Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-176

GROTON 138 KV SOLAR

75 MW Capacity / 125 MW Energy

July 2019

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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 ATSI.

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 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.

3 General

The Interconnection Customer (IC), has proposed a solar generating facility located in Erie county, Ohio at Groton substation. The installed facilities will have a total capability of 125 MW with 75 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 31, 2021. This study does not imply a TO commitment to this in-service date.

The completion of a light load analysis study 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 after the completion of the light load analysis study which shall be performed following execution of the system impact study agreement.

Queue Number	**AE2-176**
Project Name	GROTON 138 KV SOLAR
Interconnection Customer	
State	Ohio
County	Erie
Transmission Owner	ATSI
MFO	125
MWE	125
MWC	75
Fuel	Solar
Base case Study Year	2022

4 Point of Interconnection

4.1 Primary POI

The interconnection of the project at the Primary POI will be accomplished by installing a new 138 kV breaker at the FirstEnergy Groton 138 kV substation and connecting the Groton 138 kV ring bus substation and a new line exit to the Primary POI. The Groton substation is located approximately 8 miles from the FirstEnergy Hayes substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-176 generation project to connect to the ATSI transmission system. Attachment 2 provides the proposed location for the point of interconnection. IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE transmission system's direct connection facilities.

4.2 Cost Summary

The AE2-176 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 369,720
Direct Connection Network Upgrade	$ 451,880
Non-Direct Connection Network Upgrades	$ 0
Total Costs	**$ 821,600**

In addition, the AE2-176 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	**$ 26,074,600**

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

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

The Feasibility Study is used to make a preliminary determination of the type and scope of Attachment Facilities, Local Upgrades, and Network Upgrades that will be necessary to accommodate the Interconnection Request and to provide the Interconnection Customer a preliminary estimate of the time that will be required to construct any necessary facilities and upgrades and the Interconnection Customer's cost responsibility. The System Impact Study provides refined and comprehensive estimates of cost responsibility and construction

lead times for new facilities and system upgrades. Facilities Studies will include, commensurate with the degree of engineering specificity as provided in the Facilities Study Agreement, good faith estimates of the cost, determined in accordance with Section 217 of the Tariff,

(a) to be charged to each affected New Service Customer for the Facilities and System Upgrades that are necessary to accommodate this queue project;

(b) the time required to complete detailed design and construction of the facilities and upgrades; and

(c) a description of any site-specific environmental issues or requirements that could reasonably be anticipated to affect the cost or time required to complete construction of such facilities and upgrades.

The required Attachment Facilities and Direct and Non-Direct Connection work for the interconnection of the AE2-176 generation project to the FE Transmission System is detailed in the following sections. The associated one-line with the generation project Attachment Facilities and the Primary Direct and Non-Direct Connection facilities are shown in Attachment 1.

5 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI will be accomplished by installing a new 138 kV breaker at the FirstEnergy Groton 138 kV substation and connecting the Groton 138 kV ring bus substation and a new line exit to the Primary POI. The Groton substation is located approximately 8 miles from the FirstEnergy Hayes substation. The project will also require non-direct connection upgrades at Groton, Hayes and West Fremont substations. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated attachment facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-176 generation project to connect to the FirstEnergy ("FE") transmission system. Attachment 2 provides the proposed location for the point of interconnection. IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE transmission system's direct connection facilities.

6 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
Install line exit take-off structure, foundations, disconnect switch and associated equipment at expanded ring bus substation.	$ 369,720
Total Attachment Facility Costs	**$ 369,720**

7 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
Add 138kV breaker and associated equipment at Groton	$ 451,880
Total Direct Connection Facility Costs	**$ 451,880**

8 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
Non-Direct connection	$ 0
Total Non-Direct Connection Facility Costs	**$ 0**

9 Schedule

Based on the scope of work for the Attachment Facilities and the Direct Connection facilities, it is expected to take a minimum of 30 months after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the interconnection substation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that all transmission system outages will be allowed when requested. This schedule doesn't include the Non-Direct connection facilities work.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimate elapsed time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

10 Transmission Owner Analysis

10.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AE2-176 project did not contribute to any overloads on the FE transmission system.

11 Interconnection Customer Requirements

11.1 System Protection

The IC must design it's Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side.

11.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 138 kV circuit breaker to protect the AE2-176 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

4. Compliance with the FE and PJM generator power factor and voltage control requirements.

5. The execution of a back-up service agreement to serve the customer load supplied from the AE2-176 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

11.3 Power Factor Requirements

The IC shall design its Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

12 Revenue Metering and SCADA Requirements

12.1 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.

