Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-062

JUG STREET 138 KV

80 MW Capacity / 200 MW Energy

January, 2020

Table of Contents

1 Preface 3
2 General 4
2.1 Point of Interconnection 5
2.2 Cost Summary 5
3 Transmission Owner Scope of Work 6
4 Attachment Facilities 6
5 Direct Connection Cost Estimate 6
6 Non-Direct Connection Cost Estimate 6
7 Schedule 7
8 Interconnection Customer Requirements 7
9 Revenue Metering and SCADA Requirements 8
9.1 PJM Requirements 8
9.2 AEP Requirements 8
10 Network Impacts 9
11 Generation Deliverability 11
12 Multiple Facility Contingency 11
13 Contribution to Previously Identified Overloads 11
14 Potential Congestion due to Local Energy Deliverability 11
15 System Reinforcements 13
16 Flow Gate Details 14
16.1 Index 1 15
16.2 Index 2 18
17 Affected Systems 23
17.1 LG&E 23
17.2 MISO 23
17.3 TVA 23
17.4 Duke Energy Progress 23
17.5 NYISO 23
18 Short Circuit 26

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.

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.

2 General

The Interconnection Customer (IC), has proposed a Storage facility located in Licking County, Ohio. The installed facilities will have a total capability of 200 MW with 80 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 8/22/2022. This study does not imply a TO commitment to this in-service date.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required for maintaining the reliability of the AEP transmission system.

The Feasibility Study includes Short Circuit and Peak Load steady state power flow analyses. The conduct of power flow studies at other load levels, stability analysis, and coordination with non-PJM Transmission Planners, 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 these additional analyses which shall be performed following execution of the System Impact Study agreement.

Queue Number	**AF1-062**
Project Name	JUG STREET 138 KV
State	Ohio
County	Licking
Transmission Owner	AEP
MFO	200
MWE	200
MWC	80
Fuel	Storage
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-062 will interconnect with the AEP transmission system via a direct connection to the Jug Street 138 kV station.

To accommodate the interconnection at the Jug Street 138 kV substation, the substation will have to be expanded requiring the installation of one (1) 138 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA and 138 kV revenue metering will also be required.

2.2 Cost Summary

The AF1-062 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$250,000
Direct Connection Network Upgrade	$1,250,000
Non Direct Connection Network Upgrades	$
Total Costs	$1,500,000

In addition, the AF1-062 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$2,039,600

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
138 kV 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
Installation of one (1) circuit breaker and associated protection and control equipment, 138 kV line risers, and SCADA equipment	$1,250,000
Total Direct Connection Facility Costs	$1,250,000

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
Total Non-Direct Connection Facility Costs	$0

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 Agreement execution.

8 Interconnection Customer Requirements

It is understood that the Interconnection Customer is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to the Jug Street 138 kV station 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.

In addition, if the Interconnection Customer considers use of the Option to Build, they should consult the guidance AEP has posted at:
https://www.aep.com/assets/docs/requiredpostings/TransmissionStudies/docs/2019/MerchantGenerationGuidelinesPJMoptiontoBuild.pdf

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.

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 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

10 Network Impacts

The Queue Project AF1-062 was evaluated as a 200.0 MW (Capacity 80.0 MW) injection at the Jug Street 138 kV Substation in the AEP area. Project AF1-062 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-062 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

11 Generation Deliverability

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

None

12 Multiple Facility Contingency

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

None

13 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
4339905	243453	05BEATTY	345.0	AEP	243454	05BIXBY	345.0	AEP	1	AEP_P4_#3196_05BEATTY 345_302E	breaker	1203.0	119.45	121.15	DC	20.51
4339906	243453	05BEATTY	345.0	AEP	243454	05BIXBY	345.0	AEP	1	AEP_P4_#10715_05COLE 345_C	breaker	1203.0	118.06	119.73	DC	20.09
4339920	243454	05BIXBY	345.0	AEP	243459	05KIRK	345.0	AEP	1	AEP_P4_#10715_05COLE 345_C	breaker	1409.0	103.9	106.47	DC	43.02
4339921	243454	05BIXBY	345.0	AEP	243459	05KIRK	345.0	AEP	1	AEP_P4_#3196_05BEATTY 345_302E	breaker	1409.0	102.55	105.62	DC	43.24

