



**Generation Interconnection
Feasibility Study Report
for
Queue Project AF1-229
GALION-SOUTH BERWICK 345 KV
82.8 MW Capacity / 138 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 Wyandot County, OH. The installed facilities will have a total capability of 138 MW with 82.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 10/31/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF1-229
Project Name	GALION-SOUTH BERWICK 345 KV
State	Ohio
County	Wyandot
Transmission Owner	AEP
MFO	138
MWE	138
MWC	82.8
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-229 will interconnect with the AEP transmission system tapping the Galion to South Berwick 345 kV line.

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

2.2 Cost Summary

This project will be responsible for the following costs:

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

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

Description	Total Cost
System Upgrades	\$25,857,100

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

3 Transmission Owner Scope of Work

4 Attachment Facilities

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

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

5 Direct Connection Cost Estimate

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

Description	Total Cost
Construct a new three (3) circuit breaker 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus (See Figure 1). Installation of associated protection and control equipment, 345 kV line risers and SCADA will also be required.	\$8,000,000
Total Direct Connection Facility Costs	\$8,000,000

6 Non-Direct Connection Cost Estimate

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

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

7 Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

8 Schedule

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

9 Interconnection Customer Requirements

It is understood that the Interconnection Customer is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to AEP's 345kV Facilities are not included in this report; these are assumed to be the Interconnection Customer's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

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

10.2 AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

11 Network Impacts

The Queue Project AF1-229 was evaluated as a 138.0 MW (Capacity 82.8 MW) injection tapping the Galion to South Berwick 345 kV line in the AEP area. Project AF1-229 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-229 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
42243569	238569	02BEAVER	345.0	ATSI	239725	02LAKEAVER	345.0	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	100.57	101.04	DC	19.17
43548345	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	132.89	135.38	DC	32.78
43548347	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P7-1_#10999	tower	1318.0	124.81	127.11	DC	30.23
42243303	907060	X1-027A_AT12	345.0	ATSI	238569	02BEAVER	345.0	ATSI	1	ATSI-P2-3-OEC-345-031	breaker	1646.0	115.31	115.77	DC	16.71
41037911	945640	AF1-229 TAP	345.0	AEP	238745	02GALION	345.0	ATSI	1	ATSI-P7-1-TE-345-029A	tower	1409.0	104.12	107.69	DC	49.95

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
43548162	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	127.59	130.47	DC	29.41
43548163	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI- P1-2- OES- 345- 934T- B	operation	1318.0	123.5	126.91	DC	44.8

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43548347,43548345	2	05FOSTOR 345.0 kV - 05E LIMA 345.0 kV Ckt 1	AEPO0030a (174) : Replace five sub Cond 2156 ACSR 84/19 Std at E Lima Project Type : FAC Cost : \$500,000 Time Estimate : 12- 18 months Months AEPO0030b (175) : Sag study is required on 4 mile single circuit line between Fremont Center and Fremont with 1033 ACSR. The cost is expected to be around \$20,000. The Rating after the sag study S/N: 1409MVA ,S/E: 1888MVA. Rebuild/Reconductor, cost : \$ 8 million Project Type : FAC Cost : \$20,000 Time Estimate : Sag Study : 6 - 12 months Months AEPO0030c (176) : Replace sub Cond 2870 MCM ACSR at E Lima Project Type : FAC Cost : \$100,000 Time Estimate : 12- 18 months Months	\$620,000
42243569	1	02BEAVER 345.0 kV - 02LAKEAVE 345.0 kV Ckt 2	N6186 (1956) : Reconductor Beaver-LakeAve 345kV #2 line with dual 954Kcmil ACSS Project Type : Facility Cost : \$5,921,900 Time Estimate : 12.0 Months	\$5,921,900
41037911	4	AF1-229 TAP 345.0 kV - 02GALION 345.0 kV Ckt 1	AEP AEPO0035a (184) : Sag Study will be required on ACSR ~ 954 ~ 45/7, 18.3 miles line between South Berwick and Galion .The cost is expected to be 73,200. New Ratings after sag study : S/N: 1409 MVA S/E: 1888 MVA. Rebuild/Reconductor, cost : \$ 36.6 million Project Type : FAC Cost : \$73,200 Time Estimate : Sag Study : 6 - 12 months Months ATSI OES-002A (1517) : Replace 2000 A wave trap at Galion, on S Berwick / AF1-229 exit, with a 3000 A wave trap. Resulting limits on ATSI facilities will be 1415/1742/1842 MVA SN/SE/SLD. * Limits cited here are for ATSI end/facilities; resulting circuit rating will depend on required AEP upgrades to meet queue loading requirements Project Type : FAC Cost : \$250,000 Time Estimate : 9.0 Months	\$323,200
42243303	3	X1-027A_AT12 345.0 kV - 02BEAVER 345.0 kV Ckt 1	N6187 (1513) : Reconductor the line with 954 kcmil ACSS conductor Project Type : FAC Cost : \$18,992,000 Time Estimate : 14.0 Months	\$18,992,000
			TOTAL COST	\$25,857,100

