 E O1	7.5014	50/50	7.5014
941691	AE2-169	4.0814	50/50	4.0814
941721	AE2-172	5.1096	50/50	5.1096
942071	AE2-219 C	6.1156	50/50	6.1156
942072	AE2-219 E	8.4454	50/50	8.4454
942081	AE2-220 C	16.8215	50/50	16.8215
942082	AE2-220 E	23.2297	50/50	23.2297
942221	AE2-234 C O1	1.8295	Adder	2.15
942222	AE2-234 E O1	0.8275	Adder	0.97

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944031	AF1-071 C	0.6211	Adder	0.73
944032	AF1-071 E	1.0134	Adder	1.19
944531	AF1-118 C O1	99.7969	50/50	99.7969
944532	AF1-118 E O1	30.0986	50/50	30.0986
944541	AF1-119 C O1	51.9582	50/50	51.9582
944542	AF1-119 E O1	22.2678	50/50	22.2678
944831	AF1-148 C O1	35.4058	50/50	35.4058
944832	AF1-148 E O1	23.6039	50/50	23.6039
945371	AF1-202 C O1	12.6184	50/50	12.6184
945372	AF1-202 E O1	61.6076	50/50	61.6076
945561	AF1-221 C O1	9.9512	Adder	11.71
945562	AF1-221 E O1	2.9911	Adder	3.52
945581	AF1-223 C O1	33.4017	50/50	33.4017
945582	AF1-223 E O1	22.2678	50/50	22.2678
946031	AF1-268 C O1	13.7794	50/50	13.7794
946032	AF1-268 E O1	6.2502	50/50	6.2502
957741	AF2-068 C O1	14.4846	50/50	14.4846
957742	AF2-068 E O1	9.6564	50/50	9.6564
958711	AF2-162 C	11.1339	50/50	11.1339
958712	AF2-162 E	5.5670	50/50	5.5670
958821	AF2-173 C	31.1758	50/50	31.1758
958822	AF2-173 E	43.0522	50/50	43.0522
958861	AF2-177 C O1	9.6494	50/50	9.6494
958862	AF2-177 E O1	64.5766	50/50	64.5766
959201	AF2-211 C	4.9037	Adder	5.77
959202	AF2-211 E	3.2691	Adder	3.85
960441	AF2-335 C	10.8810	50/50	10.8810
960442	AF2-335 E	3.6270	50/50	3.6270
960791	AF2-370	3.6270	50/50	3.6270
960971	AF2-388 C	13.0638	50/50	13.0638
960972	AF2-388 E	61.1622	50/50	61.1622
961162	AF2-407 BAT	92.1750	50/50	92.1750
961172	AF2-408 BAT	13.2912	50/50	13.2912
961761	AG1-017 C	0.4716	50/50	0.4716
961762	AG1-017 E	2.2065	50/50	2.2065
962031	AG1-047 C	9.6564	50/50	9.6564
962032	AG1-047 E	6.4376	50/50	6.4376
962051	AG1-049	0.7624	Adder	1.69
963731	AG1-225 C	8.8749	Adder	19.7
963732	AG1-225 E	5.9595	Adder	13.23
964353	AG1-297 BAT	21.6346	Merchant Transmission	21.6346
964611	AG1-324 C O1	5.5925	50/50	5.5925
964612	AG1-324 E O1	2.3968	50/50	2.3968
965031	AG1-367 C	22.2684	50/50	22.2684
965032	AG1-367 E	14.8456	50/50	14.8456
965101	AG1-375 C	22.2678	50/50	22.2678
965102	AG1-375 E	14.8452	50/50	14.8452
965111	AG1-376 C	4.4536	50/50	4.4536
965112	AG1-376 E	6.6803	50/50	6.6803
965461	AG1-414 C O1	1.8038	Adder	4.0
965462	AG1-414 E O1	1.2026	Adder	2.67
965651	AG1-433 C	6.5319	50/50	6.5319