14 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
4339944	243453	05BEATTY	345.0	AEP	243454	05BIXBY	345.0	AEP	1	AEP_P1-2_#714	operation	1203.0	109.92	111.57	DC	19.82
4339957	243454	05BIXBY	345.0	AEP	243459	05KIRK	345.0	AEP	1	AEP_P1-2_#10137	operation	1409.0	98.94	102.0	DC	43.01

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
42388148	941510	AE2-148 TAP	345.0	DAY	945630	AF1-228 TAP	345.0	DAY	1	DAY_P1-2_#762	operation	1374.0	103.09	104.37	DC	17.55
41148142	945630	AF1-228 TAP	345.0	DAY	243453	05BEATTY	345.0	AEP	1	DAY_P1-2_#762	operation	1374.0	102.59	103.86	DC	17.55

15 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43399200,43399201	2	05BIXBY 345.0 kV - 05KIRK 345.0 kV Ckt 1	**AEPO0038a** : Replace Kirk Riser, Sub Cond 954 ACSR 45/7. **Project Type** : FAC **Cost** : $100,000 **Time Estimate** : 12-18 Months **AEPO0038b** : An engineering study will need to be conducted to determine if the Kirk Relay Thermal limits 1386 Amps settings can be adjusted to mitigate the overload, Estimated Cost $25,000. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: $600,000.. **Project Type** : FAC **Cost** : $25,000 **Time Estimate** : 12-18 Months **AEPO0038c** : Replace two Kirk risers, Sub cond 1700 kcm AAC 61 Str.. **Project Type** : FAC **Cost** : $200,000 **Time Estimate** : 12-18 Months **AEPO0038d** : Sag Study will be required on 37.9 miles of line between Bixby and kirk .The cost is expected to be 151,600.New Ratings after sag study : S/N: 1409MVA S/E: 1888MVA.Rebuild/Reconductor, cost : $ 75.8 million. **Project Type** : FAC **Cost** : $151,600 **Time Estimate** : 6-12 Months **AEPO0038e** : An engineering study will need to be conducted to determine if the Kirk Compliance Thermal limits 2396 Amps settings can be adjusted to mitigate the overload, Estimated Cost $25,000. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: $600,000. **Project Type** : FAC **Cost** : $25,000 **Time Estimate** : 12-18 Months	$501,600
43399096,43399095	1	05BEATTY 345.0 kV - 05BIXBY 345.0 kV Ckt 1	**AEPO0003a** : Upgrade/Replace Three 345kV 1600A switches and 2-954 ACSR risers at Beatty station. **Project Type** : FAC **Cost** : $1,500,000 **Time Estimate** : 12-18 Months **AEPO0003b** : 1) A sag study will be required on the 9.5 miles of ACSR ~ 954 ~ 45/7 ~ Bundled - Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between $38,000 (no remediation required, just sag study) and $19 million (complete line reconductor/rebuild). New rating after sag study: S/N:1409 S/E: 1887 . 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** : $38,000 **Time Estimate** : 12-18 Months	$1,538,000
			TOTAL COST	**$2,039,600**

16 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

16.1 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
43399095	243453	05BEATTY	AEP	243454	05BIXBY	AEP	1	AEP_P4_#3196_05BEATTY 345_302E	breaker	1203.0	119.45	121.15	DC	20.51

Bus #	Bus	MW Impact
250164	08BKJDB1	0.1465
250165	08BKJDB2	0.1465
251827	WILLYESP	0.4700
251828	CLNTESP1	0.4757
251829	CLNTESP2	0.3171
253077	**09STUART (Deativation : 09/30/17)**	**200.3363**
253110	09ADKINS	30.1137
253261	09MON D	0.2593
902531	W2-040 C	0.9122
902532	W2-040 E	1.4882
904722	V4-073 E	0.2005
913222	Y1-054 E	1.5322
918802	AA1-099 E	0.3171
923522	AB1-169 C OP	128.8336
925242	**AB2-178 E (Withdrawn : 12/10/2019)**	**1.4507**
925921	AC1-068 C	12.4535
925922	AC1-068 E	5.8239
925931	AC1-069 C	12.4535
925932	AC1-069 E	5.8239
925981	AC1-074 C O1	4.0931
925982	AC1-074 E O1	1.7542
926011	AC1-078 C O1	7.8899
926012	AC1-078 E O1	13.1498
926061	AC1-085 C	23.9628
926062	AC1-085 E	39.0972
926101	AC1-089 C O1	4.2166
926102	AC1-089 E O1	6.8797
926791	AC1-165 C	12.3070
926792	AC1-165 E	5.9704
926801	AC1-166 C	12.3070
926802	AC1-166 E	5.9704
926951	AC1-182	1.7969
930062	AB1-014 E	8.0585
932381	AC2-055 C	1.8528
932382	AC2-055 E	3.0229
932421	AC2-060 C	6.5693
932422	AC2-060 E	3.6953
932431	AC2-061 C	4.2851
932432	AC2-061 E	4.3441
932461	AC2-066 C	2.9634
932462	AC2-066 E	4.8351
932481	AC2-068 C	3.1003