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
42243569	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	100.57	101.04	DC	19.17

Bus #	Bus	MW Impact
238564	02BAYSG1	4.4909
238670	02DVBSG1 (Deactivation : 05/31/20)	25.5246
238888	02LEMOG4	4.6732
238979	02NAPMUN	5.9032
239171	02WLORG-2	5.0784
239172	02WLORG-3	5.1650
239173	02WLORG-4	5.1650
239174	02WLORG-5	5.1917
239276	02COLLW 11	-3.2504
239293	02BS-PKR	0.3920
239297	02CPPW41	-3.6783
241902	Y1-069 GE	25.7091
244357	05GRANGER EL	0.3727
247548	V4-010 C	3.4861
247551	U4-028 C	1.6271
247552	U4-029 C	1.6271
247940	U4-028 E	10.8891
247941	U4-029 E	10.8891
247947	V4-010 E	23.3297
893021	V2-006 C	1.9245
893022	V2-006 E	12.8795
915952	Y3-092 NFTWR	110.5200
923821	AB2-019 FTWR	3.0946
925751	AC1-051 C	0.7955
925752	AC1-051 E	5.3240
931951	AB1-107 1	47.4714
931961	AB1-107 2	129.1472
932051	AC2-015 C	5.5249
932052	AC2-015 E	6.5463
932791	AC2-103 C	14.4426
932792	AC2-103 E	96.6709
934252	AD1-052 E1	0.9798
934262	AD1-052 E2	0.9798
934461	AD1-070 C O1	4.6745
934462	AD1-070 E O1	21.9440
934761	AD1-103 C O1	24.2833
934762	AD1-103 E O1	162.5111
934891	AD1-118	12.4504
937021	AD2-136 C O1	5.8576
937022	AD2-136 E O1	39.2009
937381	AD2-191 C	2.7661