12.1.1 Meteorological Data Reporting Requirement

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

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

12.2 ATSI Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

The IC one-line diagram shows the revenue metering outside of the customer zone of protection. The revenue metering must be installed inside the customer zone of protection

13 Network Impacts

The Queue Project AE2-176 was evaluated as a 125 MW (Capacity 75 MW) injection at Groton 138 kV substation in the ATSI area. Project AE2-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-176 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

14 Generation Deliverability

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

None

15 Multiple Facility Contingency

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

None

16 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	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
2250713	238524	02AD Q-2	ATSI	241928	02AVQ2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	332.0	127.68	129.16	DC	10.92
2250224	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1742.0	107.07	108.56	DC	25.83
2250697	238915	02LRN Q2	ATSI	238524	02AD Q-2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	316.0	134.17	135.73	DC	10.92
2250746	239728	02BLKRVR	ATSI	239734	02USSTEEL	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	659.0	102.85	103.86	DC	14.84
2250722	239734	02USSTEEL	ATSI	238915	02LRN Q2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	593.0	109.87	111.0	DC	14.84

17 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	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
1586328	238889	02LEMOYN	ATSI	242936	05FOSTOR	AEP	1	AEP_P1-2_#768	operation	1409.0	104.85	105.41	DC	17.17
2250562	239176	02WOOD+	ATSI	238890	02LEMOYN	ATSI	1	AEP_P1-3_#744_05FOSTOR 345_1	operation	223.0	111.96	113.59	DC	8.07
1586335	241901	02LALLENDORF	ATSI	242936	05FOSTOR	AEP	1	AEP_P1-2_#770	operation	1409.0	104.11	104.57	DC	14.22

18 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
2250697, 2250713, 2250722, 2250746	4, 1, 7, 6	02LRN Q2 138.0 kV - 02AD Q-2 138.0 kV Ckt 1; 02AD Q-2 138.0 kV - 02AVQ2 138.0 kV Ckt 1; 02USSTEEL 138.0 kV - 02LRN Q2 138.0 kV Ckt 1; 02BLKRVR 138.0 kV - 02USSTEEL 138.0 kV Ckt 1	OEC-002A (18) : Build a new 138 kV line from Black River to Astor substation Project Type : Facility Cost : $20,152,700 Time Estimate : 30.0 Months	$20,152,700
2250224	2	02BEAVER 345.0 kV - 02LAKEAVE 345.0 kV Ckt 2	OEC-001A (17) : 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
			TOTAL COST	$ 26,074,600

19 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.

19.1 Contingency Description

Contingency Name	Contingency Definition
AEP_P1-2_#768	CONTINGENCY 'AEP_P1-2_#768' OPEN BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 / 241901 02LALLEND
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
AEP_P4_#10127_05FOSTOR 138_K	CONTINGENCY 'AEP_P4_#10127_05FOSTOR 138_K' OPEN BRANCH FROM BUS 242936 TO BUS 243006 CKT 1 / 242936 05FOSTOR 345 243006 05FOSTOR 138 1 OPEN BRANCH FROM BUS 242974 TO BUS 242975 CKT 1 / 242974 05BUCKLR 138 242975 05BUCKTP 138 1 OPEN BRANCH FROM BUS 242975 TO BUS 243006 CKT 1 / 242975 05BUCKTP 138 243006 05FOSTOR 138 1 OPEN BRANCH FROM BUS 242975 TO BUS 243081 CKT 1 / 242975 05BUCKTP 138 243081 05RISGSN 138 1 OPEN BRANCH FROM BUS 242974 TO BUS 245607 CKT 1 / 242974 05BUCKLR 138 245607 05BUCKLY R 69.0 1 OPEN BRANCH FROM BUS 245607 TO BUS 245626 CKT 1 / 245607 05BUCKLY R 69.0 245626 05N END
ATSI-P7-1-CEI-345-001-A	CONTINGENCY 'ATSI-P7-1-CEI-345-001-A' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END
ATSI-P7-1-TE-138-026	CONTINGENCY 'ATSI-P7-1-TE-138-026' /* WEST FREMONT-OTTAWA & W.FREMONT-KH-OTTAWA DISCONNECT BRANCH FROM BUS 239030 TO BUS 239154 CKT 1 /* 02OTTAWA 138 02W.FREM 138 DISCONNECT BUS 238871 /* 02KY-HS 138 END