Bus #	Bus	MW Impact
932482	AC2-068 E	5.0775
932551	AC2-075 C	0.9721
932552	AC2-075 E	0.4897
932651	**AC2-087 C O1 (Withdrawn : 01/15/2020)**	**4.8654**
932652	**AC2-087 E O1 (Withdrawn : 01/15/2020)**	**3.8595**
932661	AC2-088 C O1	4.0470
932662	AC2-088 E O1	3.3304
934491	AD1-073 C	1.3549
934492	AD1-073 E	0.6980
934561	AD1-081 C	1.5780
934562	AD1-081 E	0.8129
935031	AD1-136 C	0.5691
935032	AD1-136 E	0.4848
935041	AD1-140 C O1	11.5264
935042	AD1-140 E O1	9.5291
936251	AD2-031 C O1	2.4065
936252	AD2-031 E O1	3.9264
936381	AD2-048 C	3.3665
936382	AD2-048 E	1.6797
938051	AE1-007 C	0.8892
938052	AE1-007 E	1.4507
938271	AE1-040 C O1	4.0620
938272	AE1-040 E O1	2.0439
938921	AE1-120	4.5751
939141	AE1-144 C O1	6.9240
939142	AE1-144 E O1	3.4361
940531	AE2-038 C O1	4.6189
940532	AE2-038 E O1	2.2879
941411	AE2-138 C	14.2019
941412	AE2-138 E	5.2528
941511	AE2-148 C	184.4227
941512	AE2-148 E	83.4149
941981	AE2-210 C O1	4.8936
941982	AE2-210 E O1	1.8407
942051	AE2-217 C	9.8015
942052	AE2-217 E	6.5343
942061	AE2-218 C	10.6174
942062	AE2-218 E	7.2118
942091	AE2-221 C	30.1050
942092	AE2-221 E	20.0700
942521	AE2-267 C O1	1.4378
942522	AE2-267 E O1	0.8888
942621	AE2-278 C	6.7842
942622	AE2-278 E	4.5253
942951	AE2-315	3.0392
942981	AE2-320 C O1	24.5041
942982	AE2-320 E O1	12.1239
943111	AE2-339 C	1.8424
943112	AE2-339 E	0.9075
943191	AE2-319 C O1	24.5041
943192	AE2-319 E O1	12.1239
943201	AE2-318 C	6.6168

Bus #	Bus	MW Impact
943202	AE2-318 E	3.2296
943771	AF1-045	2.7241
943943	AF1-062 BAT	20.5100
944521	AF1-117 C	52.2154
944522	AF1-117 E	16.0847
944621	AF1-127 C O1	2.0938
944622	AF1-127 E O1	1.0313
944941	AF1-159	0.7384
945631	AF1-228 C	45.6007
945632	AF1-228 E	30.4005
945681	AF1-233 C O1	6.9168
945682	AF1-233 E O1	3.4171
945821	AF1-247 C	1.4378
945822	AF1-247 E	0.8888
945841	AF1-249 C	0.6205
945842	AF1-249 E	0.2920
945861	AF1-251 C	5.1973
945862	AF1-251 E	3.4649
945911	AF1-256 C	2.2292
945912	AF1-256 E	1.4861
946171	AF1-282 C	9.4590
946172	AF1-282 E	6.3060
946181	AF1-283 C	12.2967
946182	AF1-283 E	8.1978
946511	AF1-315 C O1	1.8917
946512	AF1-315 E O1	1.2611
LGEE	LGEE	3.2216
CPLE	CPLE	0.2156
WEC	WEC	0.7349
CBM-W2	CBM-W2	24.0458
NY	NY	0.9727
CBM-W1	CBM-W1	22.6681
TVA	TVA	3.5112
O-066	O-066	11.6256
CBM-S2	CBM-S2	4.3870
CBM-S1	CBM-S1	26.3353
G-007	G-007	1.7919
MEC	MEC	4.0472