Bus #	Bus	MW Impact
937382	AD2-191 E	18.5115
938911	AE1-119	97.8244
939161	AE1-146 C O1	9.9136
939162	AE1-146 E O1	4.6296
940841	AE2-072 C	5.1326
940842	AE2-072 E	3.4217
941741	AE2-174 C	2.4765
941742	AE2-174 E	11.5937
941761	AE2-176 C	15.8827
941762	AE2-176 E	10.5885
941781	AE2-181 C	4.4547
941782	AE2-181 E	2.9698
942661	AE2-282 C O1	6.7921
942662	AE2-282 E O1	3.5740
943951	AF1-063 C O1	1.0623
943952	AF1-063 E O1	0.5890
943961	AF1-064 C O1	2.9433
943962	AF1-064 E O1	1.4628
944392	AF1-104 BAT	2.1502
944551	AF1-120 C	2.1812
944552	AF1-120 E	1.0988
945401	AF1-205 C O1	2.0294
945402	AF1-205 E O1	1.3529
945411	AF1-206 C O1	9.7908
945412	AF1-206 E O1	6.5272
945641	AF1-229 C	5.1827
945642	AF1-229 E	3.4551
945651	AF1-230 C	1.7062
945652	AF1-230 E	1.1375
955621	J1046	5.7380
955721	J1056 C	3.3468
955722	J1056 E	18.1072
955781	J1062	22.9520
LGEE	LGEE	2.4589
CPL	CPL	0.5484
WEC	WEC	1.9177
CBM-W2	CBM-W2	35.1679
NY	NY	2.3873
CBM-W1	CBM-W1	110.4633
TVA	TVA	4.6158
O-066	O-066	24.2256
CBM-S2	CBM-S2	8.0747
CBM-S1	CBM-S1	29.6922
G-007	G-007	3.7149
MADISON	MADISON	1.9596
MEC	MEC	8.5679

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
43548345	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	132.89	135.38	DC	32.78

Bus #	Bus	MW Impact
238564	02BAYSG1	4.2891
238670	02DVBSG1 (Deactivation : 05/31/20)	19.2828
238885	02LEMOG1	4.9048
238886	02LEMOG2	4.9048
238887	02LEMOG3	4.9048
238888	02LEMOG4	4.9048
238979	02NAPMUN	5.2588
239293	02BS-PKR	0.3744
241902	Y1-069 GE	25.4390
244357	05GRANGER EL	0.2405
247548	V4-010 C	3.4518
247551	U4-028 C	1.6685
247552	U4-029 C	1.6685
247940	U4-028 E	11.1664
247941	U4-029 E	11.1664
247947	V4-010 E	23.1005
924791	AB2-131 C OP	3.1774
924792	AB2-131 E OP	5.1841
925751	AC1-051 C	0.7634
925752	AC1-051 E	5.1088
927181	AC1-212 C	-0.1293
927182	AC1-212 E	-1.2254
927183	AC1-212 BAT	1.5938
931951	AB1-107 1	53.3315
931961	AB1-107 2	127.7904
932051	AC2-015 C	5.3765
932052	AC2-015 E	6.3705
932791	AC2-103 C	7.9995
932792	AC2-103 E	53.5446
933721	AC2-195 C O1	2.9312
933722	AC2-195 E O1	1.7870
934252	AD1-052 E1	0.8479
934262	AD1-052 E2	0.8479
934461	AD1-070 C O1	6.4807
934462	AD1-070 E O1	30.4234
934761	AD1-103 C O1	13.4502
934762	AD1-103 E O1	90.0126
934891	AD1-118	15.3734
936722	AD2-091 BAT	8.2145
936752	AD2-096 BAT	2.8990

Bus #	Bus	MW Impact
937021	AD2-136 C O1	6.0068
937022	AD2-136 E O1	40.1992
937381	AD2-191 C	2.8365
937382	AD2-191 E	18.9830
938911	AE1-119	120.7910
939161	AE1-146 C O1	8.3874
939162	AE1-146 E O1	3.9169
941741	AE2-174 C	2.4522
941742	AE2-174 E	11.4798
941761	AE2-176 C	9.7665
941762	AE2-176 E	6.5110
941781	AE2-181 C	3.6303
941782	AE2-181 E	2.4202
942042	AE2-216 BAT	9.0359
942661	AE2-282 C O1	5.7413
942662	AE2-282 E O1	3.0210
943011	AE2-324	0.9582
943961	AF1-064 C O1	6.1383
943962	AF1-064 E O1	3.0507
944551	AF1-120 C	1.8438
944552	AF1-120 E	0.9288
944571	AF1-122 C O1	1.2160
944572	AF1-122 E O1	1.6793
945401	AF1-205 C O1	1.8079
945402	AF1-205 E O1	1.2052
945411	AF1-206 C O1	8.2761
945412	AF1-206 E O1	5.5174
945623	AF1-227 BAT	7.2500
945641	AF1-229 C	19.6658
945642	AF1-229 E	13.1106
945651	AF1-230 C	1.6887
945652	AF1-230 E	1.1258
946203	AF1-285 BAT	2.9626
950311	G934 C	2.0802
950312	G934 E	8.3208
950351	J466	3.3642
950791	J201 C	0.4019
950792	J201 E	1.6075
950871	J246 C	0.1061
950872	J246 E	0.4245
950942	J325 E	0.4630
951531	J533 C	3.0320
951532	J533 E	12.1280
951571	J538 C	3.0651
951572	J538 E	12.2604
951941	J602 C	2.9824
951942	J602 E	16.1356
952201	J589 C	2.5144
952202	J589 E	13.6036
952312	J646 E	0.2016
952401	J752 C	1.7113
952402	J752 E	9.2587