Contingency Name	Contingency Definition
AEP_P1-3_#744_05FOSTOR 345_1	CONTINGENCY 'AEP_P1-3_#744_05FOSTOR 345_1' OPEN BRANCH FROM BUS 242936 TO BUS 243006 CKT 1 / 242936 05FOSTOR 345 243006 05FOSTOR 138 1 END
AEP_P1-2_#770	CONTINGENCY 'AEP_P1-2_#770' OPEN BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 / 238889 02LEMOYN 345 242936 05FOSTOR 345 1 END
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END
AEP_P4_#3141_05FOSTOR 345_B2	CONTINGENCY 'AEP_P4_#3141_05FOSTOR 345_B2' OPEN BRANCH FROM BUS 242935 TO BUS 242936 CKT 1 / 242935 05E LIMA 345 242936 05FOSTOR 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 243006 CKT 1 / 242936 05FOSTOR 345 243006 05FOSTOR 138 1 END

19.2 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
2250713	238524	02AD Q-2	ATSI	241928	02AVQ2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	332.0	127.68	129.16	DC	10.92

Bus #	Bus	MW Impact
238571	02BEAVGA	0.89
238572	02BEAVGB	0.91
238670	02DVBSG1	66.4
238979	02NAPMUN	2.0
239174	02WLORG-5	1.06
239175	02WLORG-6	1.38
240968	02BG2 GEN	0.42
240969	02BG4 G1	0.11
240973	02BG6 AMPO	1.66
240975	02PGE GEN	2.19
241908	02LLF_W4-004	0.3
247548	V4-010 C	1.53
247940	U4-028 E	4.44
247941	U4-029 E	4.44
247947	V4-010 E	10.24
931951	AB1-107 1	16.61
931961	AB1-107 2	36.46
932791	AC2-103 C	3.56
932792	AC2-103 E	23.82
934251	AD1-052 C1	0.85
934261	AD1-052 C2	0.85
934761	AD1-103 C O1	5.98
934762	AD1-103 E O1	40.04
934891	AD1-118	4.16
937021	AD2-136 C O1	2.39
937022	AD2-136 E O1	15.99
937381	AD2-191 C	1.13
937382	AD2-191 E	7.55
938911	AE1-119	32.71
941741	AE2-174 C	2.05
941742	AE2-174 E	9.6
941761	AE2-176 C	6.55
941762	AE2-176 E	4.37
941781	AE2-181 C	1.58
941782	AE2-181 E	1.05
942661	AE2-282 C O1	2.36
942662	AE2-282 E O1	1.24
CARR	CARR	0.55
CBM-S1	CBM-S1	3.73
CBM-S2	CBM-S2	0.85

Bus #	Bus	MW Impact
CBM-W1	CBM-W1	15.2
CBM-W2	CBM-W2	32.82
CIN	CIN	4.0
CPLE	CPLE	0.23
G-007	G-007	1.12
IPL	IPL	2.56
LGEE	LGEE	0.99
MEC	MEC	7.89
MECS	MECS	15.45
O-066	O-066	7.25
RENSSELAER	RENSSELAER	0.43
WEC	WEC	1.27

19.3 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
2250224	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1742.0	107.07	108.56	DC	25.83

Bus #	Bus	MW Impact
238564	02BAYSG1	3.86
238670	02DVBSG1	246.66
238979	02NAPMUN	6.71
239171	02WLORG-2	4.45
239172	02WLORG-3	4.52
239173	02WLORG-4	4.53
239174	02WLORG-5	4.55
239293	02BS-PKR	0.34
240968	02BG2 GEN	1.4
240969	02BG4 G1	0.35
240973	02BG6 AMPO	5.46
240975	02PGE GEN	7.21
241902	Y1-069 GE	22.18
247548	V4-010 C	4.21
247567	V2-006 C	2.24
247940	U4-028 E	12.37
247941	U4-029 E	12.37
247947	V4-010 E	28.21
247961	V2-006 E	15.01
900041	V4-011	0.44
925751	AC1-051 C	0.88
925752	AC1-051 E	5.88
931951	AB1-107 1	54.98
931961	AB1-107 2	127.64
932051	AC2-015 C	6.11
932052	AC2-015 E	7.24
932791	AC2-103 C	14.43
932792	AC2-103 E	96.61
934251	AD1-052 C1	2.31
934261	AD1-052 C2	2.31
934461	AD1-070 C O1	5.4
934462	AD1-070 E O1	25.37
934761	AD1-103 C O1	24.27
934762	AD1-103 E O1	162.42
934891	AD1-118	14.44
937021	AD2-136 C O1	6.66
937022	AD2-136 E O1	44.54
937381	AD2-191 C	3.14
937382	AD2-191 E	21.03
938911	AE1-119	113.47
939161	AE1-146 C O1	11.38