16.2 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
43399200	243454	05BIXBY	AEP	243459	05KIRK	AEP	1	AEP_P4_#10715_05COLE 345_C	breaker	1409.0	103.9	106.47	DC	43.02

Bus #	Bus	MW Impact
250164	08BKJDB1	0.1374
250165	08BKJDB2	0.1374
251827	WILLYESP	0.4183
251828	CLNTESP1	0.4809
251829	CLNTESP2	0.3206
253077	**09STUART (Deativation : 09/30/17)**	**179.8069**
253110	09ADKINS	20.2467
902531	W2-040 C	0.7025
902532	W2-040 E	1.1461
904722	V4-073 E	0.1532
913222	Y1-054 E	1.3887
918802	AA1-099 E	0.3206
923522	AB1-169 C OP	115.6314
924351	AB2-083 C O1	4.1984
924352	AB2-083 E O1	1.9757
924371	AB2-085 C O1	5.1285
924372	AB2-085 E O1	2.4134
925242	**AB2-178 E (Withdrawn : 12/10/2019)**	**1.3600**
925341	AC1-001 C O1	8.3967
925342	AC1-001 E O1	3.9514
925921	AC1-068 C	8.7451
925922	AC1-068 E	4.0896
925931	AC1-069 C	8.7451
925932	AC1-069 E	4.0896
925981	AC1-074 C O1	3.8380
925982	AC1-074 E O1	1.6449
926011	AC1-078 C O1	7.5645
926012	AC1-078 E O1	12.6075
926061	AC1-085 C	16.7753
926062	AC1-085 E	27.3703
926101	AC1-089 C O1	4.6425
926102	AC1-089 E O1	7.5746
926791	AC1-165 C	8.6423
926792	AC1-165 E	4.1925
926801	AC1-166 C	8.6423
926802	AC1-166 E	4.1925
926951	AC1-182	1.6056
930062	AB1-014 E	7.0947
932201	AC2-029 C	4.4503
932202	AC2-029 E	7.2611
932381	AC2-055 C	2.6832
932382	AC2-055 E	4.3779

Bus #	Bus	MW Impact
932411	AC2-059 C	13.4238
932412	AC2-059 E	13.8533
932421	AC2-060 C	9.5140
932422	AC2-060 E	5.3516
932431	AC2-061 C	4.7760
932432	AC2-061 E	4.8418
932451	**AC2-064 C (Withdrawn : 12/09/2019)**	**5.0838**
932452	**AC2-064 E (Withdrawn : 12/09/2019)**	**3.3892**
932461	AC2-066 C	2.6090
932462	AC2-066 E	4.2568
932481	AC2-068 C	2.3611
932482	AC2-068 E	3.8668
932551	AC2-075 C	0.9115
932552	AC2-075 E	0.4592
932651	**AC2-087 C O1 (Withdrawn : 01/15/2020)**	**7.0463**
932652	**AC2-087 E O1 (Withdrawn : 01/15/2020)**	**5.5895**
932661	AC2-088 C O1	3.6364
932662	AC2-088 E O1	2.9925
934481	AD1-072 C	2.9489
934482	AD1-072 E	1.3467
934491	AD1-073 C	1.9623
934492	AD1-073 E	1.0109
934561	AD1-081 C	1.5129
934562	AD1-081 E	0.7794
935031	AD1-136 C	0.5114
935032	AD1-136 E	0.4356
935041	AD1-140 C O1	8.4394
935042	AD1-140 E O1	6.9770
935051	AD1-141 C O1	2.2065
935052	AD1-141 E O1	1.4710
936111	AD2-016 C	13.4238
936112	AD2-016 E	13.8533
936251	AD2-031 C O1	2.1531
936252	AD2-031 E O1	3.5130
936381	AD2-048 C	3.1847
936382	AD2-048 E	1.5890
937231	AD2-162 C	15.4455
937232	AD2-162 E	7.5731
938051	AE1-007 C	0.6771
938052	AE1-007 E	1.1048
938271	AE1-040 C O1	4.8442
938272	AE1-040 E O1	2.4374
938921	AE1-120	4.0280
939141	AE1-144 C O1	6.4557
939142	AE1-144 E O1	3.2037
940531	AE2-038 C O1	4.3065
940532	AE2-038 E O1	2.1331
941411	AE2-138 C	13.2355
941412	AE2-138 E	4.8953
941511	AE2-148 C	121.9115
941512	AE2-148 E	55.1409
941521	AE2-149 C	100.7020