Bus #	Bus	MW Impact
952611	J717 C	2.8072
952612	J717 E	15.1878
952761	J728 C	2.6107
952762	J728 E	14.1433
952881	J758	12.4400
952971	J793	166.1490
953071	J794 C	0.1655
953072	J794 E	0.8954
953271	J701 C	0.8330
953272	J701 E	4.5066
953291	J796	22.3776
953321	J799	27.3426
953361	J806	11.5415
953421	J841	66.0161
953771	J832	7.6750
953781	J833	14.5640
953811	J839	12.2010
953941	J857	8.7328
954111	J875	18.6240
955021	J978 C	0.9842
955022	J978 E	5.3248
955071	J984 C	2.1634
955072	J984 E	11.7046
955121	J989	8.5104
955181	J996	11.2808
955261	J1005	18.7400
955351	J1014 C	5.1420
955352	J1014 E	3.0852
955591	J1043 C	1.1556
955592	J1043 E	20.4772
955621	J1046	8.4605
955721	J1056 C	4.7555
955722	J1056 E	25.7285
955781	J1062	33.8420
955811	J1065 C	2.2492
955812	J1065 E	12.1688
955831	J1068 C	4.4139
955832	J1068 E	23.8801
955961	J1083	6.2769
956011	J1088	14.0550
956021	J1089	16.1007
956031	J1090	8.9154
956161	J1103	2.1794
956291	J1117	7.3864
956301	J1119	60.8400
956741	J1172	5.1165
956751	J1173	10.2776
956801	J1178	5.8286
DUCKCREEK	DUCKCREEK	1.2897
NEWTON	NEWTON	1.6203
FARMERCITY	FARMERCITY	0.0686
G-007A	G-007A	0.5083

Bus #	Bus	MW Impact
VFT	VFT	1.3996
CBM-W1	CBM-W1	39.8569
PRAIRIE	PRAIRIE	3.6291
COFFEEN	COFFEEN	0.7341
EDWARDS	EDWARDS	0.3783
CHEOAH	CHEOAH	0.6812
TILTON	TILTON	0.9236
MADISON	MADISON	3.5986
GIBSON	GIBSON	1.0194
CALDERWOOD	CALDERWOOD	0.6809
BLUEG	BLUEG	3.5692
TRIMBLE	TRIMBLE	1.1514
CATAWBA	CATAWBA	0.3882

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
42243303	907060	X1-027A_AT12	ATSI	238569	02BEAVER	ATSI	1	ATSI-P2-3-OEC-345-031	breaker	1646.0	115.31	115.77	DC	16.71