Bus #	Bus	MW Impact
939162	AE1-146 E O1	5.42
940841	AE2-072 C	11.37
940842	AE2-072 E	7.58
941741	AE2-174 C	5.65
941742	AE2-174 E	26.45
941761	AE2-176 C	15.5
941762	AE2-176 E	10.33
941781	AE2-181 C	5.32
941782	AE2-181 E	3.54
942661	AE2-282 C O1	7.94
942662	AE2-282 E O1	4.18
CARR	CARR	1.56
CBM-S1	CBM-S1	11.01
CBM-S2	CBM-S2	2.22
CBM-W1	CBM-W1	49.68
CBM-W2	CBM-W2	99.39
CIN	CIN	12.23
CPLE	CPLE	0.54
G-007	G-007	3.47
IPL	IPL	7.83
LGEE	LGEE	2.96
MEC	MEC	24.48
MECS	MECS	52.6
O-066	O-066	22.46
RENSSELAER	RENSSELAER	1.23
WEC	WEC	3.99
Z1-043	Z1-043	15.37

19.4 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
2250697	238915	02LRN Q2	ATSI	238524	02AD Q-2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	316.0	134.17	135.73	DC	10.92

Bus #	Bus	MW Impact
238571	02BEAVGA	0.89
238572	02BEAVGB	0.91
238670	02DVBSG1	66.4
238979	02NAPMUN	2.0
239174	02WLORG-5	1.06
239175	02WLORG-6	1.38
240968	02BG2 GEN	0.42
240969	02BG4 G1	0.11
240973	02BG6 AMPO	1.66
240975	02PGE GEN	2.19
241908	02LLF_W4-004	0.3
247548	V4-010 C	1.53
247940	U4-028 E	4.44
247941	U4-029 E	4.44
247947	V4-010 E	10.24
931951	AB1-107 1	16.61
931961	AB1-107 2	36.46
932791	AC2-103 C	3.56
932792	AC2-103 E	23.82
934251	AD1-052 C1	0.85
934261	AD1-052 C2	0.85
934761	AD1-103 C O1	5.98
934762	AD1-103 E O1	40.04
934891	AD1-118	4.16
937021	AD2-136 C O1	2.39
937022	AD2-136 E O1	15.99
937381	AD2-191 C	1.13
937382	AD2-191 E	7.55
938911	AE1-119	32.71
941741	AE2-174 C	2.05
941742	AE2-174 E	9.6
941761	AE2-176 C	6.55
941762	AE2-176 E	4.37
941781	AE2-181 C	1.58
941782	AE2-181 E	1.05
942661	AE2-282 C O1	2.36
942662	AE2-282 E O1	1.24
CARR	CARR	0.55
CBM-S1	CBM-S1	3.73
CBM-S2	CBM-S2	0.85

Bus #	Bus	MW Impact
CBM-W1	CBM-W1	15.2
CBM-W2	CBM-W2	32.82
CIN	CIN	4.0
CPLE	CPLE	0.23
G-007	G-007	1.12
IPL	IPL	2.56
LGEE	LGEE	0.99
MEC	MEC	7.89
MECS	MECS	15.45
O-066	O-066	7.25
RENSSELAER	RENSSELAER	0.43
WEC	WEC	1.27

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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
2250746	239728	02BLKRVR	ATSI	239734	02USSTEEL	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	659.0	102.85	103.86	DC	14.84

Bus #	Bus	MW Impact
238571	02BEAVGA	1.2
238572	02BEAVGB	1.22
238670	02DVBSG1	89.82
238979	02NAPMUN	2.71
239174	02WLORG-5	1.43
239175	02WLORG-6	1.85
240968	02BG2 GEN	0.57
240969	02BG4 G1	0.14
240973	02BG6 AMPO	2.25
240975	02PGE GEN	2.96
241908	02LLF_W4-004	0.4
247548	V4-010 C	2.07
247940	U4-028 E	6.02
247941	U4-029 E	6.02
247947	V4-010 E	13.87
900041	V4-011	0.19
925751	AC1-051 C	0.47
925752	AC1-051 E	3.12
931951	AB1-107 1	22.48
931961	AB1-107 2	49.32
932051	AC2-015 C	3.24
932052	AC2-015 E	3.84
932791	AC2-103 C	4.81
932792	AC2-103 E	32.2
934251	AD1-052 C1	1.16
934261	AD1-052 C2	1.16
934461	AD1-070 C O1	2.33
934462	AD1-070 E O1	10.93
934761	AD1-103 C O1	8.09
934762	AD1-103 E O1	54.14
934891	AD1-118	5.63
937021	AD2-136 C O1	3.24
937022	AD2-136 E O1	21.65
937381	AD2-191 C	1.53
937382	AD2-191 E	10.23
938911	AE1-119	44.25
939161	AE1-146 C O1	4.9
939162	AE1-146 E O1	2.33
940841	AE2-072 C	4.71
940842	AE2-072 E	3.14

