Revised Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-322

MEADOW LAKE 345 KV

84 MW Capacity / 200 MW Energy

January, 2020

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1 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

2 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in White County, IN. The installed facilities will have a total capability of 200 MW with 84 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 8/15/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-322**
Project Name	MEADOW LAKE 345 KV
State	Indiana
County	White
Transmission Owner	AEP
MFO	200
MWE	200
MWC	84
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-322 will interconnect with the AEP transmission system at the Meadow Lake 345 kV substation.

To accommodate this interconnection, the 345 kV substation will have to be expanded requiring the installation of one (1) 345 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

2.2 Cost Summary

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$350,000
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$2,550,000
Total Costs	$2,900,000

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

Description	Total Cost
System Upgrades	$ 10,906,000

Cost allocations for these upgrades will be provided in the System Impact Study Report.

3 Transmission Owner Scope of Work

4 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

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

5 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Total Direct Connection Facility Costs	$0

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
Expand the Meadow Lake Switch 345 kV station, install one (1) 345 kV circuit breakers. Installation of associated protection and control equipment, SCADA, and 345 kV revenue metering will also be required	$2,500,000
Upgrade protection and controls	$50,000
Total Non-Direct Connection Facility Costs	$2,550,000

7 Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

8 Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after signing Agreement execution.

9 Interconnection Customer Requirements

It is understood that the Interconnection Customer is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to the Meadow Lake 345kV 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

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

10.2 AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:
http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

11 Network Impacts

The Queue Project AF1-322 was evaluated as a 200.0 MW (Capacity 84.0 MW) injection at the Meadow Lake 345 kV substation in the AEP area. Project AF1-322 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-322 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

12 Generation Deliverability

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

None

13 Multiple Facility Contingency

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

None

14 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4363424 5	243209	05ROCKPT	765.0	AEP	243208	05JEFRSO	765.0	AEP	1	AEP_P7-1_#11042	tower	3452.0	120.87	121.92	DC	36.34
4363366 0	243918	05ELDERBERRY	345.0	AEP	938670	AE1-089 TAP	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	130.79	131.61	DC	25.69
4363428 6	923880	AB2-028 TAP	345.0	AEP	243218	05DESOTO	345.0	AEP	1	AEP_P7-1_#11042	tower	1160.0	107.48	108.1	DC	15.98
4363368 0	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	122.52	123.34	DC	25.69
4363368 1	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8167_05OLIVE	breaker	1409.0	106.17	106.79	DC	19.47

15 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4363393 6	243878	05MEADOW	345.0	AEP	255205	17REYNOLDS	345.0	NIPS	1	AEP_P1-2_#8807-B	operation	2246.0	135.8	141.77	DC	134.11

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
4363396 9	24387 8	05MEADOW	345. 0	AEP	94542 0	AF1-207 TAP	345. 0	AEP	2	AEP_P1-2_#8695	operatio n	2246. 0	130.63	136.6	DC	134.15
4363414 3	24391 8	05ELDERBER RY	345. 0	AEP	93867 0	AE1-089 TAP	345. 0	AEP	1	AEP_P1-2_#671	operatio n	1409. 0	101.19	101.9	DC	22.15
4363411 2	93867 0	AE1-089 TAP	345. 0	AEP	24321 9	05DUMON T	345. 0	AEP	1	AEP_P1-2_#1121 9	operatio n	1409. 0	104.67	106.61	DC	27.32
4363393 1	94542 0	AF1-207 TAP	345. 0	AEP	25520 5	17REYNOLD S	345. 0	NIPS	2	AEP_P1-2_#8695	operatio n	2246. 0	136.62	142.59	DC	134.15

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43633681,43633680	4	AE1-089 TAP 345.0 kV - 05DUMONT 345.0 kV Ckt 1	AEP_AE1_REF_r0040 (602) : 1) A Sag Study will be required on the 7.0 miles of conductor to mitigate the overload. The new ratings after sag study will be: S/N: 1409 MVA, S/E: 1888 MVA, Depending on the sag study results, the cost for this upgrade is expected to be between $28,000(no remediation required, just sag study) and $14.0 million (complete line Reconductor/rebuild). 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 : $28,000 Time Estimate : 6-12 Months	$28,000
43634286	3	AB2-028 TAP 345.0 kV - 05DESOTO 345.0 kV Ckt 1	NonPJMArea (1101) : The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact study phase. Project Type : FAC Cost : $0 Time Estimate : 0.0 Months	$0
43634245	1	05ROCKPT 765.0 kV - 05JEFRSO 765.0 kV Ckt 1	AEPI0002a (549) : An engineering study will need to be conducted to determine if the Rockport Relay Thermal limits 2996 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 AEPI0002b (550) : An engineering study will need to be conducted to determine if the Jefferson CT Thermal limits 2996 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 AEPI0002c (551) : Replace 6 Rockport Current Transformers 3000Amps Project Type : FAC Cost : $4,800,000 Time Estimate : 12-18 Months AEPI0002d (552) : Replace 2 Rockport 3000A non-oil Breakers at Rockport Project Type : FAC Cost : $6,000,000 Time Estimate : 12-18 Months	$10,850,000