Bus #	Bus	MW Impact
941522	AE2-149 E	37.5300
941981	AE2-210 C O1	4.5606
941982	AE2-210 E O1	1.7155
942021	AE2-214 C	41.9868
942022	AE2-214 E	27.9912
942051	AE2-217 C	7.9416
942052	AE2-217 E	5.2944
942061	AE2-218 C	7.6783
942062	AE2-218 E	5.2155
942091	AE2-221 C	20.3230
942092	AE2-221 E	13.5487
942521	AE2-267 C O1	1.2430
942522	AE2-267 E O1	0.7683
942831	AE2-302 C O1	1.4527
942832	AE2-302 E O1	0.9685
942951	AE2-315	2.3225
942981	AE2-320 C O1	17.2073
942982	AE2-320 E O1	8.5137
943041	AE2-327 C	6.5603
943042	AE2-327 E	1.9656
943111	AE2-339 C	1.7347
943112	AE2-339 E	0.8544
943191	AE2-319 C O1	17.2073
943192	AE2-319 E O1	8.5137
943201	AE2-318 C	5.8491
943202	AE2-318 E	2.8549
943771	AF1-045	2.4080
943943	AF1-062 BAT	43.0180
944521	AF1-117 C	36.7205
944522	AF1-117 E	11.3115
944621	AF1-127 C O1	1.9547
944622	AF1-127 E O1	0.9628
944941	AF1-159	0.6607
945631	AF1-228 C	30.0195
945632	AF1-228 E	20.0130
945681	AF1-233 C O1	6.4453
945682	AF1-233 E O1	3.1841
945821	AF1-247 C	1.2430
945822	AF1-247 E	0.7683
945841	AF1-249 C	0.5492
945842	AF1-249 E	0.2584
945861	AF1-251 C	4.8477
945862	AF1-251 E	3.2318
945911	AF1-256 C	2.0727
945912	AF1-256 E	1.3818
946101	AF1-275	17.4945
946171	AF1-282 C	3.5096
946172	AF1-282 E	2.3397
946181	AF1-283 C	4.5624
946182	AF1-283 E	3.0416
946441	AF1-308 C O1	1.8806
946442	AF1-308 E O1	1.2538

Bus #	Bus	MW Impact
946511	AF1-315 C O1	1.6730
946512	AF1-315 E O1	1.1154
LGEE	LGEE	3.1218
CPLE	CPLE	0.6185
WEC	WEC	0.5840
CBM-W2	CBM-W2	23.8575
NY	NY	0.9395
CBM-W1	CBM-W1	19.3154
TVA	TVA	3.9200
O-066	O-066	11.2493
CBM-S2	CBM-S2	8.0284
CBM-S1	CBM-S1	28.0904
G-007	G-007	1.7316
MEC	MEC	3.5832

Affected Systems

17 Affected Systems

17.1 LG&E

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

17.2 MISO

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

17.3 TVA

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

17.4 Duke Energy Progress

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

17.5 NYISO

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

Contingency Name	Contingency Definition
AEP_P4_#10715_05COLE 345_C	CONTINGENCY 'AEP_P4_#10715_05COLE 345_C' OPEN BRANCH FROM BUS 244022 TO BUS 243457 CKT 1 / 244022 05COLE 345 243457 05HAYDEN 345 1 OPEN BRANCH FROM BUS 244022 TO BUS 244023 CKT 1 / 244022 05COLE 345 244023 05COLE 138 1 END
AEP_P1-2_#714	CONTINGENCY 'AEP_P1-2_#714' OPEN BRANCH FROM BUS 244022 TO BUS 243457 CKT 1 / 244022 05COLE 345 243457 05HAYDEN 345 1 END
AEP_P1-2_#10137	CONTINGENCY 'AEP_P1-2_#10137' OPEN BRANCH FROM BUS 243453 TO BUS 244022 CKT 1 / 243453 05BEATTY 345 244022 05COLE 345 1 END
AEP_P4_#3196_05BEATTY 345_302E	CONTINGENCY 'AEP_P4_#3196_05BEATTY 345_302E' OPEN BRANCH FROM BUS 243453 TO BUS 244022 CKT 1 / 243453 05BEATTY 345 244022 05COLE 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 243468 CKT 4 / 243453 05BEATTY 345 243468 05BEATTX 138 4 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

Short Circuit

18 Short Circuit

The following Breakers are overduty

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