Bus #	Bus	MW Impact
941741	AE2-174 C	2.78
941742	AE2-174 E	13.01
941761	AE2-176 C	8.9
941762	AE2-176 E	5.94
941781	AE2-181 C	2.14
941782	AE2-181 E	1.43
942661	AE2-282 C O1	3.19
942662	AE2-282 E O1	1.68
942813	AE2-299 BAT	4.33
CARR	CARR	0.76
CBM-S1	CBM-S1	5.0
CBM-S2	CBM-S2	1.12
CBM-W1	CBM-W1	20.5
CBM-W2	CBM-W2	44.07
CIN	CIN	5.38
CPLE	CPLE	0.3
G-007	G-007	1.56
IPL	IPL	3.45
LGEE	LGEE	1.33
MEC	MEC	10.62
MECS	MECS	20.89
O-066	O-066	10.14
RENSSELAER	RENSSELAER	0.6
WEC	WEC	1.72

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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
2250722	239734	02USSTEEL	ATSI	238915	02LRN Q2	ATSI	1	ATSI-P7-1-CEI-345-001-A	tower	593.0	109.87	111.0	DC	14.84

Bus #	Bus	MW Impact
238571	02BEAVGA	1.2
238572	02BEAVGB	1.22
238670	02DVBSG1	89.82
238979	02NAPMUN	2.71
239174	02WLORG-5	1.43
239175	02WLORG-6	1.85
240968	02BG2 GEN	0.57
240969	02BG4 G1	0.14
240973	02BG6 AMPO	2.25
240975	02PGE GEN	2.96
241908	02LLF_W4-004	0.4
247548	V4-010 C	2.07
247940	U4-028 E	6.02
247941	U4-029 E	6.02
247947	V4-010 E	13.87
900041	V4-011	0.19
925751	AC1-051 C	0.47
925752	AC1-051 E	3.12
931951	AB1-107 1	22.48
931961	AB1-107 2	49.32
932051	AC2-015 C	3.24
932052	AC2-015 E	3.84
932791	AC2-103 C	4.81
932792	AC2-103 E	32.2
934251	AD1-052 C1	1.16
934261	AD1-052 C2	1.16
934461	AD1-070 C O1	2.33
934462	AD1-070 E O1	10.93
934761	AD1-103 C O1	8.09
934762	AD1-103 E O1	54.14
934891	AD1-118	5.63
937021	AD2-136 C O1	3.24
937022	AD2-136 E O1	21.65
937381	AD2-191 C	1.53
937382	AD2-191 E	10.23
938911	AE1-119	44.25
939161	AE1-146 C O1	4.9
939162	AE1-146 E O1	2.33
940841	AE2-072 C	4.71
940842	AE2-072 E	3.14

Bus #	Bus	MW Impact
941741	AE2-174 C	2.78
941742	AE2-174 E	13.01
941761	AE2-176 C	8.9
941762	AE2-176 E	5.94
941781	AE2-181 C	2.14
941782	AE2-181 E	1.43
942661	AE2-282 C O1	3.19
942662	AE2-282 E O1	1.68
942813	AE2-299 BAT	4.33
CARR	CARR	0.76
CBM-S1	CBM-S1	5.0
CBM-S2	CBM-S2	1.12
CBM-W1	CBM-W1	20.5
CBM-W2	CBM-W2	44.07
CIN	CIN	5.38
CPLE	CPLE	0.3
G-007	G-007	1.56
IPL	IPL	3.45
LGEE	LGEE	1.33
MEC	MEC	10.62
MECS	MECS	20.89
O-066	O-066	10.14
RENSSELAER	RENSSELAER	0.6
WEC	WEC	1.72

Affected Systems

20 Affected Systems

20.1 LG&E

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

20.2 MISO

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

20.3 TVA

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

20.4 Duke Energy Progress

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

20.5 NYISO

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

Short Circuit

21 Short Circuit

The following Breakers are overduty: None

Attachment 1 – One Line

Attachment 2 – Project Location