ID	Index	Facility	Upgrade Description	Cost
43633660	2	05ELDERBRYSS 345.0 kV - AE1-089 TAP 345.0 kV Ckt 1	AEP_AE1_REF_r0021 (587) : A Sag Study will be required on the 7.2 miles of ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor section 1 conductor to mitigate the overload. The new ratings after sag study will be: S/N: 1409 MVA, S/E: 1887 MVA, Depending on the sag study results, the cost for this upgrade is expected to be between $28,800 (no remediation required, just sag study) and $14.4million (complete line Reconductor/rebuild). 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 : $28,000 Time Estimate : 6-12 Months	$28,000
			TOTAL COST	$10,906,000

17 Flow Gate Details

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

17.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43634245	243209	05ROCKPT	AEP	243208	05JEFRSO	AEP	1	AEP_P7-1_#11042	tower	3452.0	120.87	121.92	DC	36.34

Bus #	Bus	MW Impact
243442	05RKG1	116.6504
243443	05RKG2	114.8827
243859	05FR-11G C	0.4971
243862	05FR-12G C	0.4895
243864	05FR-21G C	0.5225
243866	05FR-22G C	0.4996
243870	05FR-3G C	1.0120
243873	05FR-4G C	0.7837
246909	05MDL-1G C	1.0145
246910	05MDL-2G C	0.5022
246976	05MDL-3G C	0.5123
246979	05MDL-4G C	0.4996
247556	T-127 C	0.5072
247900	05FR-11G E	14.2271
247901	05FR-12G E	13.9909
247902	05FR-21G E	14.9539
247903	05FR-22G E	14.3180
247904	05FR-3G E	28.9993
247905	05FR-4G E	22.7125
247906	05MDL-1G E	29.0175
247907	05MDL-2G E	14.5360
247912	05MDL-3G E	14.5360
247913	05MDL-4G E	14.5360
247943	T-127 E	14.5360
274650	KINCAID ;1U	8.4345
274651	KINCAID ;2U	8.4314
930041	AB1-006 C	0.6594
930042	AB1-006 E	31.6158
930461	AB1-087	182.5945
930471	AB1-088	182.5945
933441	AC2-157 C	25.2312
933442	AC2-157 E	41.1668
935271	**AD1-137 C (Withdrawn : 01/16/2020)**	**11.8105**
935272	**AD1-137 E (Withdrawn : 01/16/2020)**	**79.0395**
936771	AD2-100 C	14.1725
936772	AD2-100 E	9.4483
936971	AD2-131 C	0.9336
936972	AD2-131 E	4.6904
941341	AE2-130 C	303.8928
941342	AE2-130 E	202.5952
941571	AE2-154 C	5.9053
941572	AE2-154 E	39.5198

Bus #	Bus	MW Impact
942481	AE2-261 C	19.6802
942482	AE2-261 E	13.1201
942601	AE2-276	16.5995
944221	AF1-090 C O1	4.2465
944222	AF1-090 E O1	19.8815
945391	AF1-204 C O1	12.4582
945392	AF1-204 E O1	37.3747
945881	AF1-253 O1	12.7396
946581	AF1-322 C	15.2628
946582	AF1-322 E	21.0772
954681	J949 C	18.6796
954761	J468 C	3.0976
954762	J468 E	17.5529
956821	J1180	15.9128
LGEE	LGEE	0.2402
WEC	WEC	1.3825
CBM-W2	CBM-W2	61.0319
NY	NY	1.0817
CBM-W1	CBM-W1	40.5574
TVA	TVA	5.1982
O-066	O-066	12.7613
CBM-S1	CBM-S1	26.4205
G-007	G-007	1.9739
MADISON	MADISON	17.0937
MEC	MEC	10.2570
BLUEG	BLUEG	0.4375
TRIMBLE	TRIMBLE	0.5025
CATAWBA	CATAWBA	0.0627

17.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43633660	243918	05ELDERBERRY	AEP	938670	AE1-089 TAP	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	130.79	131.61	DC	25.69