Bus #	Bus	MW Impact
238564	02BAYSG1	3.9432
238670	02DVBSG1 (Deativation : 05/31/20)	27.1070
238885	02LEMOG1	4.5115
238886	02LEMOG2	4.5115
238887	02LEMOG3	4.5115
238888	02LEMOG4	4.5115
238979	02NAPMUN	5.4078
239276	02COLLW 11	-2.3669
239293	02BS-PKR	0.3442
239297	02CPPW41	-2.6666
241902	Y1-069 GE	25.1299
244357	05GRANGER EL	0.3074
247548	V4-010 C	2.0328
247551	U4-028 C	1.0072
247552	U4-029 C	1.0072
247940	U4-028 E	6.7405
247941	U4-029 E	6.7405
247947	V4-010 E	13.6038
893021	V2-006 C	1.7067
893022	V2-006 E	11.4219
931951	AB1-107 1	49.1692
931961	AB1-107 2	126.2381
932791	AC2-103 C	20.4163
932792	AC2-103 E	136.6559
934252	AD1-052 E1	0.4577
934262	AD1-052 E2	0.4577
934461	AD1-070 C O1	3.7987
934462	AD1-070 E O1	17.8327
934761	AD1-103 C O1	34.3273
934762	AD1-103 E O1	229.7288
934891	AD1-118	14.1407
936601	AD2-075	10.7104
937021	AD2-136 C O1	3.6259
937022	AD2-136 E O1	24.2660
937381	AD2-191 C	1.7123
937382	AD2-191 E	11.4589
938911	AE1-119	111.1055
939161	AE1-146 C O1	8.1301
939162	AE1-146 E O1	3.7967
940841	AE2-072 C	4.5998
940842	AE2-072 E	3.0666

Bus #	Bus	MW Impact
941741	AE2-174 C	1.4441
941742	AE2-174 E	6.7604
941781	AE2-181 C	4.0881
941782	AE2-181 E	2.7254
942661	AE2-282 C O1	6.2417
942662	AE2-282 E O1	3.2843
943951	AF1-063 C O1	0.9641
943952	AF1-063 E O1	0.5345
943961	AF1-064 C O1	5.8367
943962	AF1-064 E O1	2.9009
944551	AF1-120 C	2.0044
944552	AF1-120 E	1.0098
945401	AF1-205 C O1	1.8591
945402	AF1-205 E O1	1.2394
945411	AF1-206 C O1	8.9974
945412	AF1-206 E O1	5.9983
945641	AF1-229 C	4.5176
945642	AF1-229 E	3.0117
952312	J646 E	0.1437
952971	J793	118.4115
953321	J799	19.0191
953781	J833	10.0920
953811	J839	8.7240
954111	J875	13.0680
955181	J996	7.7392
955621	J1046	5.6675
955721	J1056 C	3.2616
955722	J1056 E	17.6464
955781	J1062	22.6700
955831	J1068 C	3.0813
955832	J1068 E	16.6707
956751	J1173	7.1744
LGEE	LGEE	2.1422
CPL	CPL	0.4631
WEC	WEC	1.7256
CBM-W2	CBM-W2	31.1138
NY	NY	1.9427
CBM-W1	CBM-W1	102.4944
TVA	TVA	4.0390
O-066	O-066	20.2070
CBM-S2	CBM-S2	6.9013
CBM-S1	CBM-S1	25.9519
G-007	G-007	3.0992
MADISON	MADISON	2.0805
MEC	MEC	7.6701

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
41037911	945640	AF1-229 TAP	AEP	238745	02GALION	ATSI	1	ATSI-P7-1-TE-345-029A	tower	1409.0	104.12	107.69	DC	49.95