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
965652	AG1-433 E	30.5811	50/50	30.5811
G-007A	G-007A	0.4771	Confirmed LTF	0.4771
VFT	VFT	1.2900	Confirmed LTF	1.2900
CALDERWOOD	CALDERWOOD	0.6222	Confirmed LTF	0.6222
PRAIRIE	PRAIRIE	8.6195	Confirmed LTF	8.6195
CHEOAH	CHEOAH	0.6166	Confirmed LTF	0.6166
CBM-N	CBM-N	0.2412	Confirmed LTF	0.2412
COTTONWOOD	COTTONWOOD	4.5381	Confirmed LTF	4.5381
HAMLET	HAMLET	0.3101	Confirmed LTF	0.3101
GIBSON	GIBSON	3.8804	Confirmed LTF	3.8804
BLUEG	BLUEG	3.2394	Confirmed LTF	3.2394
TRIMBLE	TRIMBLE	0.8826	Confirmed LTF	0.8826
CATAWBA	CATAWBA	0.2222	Confirmed LTF	0.2222

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AA2-148	Madison-Tanners Creek 138kV	Active
AB2-028	Fall Creek-Desoto 345kV	Active
AC1-175	Losantville 345kV	Active
AC2-088	S. Bethel-Brown 69kV	Engineering and Procurement
AC2-090	Losantville 345kV	Active
AC2-111	College Corner 138kV	Active
AC2-176	Jay 138 kV	In Service
AD1-043	Makahoy 138 kV	Active
AD1-128	Modoc-Delaware 138 kV	Active
AD1-136	South Bethel-Brown 69 kV	Engineering and Procurement
AD2-071	Strawton-Pipe Creek 138 kV	Active
AE1-207	Mississinewa-Gaston 138 kV	Active
AE1-208	Delaware-Van Buren 138 kV	Active
AE1-209	Desoto 345 kV	Active
AE1-210	Desoto 345 kV	Active
AE2-089	Pennville-Adams 138 kV	Active
AE2-169	Delaware-Van Buren 138 kV	Active
AE2-171	Makahoy 138 kV	Active
AE2-172	Mississinewa-Gaston 138 kV	Active
AE2-219	Bluff Point-Randolph 138 kV	Active
AE2-220	Losantville 345 kV	Active
AE2-234	Liberty Center-Buckeye Tap 69 kV	Active
AE2-297	Madison-Tanners Creek 138 kV	Active
AF1-045	Cedarville-Ford 138 kV	Active
AF1-071	College Corner 138 kV	Active
AF1-118	Sorenson-Desoto 345 kV	Active
AF1-119	Keystone-Desoto 345 kV	Active
AF1-148	Sorenson-Desoto 345 kV	Active
AF1-202	Keystone-Desoto 345 kV	Active
AF1-221	College Corner-Drewersburg 138 kV	Active
AF1-223	Jay-Desoto 138 kV	Active
AF1-268	Desoto-Jay 138 kV	Active
AF2-068	Jay 138 kV	Active
AF2-162	Keystone-Desoto 345 kV	Active
AF2-173	Desoto 345 kV	Active
AF2-177	Sorenson-DeSoto #2 345 kV	Active
AF2-204	Van Buren 138 kV	Active
AF2-211	College Corner 138 kV	Active
AF2-335	West Del-Royerton 138 kV	Active