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
274881	PILOT HIL;1E	8.2812
275149	KELLYCK ;1E	8.2812
276169	Z1-107 E	1.1703
290021	O50 E	8.7870
293644	O22 E1	4.7213
293645	O22 E2	9.1649
910542	X3-005 E	0.3092
918052	AA1-018 E OP	7.9700
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
927091	AC1-204 1	32.3586
927101	AC1-204 2	32.3538
927451	AC1-142A 1	1.8912
927461	AC1-142A 2	1.8909
930042	AB1-006 E	19.0007
930501	AB1-091 O1	31.9490
930751	AB1-122 2O1	32.5801
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
933411	AC2-154 C	1.1240
933412	AC2-154 E	1.8340
934111	AD1-039 2	3.1928

Bus #	Bus	MW Impact
934871	AD1-116 C	0.4642
934872	AD1-116 E	0.7573
935271	**AD1-137 C (Withdrawn : 01/16/2020)**	**6.2084**
935272	**AD1-137 E (Withdrawn : 01/16/2020)**	**41.5488**
936291	AD2-038 C O1	1.1170
936292	AD2-038 E O1	7.4752
936371	AD2-047 C O1	2.0114
936372	AD2-047 E O1	9.8206
936461	AD2-060	0.6271
936511	AD2-066 C O1	3.8016
936512	AD2-066 E O1	2.5344
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
937321	**AD2-175 C (Withdrawn : 12/10/2019)**	**7.1418**
937322	**AD2-175 E (Withdrawn : 12/10/2019)**	**4.7612**
937401	AD2-194 1	3.4797
937411	AD2-194 2	3.4792
938511	AE1-070 1	4.0887
938521	AE1-070 2	3.7402
938851	AE1-113 C	3.6246
938852	AE1-113 E	12.8509
939321	AE1-163 C O1	2.8068
939322	AE1-163 E O1	17.2417
939351	AE1-166 C O1	2.3389
939352	AE1-166 E O1	2.1589
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940262	AE2-008 BAT	22.9208
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580
940621	AE2-049 C O1	2.1566
940622	AE2-049 E O1	1.4378
940631	AE2-050 C O1	2.9505
940632	AE2-050 E O1	1.9670
940752	AE2-062 E	0.0310
940762	**AE2-063 E (Withdrawn : 01/14/2020)**	**0.0310**
941551	AE2-152 C O1	2.6987
941552	AE2-152 E O1	1.7991
941561	AE2-153 C O1	2.1124
941562	AE2-153 E O1	9.8896
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
942421	AE2-255 C O1	1.3730
942422	AE2-255 E O1	4.1189
942651	AE2-281 C O1	0.4010
942652	AE2-281 E O1	2.4631

Bus #	Bus	MW Impact
942682	AE2-284 BAT	5.3182
942881	AE2-307 C O1	5.4092
942882	AE2-307 E O1	1.9670
942911	AE2-310 C O1	2.0941
942912	AE2-310 E O1	0.5626
943023	AE2-325 BAT	3.4447
944911	AF1-156 C	2.8625
944912	AF1-156 E	1.9083
944963	AF1-161 BAT	3.2995
945421	AF1-207 C O1	2.3133
945422	AF1-207 E O1	9.8619
945501	AF1-215 C O1	60.8760
945502	AF1-215 E O1	40.5840
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955821	J1067	15.9360
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

17.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43634286	923880	AB2-028 TAP	AEP	243218	05DESOTO	AEP	1	AEP_P7-1_#11042	tower	1160.0	107.48	108.1	DC	15.98

Bus #	Bus	MW Impact
247285	05AND G1	0.9242
247286	05AND G2	0.9242
247287	05AND G3	1.9328
247900	05FR-11G E	5.3211
247901	05FR-12G E	5.2327
247902	05FR-21G E	5.5929
247903	05FR-22G E	5.3551
247904	05FR-3G E	10.8460
247905	05FR-4G E	8.4947
247906	05MDL-1G E	10.8487
247907	05MDL-2G E	5.4346
247912	05MDL-3G E	5.4346
247913	05MDL-4G E	5.4346
247935	V3-007 E	-29.3227
247943	T-127 E	5.4346
920501	AA2-148 C OP	2.3785
920502	AA2-148 E OP	15.9177
923881	AB2-028 C	12.9420
923882	AB2-028 E	86.6120
930042	AB1-006 E	11.8202
930461	AB1-087	32.4772
930471	AB1-088	32.4772
933441	AC2-157 C	4.4878
933442	AC2-157 E	7.3221
933591	AC2-176 C O1	-1.6513
933592	AC2-176 E O1	-11.0507
934161	AD1-043 C O1	2.7182
934162	AD1-043 E O1	4.4350
935271	**AD1-137 C (Withdrawn : 01/16/2020)**	**4.4172**
935272	**AD1-137 E (Withdrawn : 01/16/2020)**	**29.5615**
941571	AE2-154 C	1.1701
941572	AE2-154 E	7.8309
941692	AE2-169 BAT	1.9919
941702	AE2-170 BAT	4.4510
941711	AE2-171	0.9478
941722	AE2-172 BAT	2.6892
942601	AE2-276	1.5648
942791	AE2-297 C O1	9.9396
942792	AE2-297 E O1	6.6264
945391	AF1-204 C O1	3.1182
945392	AF1-204 E O1	9.3547
946581	AF1-322 C	3.0243