Bus #	Bus	MW Impact
238564	02BAYSG1	3.2612
238670	02DVBSG1 (Deactivation : 05/31/20)	14.3755
238885	02LEMOG1	3.7004
238886	02LEMOG2	3.7004
238887	02LEMOG3	3.7004
238888	02LEMOG4	3.7004
238979	02NAPMUN	4.4923
239293	02BS-PKR	0.2847
241902	Y1-069 GE	19.1335
244357	05GRANGER EL	0.3785
247506	U2-041 C (Withdrawn : 12/05/2019)	1.8110
247548	V4-010 C	2.6071
247549	V3-028 C	0.3529
247551	U4-028 C	1.2492
247552	U4-029 C	1.2492
247607	V1-011 C	0.6602
247908	05BLCK-1 E	5.1911
247909	05BLCK-2 E	5.1911
247910	05BLCK-3 E	5.2806
247911	05TIMB G E	5.5119
247919	U2-041 E (Withdrawn : 12/05/2019)	12.1197
247926	U1-059 E	3.3795
247940	U4-028 E	8.3600
247941	U4-029 E	8.3600
247942	W1-056 E	1.2430
247947	V4-010 E	17.4478
247948	V3-028 E	0.5758
247959	V1-011 E	4.4185
893021	V2-006 C	1.5503
893022	V2-006 E	10.3748
925131	AB2-170 C O1	2.2939
925132	AB2-170 E O1	3.7427
925751	AC1-051 C	0.4341
925752	AC1-051 E	2.9049
926811	AC1-167 C O1	1.7584
926812	AC1-167 E O1	0.8531
926901	AC1-176 C	0.3468
926902	AC1-176 E	2.3316
931951	AB1-107 1	40.6520
931961	AB1-107 2	96.1154

Bus #	Bus	MW Impact
932051	AC2-015 C	2.9368
932052	AC2-015 E	3.4797
932301	AC2-044 C	0.4251
932302	AC2-044 E	0.6936
932791	AC2-103 C	5.9408
932792	AC2-103 E	39.7648
934252	AD1-052 E1	0.6219
934262	AD1-052 E2	0.6219
934461	AD1-070 C O1	5.8291
934462	AD1-070 E O1	27.3645
934741	AD1-101 C O1	1.1481
934742	AD1-101 E O1	1.8735
934761	AD1-103 C O1	9.9887
934762	AD1-103 E O1	66.8477
934891	AD1-118	11.5983
934901	AD1-119 C O1	0.9670
934902	AD1-119 E O1	1.5779
934981	AD1-130 C	5.3401
934982	AD1-130 E	2.5540
936601	AD2-075	7.0055
936671	AD2-086 C	6.4081
936672	AD2-086 E	4.2721
936721	AD2-091	2.3218
937021	AD2-136 C O1	4.4971
937022	AD2-136 E O1	30.0962
937381	AD2-191 C	2.1236
937382	AD2-191 E	14.2121
938681	AE1-090 C	1.0011
938682	AE1-090 E	1.3206
938691	AE1-091 C	2.8793
938692	AE1-091 E	3.8695
938761	AE1-102 C	0.8726
938762	AE1-102 E	0.5818
938911	AE1-119	91.1295
939161	AE1-146 C O1	12.0475
939162	AE1-146 E O1	5.6261
940031	AE1-245 C O1	0.5249
940032	AE1-245 E O1	3.5127
940841	AE2-072 C	4.0148
940842	AE2-072 E	2.6765
941741	AE2-174 C	1.8521
941742	AE2-174 E	8.6707
941761	AE2-176 C	6.6051
941762	AE2-176 E	4.4034
941781	AE2-181 C	3.3659
941782	AE2-181 E	2.2439
942041	AE2-216	2.5540
942661	AE2-282 C O1	5.1271
942662	AE2-282 E O1	2.6978
942801	AE2-298 C O1	0.8162
942802	AE2-298 E O1	0.5441
943012	AE2-324 BAT	3.9244