Queue Number	Project Name	Status
AF2-370	West Del-Royerton 138 kV	Active
AF2-388	Desoto-Sorenson 345 kV	Active
AF2-407	Fall Creek 345 kV	Active
AF2-408	Fall Creek 138 kV	Active
AG1-017	Jay 138 kV	Active
AG1-047	Jay 138 kV	Active
AG1-049	College Corner 138 kV	Active
AG1-224	Pendleton-Tanners Creek 138 kV	Active
AG1-225	Adams 138 kV	Active
AG1-232	Magley 138 kV	Active
AG1-297	Hanna-Tanners Creek 345 kV	Active
AG1-324	Jay-Desoto 138 kV	Active
AG1-367	DeSoto 345 kV	Active
AG1-375	Sorenson-Desoto 345 kV	Active
AG1-376	Sorenson-DeSoto 345 kV	Active
AG1-414	Mississinewa 138 kV	Active
AG1-433	DeSoto-Keystone 345 kV	Active
V3-007	Desoto-Tanners Creek #1 345kV	Under Construction
Y1-054	Rochelle 138kV	In Service
Y3-024	Bluff Point 12kV	In Service
Y3-099	Beckjord 2 MW-1	In Service
Z1-065	Wiley 34.5kV	In Service
Z2-115	Deer Creek 12.47kV	In Service
J1152	MISO	MISO
J805	MISO	MISO
J903	MISO	MISO
J993	MISO	MISO

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#7441_100545-A	CONTINGENCY 'AEP_P1-2_#7441_100545-A' OPEN BRANCH FROM BUS 242928 TO BUS 958430 CKT 1 / 242928 05MARYSV 765 958430 AF2-137 TAP 765 1 END
AEP_P7-1_#11087-H	CONTINGENCY 'AEP_P7-1_#11087-H' OPEN BRANCH FROM BUS 960970 TO BUS 243225 CKT 1 / 960970 AF2-388 TAP 345 243225 05KEYSTN 345 1 OPEN BRANCH FROM BUS 944530 TO BUS 243232 CKT 2 / 944530 AF1-118 TAP 345 243232 05SORENS 345 2 END
AEP_P4_#14920_05TANNER 345_T	CONTINGENCY 'AEP_P4_#14920_05TANNER 345_T' OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1 / 243233 05TANNER 345 249565 08EBEND
AEP_P1-2_#4817_6341	CONTINGENCY 'AEP_P1-2_#4817_6341' OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END
DEOK_P7_4504MFTANNERS4512EBTANNERS	CONTINGENCY 'DEOK_P7_4504MFTANNERS4512EBTANNERS' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1 END
DEOK_P2-3_1401_MIAMIFORT	CONTINGENCY 'DEOK_P2-3_1401_MIAMIFORT' OPEN BRANCH FROM BUS 249567 TO BUS 250057 CKT 9 OPEN BRANCH FROM BUS 249567 TO BUS 243233 CKT 1 END
Base Case	
AEP_P1-3_#6854_05DESOTO 345_2	CONTINGENCY 'AEP_P1-3_#6854_05DESOTO 345_2' OPEN BRANCH FROM BUS 243218 TO BUS 243278 CKT 2 / 243218 05DESOTO 345 243278 05DESOTO 138 2 END
AEP_P1-2_#8702_2543-C	CONTINGENCY 'AEP_P1-2_#8702_2543-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
AEP_P1-2_#144_1696	CONTINGENCY 'AEP_P1-2_#144_1696' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FORT 345 1 END
AEP_P7-1_#11019-D	CONTINGENCY 'AEP_P7-1_#11019-D' OPEN BRANCH FROM BUS 944530 TO BUS 243232 CKT 2 / 944530 AF1-118 TAP 345 243232 05SORENS 345 2 OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END
AEP_P1-3_#674_05DESOTO 345_1	CONTINGENCY 'AEP_P1-3_#674_05DESOTO 345_1' OPEN BRANCH FROM BUS 243218 TO BUS 243278 CKT 1 / 243218 05DESOTO 345 243278 05DESOTO 138 1 END
AEP_P4_#4814_05DESOTO	CONTINGENCY '"AEP_P4_#4814_05DESOTO' 345_C1" / 1555 OPEN BRANCH FROM BUS 243218 TO BUS 958860 CKT 2 / 243218 05DESOTO 345 958860 AF2-177 TAP 345 2 OPEN BRANCH FROM BUS 243218 TO BUS 243278 CKT 2 / 243218 05DESOTO 345 243278 05DESOTO 138 2 END

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

13 Affected Systems

13.1 TVA

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

13.2 Duke Energy Progress

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

13.3 MISO

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

13.4 LG&E

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