Bus #	Bus	MW Impact
946582	AF1-322 E	4.1765
950981	J333	12.3471
950991	J334	12.3768
952801	J754 C	4.5377
952802	J754 E	24.5502
953351	J805	32.8768
953761	J829	16.9250
953831	J842 C	2.0935
953832	J842 E	11.3265
953841	J843 C	2.1413
953842	J843 E	11.5847
953931	J856	4.7000
954351	J903	15.9830
954772	J515 E	27.5800
955151	J993	38.3420
955371	J1016	3.1775
955451	J1027	10.4430
955461	J1028	9.8460
955491	J1031 C	4.3842
955492	J1031 E	23.7198
955891	J1074	12.7100
956561	J1152	37.3460
956911	J1189	0.3786
LGEE	LGEE	2.5370
CPLE	CPLE	0.6350
WEC	WEC	0.3380
CBM-W2	CBM-W2	41.2694
NY	NY	0.1665
CBM-W1	CBM-W1	7.5310
TVA	TVA	4.3596
O-066	O-066	1.7674
CBM-S2	CBM-S2	7.4215
CBM-S1	CBM-S1	28.6357
G-007	G-007	0.2694
MADISON	MADISON	6.5621
MEC	MEC	3.9248

17.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43633680	938670	AE1-089 TAP	AEP	243219	05DUMONT	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	122.52	123.34	DC	25.69

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
930042	AB1-006 E	19.0007
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
935271	**AD1-137 C (Withdrawn : 01/16/2020)**	**6.2084**
935272	**AD1-137 E (Withdrawn : 01/16/2020)**	**41.5488**
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
938671	AE1-089 C	93.2175
938672	AE1-089 E	127.9644
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940261	AE2-008	57.0792
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580

Bus #	Bus	MW Impact
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
945421	AF1-207 C O1	2.3133
945422	AF1-207 E O1	9.8619
945501	AF1-215 C O1	60.8760
945502	AF1-215 E O1	40.5840
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

Affected Systems

18 Affected Systems

18.1 LG&E

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

18.2 MISO

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

18.3 TVA

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

18.4 Duke Energy Progress

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

18.5 NYISO

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

19 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#671	CONTINGENCY 'AEP_P1-2_#671' OPEN BRANCH FROM BUS 243215 TO BUS 243229 CKT 1 / 243215 05COOK 345 243229 05OLIVE 345 1 END
AEP_P4_#8167_05OLIVE	CONTINGENCY 'AEP_P4_#8167_05OLIVE' OPEN BRANCH FROM BUS 243229 TO BUS 274804 CKT 1 / 243229 05OLIVE 345 274804 UNIV PK N;RP 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 END
AEP_P4_#8165_05OLIVE 345_B1	CONTINGENCY 'AEP_P4_#8165_05OLIVE 345_B1' OPEN BRANCH FROM BUS 243215 TO BUS 243229 CKT 1 / 243215 05COOK 345 243229 05OLIVE 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 END
AEP_P1-2_#8807-B	CONTINGENCY 'AEP_P1-2_#8807-B' OPEN BRANCH FROM BUS 945420 TO BUS 255205 CKT 2 / 945420 AF1-207 TAP 345 255205 17REYNOLDS 345 2 END
AEP_P1-2_#11219	CONTINGENCY 'AEP_P1-2_#11219' OPEN BRANCH FROM BUS 243207 TO BUS 255204 CKT N1 / 243207 05GRNTWN 765 255204 17REYNOLDS 765 N1 END
AEP_P1-2_#8695	CONTINGENCY 'AEP_P1-2_#8695' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878 05MEADOW 345 255205 17REYNOLDS 345 1 END
AEP_P7-1_#11042	CONTINGENCY 'AEP_P7-1_#11042' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878 05MEADOW 345 255205 17REYNOLDS 345 1 OPEN BRANCH FROM BUS 243878 TO BUS 945420 CKT 2 / 243878 05MEADOW 345 255205 17REYNOLDS 345 2 END

Short Circuit

20 Short Circuit

The following Breakers are overduty

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