Bus #	Bus	MW Impact
943181	AE2-322 C	1.1178
943182	AE2-322 E	0.5464
943581	AF1-029 C O1	0.4081
943582	AF1-029 E O1	0.2721
943791	AF1-047 C	0.5792
943792	AF1-047 E	0.3861
943951	AF1-063 C O1	0.7582
943952	AF1-063 E O1	0.4203
943961	AF1-064 C O1	4.9472
943962	AF1-064 E O1	2.4588
944091	AF1-077 C O1	3.3085
944092	AF1-077 E O1	2.0624
944171	AF1-085 C O1	0.8234
944172	AF1-085 E O1	1.1371
944551	AF1-120 C	1.6465
944552	AF1-120 E	0.8294
945401	AF1-205 C O1	1.5444
945402	AF1-205 E O1	1.0296
945411	AF1-206 C O1	7.3907
945412	AF1-206 E O1	4.9271
945641	AF1-229 C	29.9711
945642	AF1-229 E	19.9807
945651	AF1-230 C	1.0430
945652	AF1-230 E	0.6953
946052	AF1-270 BAT	4.9200
950351	J466	2.1945
950791	J201 C	0.2663
950792	J201 E	1.0653
950942	J325 E	0.3008
951571	J538 C	2.0559
951572	J538 E	8.2236
951941	J602 C	1.9915
951942	J602 E	10.7745
952201	J589 C	1.7272
952202	J589 E	9.3448
952312	J646 E	0.1295
952401	J752 C	1.1196
952402	J752 E	6.0574
952611	J717 C	1.8923
952612	J717 E	10.2378
952761	J728 C	1.7598
952762	J728 E	9.5337
952971	J793	106.7912
953071	J794 C	0.1127
953072	J794 E	0.6095
953271	J701 C	0.5455
953272	J701 E	2.9512
953291	J796	14.9877
953321	J799	17.3219
953361	J806	8.0654
953421	J841	44.1839
953781	J833	9.2240

Bus #	Bus	MW Impact
953811	J839	7.8720
954111	J875	12.0525
955121	J989	5.5952
955181	J996	7.1984
955261	J1005	12.5500
955351	J1014 C	3.4125
955352	J1014 E	2.0475
955621	J1046	5.2745
955721	J1056 C	2.9999
955722	J1056 E	16.2301
955781	J1062	21.0980
955831	J1068 C	2.8027
955832	J1068 E	15.1633
955961	J1083	4.2567
956011	J1088	9.4200
956021	J1089	10.7729
956031	J1090	5.9481
956161	J1103	1.4272
956291	J1117	4.9816
956301	J1119	40.4220
956741	J1172	3.3815
956751	J1173	6.6232
956801	J1178	3.9526
LGEE	LGEE	0.5152
WEC	WEC	0.8647
CBM-W2	CBM-W2	10.8354
NY	NY	0.6802
CBM-W1	CBM-W1	64.9144
TVA	TVA	0.8862
O-066	O-066	8.2723
CBM-S1	CBM-S1	5.8192
G-007	G-007	1.2782
MADISON	MADISON	3.3022
MEC	MEC	3.4831
CATAWBA	CATAWBA	0.0980

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_P7-1_#10999	CONTINGENCY 'AEP_P7-1_#10999' OPEN BRANCH FROM BUS 243212 TO BUS 247803 CKT 1 / 243212 05BENTON 345 247803 05SEGRETO 345 1 OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1 END
Base Case	
ATSI-P2-3-OEC-345-031	CONTINGENCY 'ATSI-P2-3-OEC-345-031' /* HAYES 345KV BRK B-3_6_12 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1 /* 02HAYES 345 02HAYES 138 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
ATSI-P7-1-TE-345-029A	CONTINGENCY 'ATSI-P7-1-TE-345-029A' /* X1-027A - BEAVER & BEAVER - HAYES 345 DISCONNECT BRANCH FROM BUS 907060 TO BUS 238569 CKT 1 /* X1-027A_AT12 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 END
ATSI-P1-2-OES-345-934T-B	CONTINGENCY 'ATSI-P1-2-OES-345-934T-B' /* LINE 02GALION - 05SSBERWI(AEP) 345 CK 1 DISCONNECT BRANCH FROM BUS 945640 TO BUS 238745 CKT 1 /* AF1-229 TAP 345 02GALION 345 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