



**Generation Interconnection
Feasibility Study Report
for
Queue Project AG1-500
BEAVER 345 KV**

385.5 MW Capacity / 406.4 MW Energy

January 2021

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1 Introduction

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

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.

3 General

The Interconnection Customer (IC) has proposed an uprate to an existing Natural Gas generating facility located in Lorain, Ohio. This project is an increase to the Interconnection Customer's West Lorain Power Plant, which will share the same point of interconnection. The AG1-500 queue position is a 406.4 MW uprate (385.5 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 784.6 MW with 723.1 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is October 01, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-500
Project Name	BEAVER 345 KV
State	Ohio
County	Lorain
Transmission Owner	ATSI
MFO	784.6
MWE	406.4
MWC	385.5
Fuel	Natural Gas
Basecase Study Year	2024

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

4 Point of Interconnection

4.1 Primary Point of Interconnection

AG1-500 will interconnect with the ATSI on transmission system as an uprate to West Lorain Units 2-5 and AF2-004 which is a direct connection at the Beaver 345 kV substation. The project requires Attachment and Non-Direct Connection facilities upgrades.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AG1-500 generation project to connect to the FirstEnergy (“FE”) Transmission System. The IC will be responsible for constructing 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 Secondary Point of Interconnection

There is no secondary point of interconnection specified for AG1-500.

5 Cost Summary

The AG1-500 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$2,330,000
Total System Network Upgrade Costs	\$51,554,800 ¹
Total Costs	\$53,884,800

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

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

¹ This project currently causes and/or contributes to overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcements listed in the report. This will be re-evaluated in the System Impact phase. The results may vary with queue customers withdrawing from the queue and other generators deactivating over time. If a customer is the first to cause the need for a project (causes loading to exceed 100% of rating), then the customer is responsible. If a customer contributes to a facility that is already overloaded by a prior queue, then they may receive cost allocation.

6 Transmission Owner Scope of Work

The AG1-500 project is an uprate to West Lorain Units 2-5 and AF2-004 which is a direct connection at the Beaver 345 kV substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to expand substation and associated attachment facilities. The project requires Attachment Facilities and Non-Direct Connection upgrades.

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

Description	Total Cost
Remove revenue metering located in plant, set-up metering connection, supply station power, provide fence for separation of plant and substation, create access separate from West Lorain & Beaver Microwave path-ways	\$1,070,000
Replace the existing 345 kV bus protection relay with new primary and backup 411L relays at Beaver 345 kV.	\$1,260,000
Total Physical Interconnection Costs	\$2,330,000

7 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of **13 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.

If the customer is ultimately responsible for network upgrades, then the schedule for those upgrades will be refined in future study phases. The customer would need to wait for those upgrades to be completed prior to commercial operation unless determined deliverable by an interim deliverability study. The elapsed time to complete any network upgrades is provided in the System Reinforcements table of this report.

8 Transmission Owner Analysis

8.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AG1-500 project did not contribute to any overloads on the FE Transmission System.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its 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 AG1-500 delivery point substation (DPS) is the existing ATSI Beaver 345KV substation.

The AG1-500 project consists of uprates to the existing Units 2-5 and the addition of 2 new units 7a and 7b. The addition of 2 new units to the existing plant 345 kV bus requires the purchase and installation of a fully rated 345KV circuit breaker to protect the generator lead line to the ATSI Beaver substation.

The customer 345 kV bus is required to have 2 sets of high speed bus protection.

All new customer 345 kV breakers are required to have breaker failure protection.

Protection of the 345 kV Generator Lead Line shall consist of two SEL-411L line current differential schemes with pilot communication over fiber optic cable, at each terminal.

For the new Unit 7a and 7b GSU and generator required protection refer to FE's "Requirements for Transmission Connected Facilities" document.

Connecting Party will design, install, own and maintain fiber optic communications between the AG1-500 generating substation and the ATSI Beaver 345KV substation to be used for line protection and direct transfer trip (DTT).

Detailed protection requirements will be provided as part of the Facility Study.

9.2 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 345 kV circuit breaker to protect the AG1-500 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 AG1-500 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 Transmission System.

9.3 Power Factor Requirements

The existing 378.2 MW portion of the Customer Facility shall retain its existing ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.90 lagging (supplying VARs) measured at the generator's terminals. The increase of 406.4 MW to the Customer Facilities associated with the AG1-500 project shall be designed with the ability to maintain a Power Factor of at least 1.0 (unity) to 0.90 lagging (supplying VARs) measured at the generator's terminals.

For synchronous generators with multiple units and the power factor is measured at the generator's terminals, a table for each unit. Each unit must generally meet the PF requirements independently. That is, one unit with a reactive power surplus cannot be used to supplement a unit that has a reactive power deficiency unless the IC guarantees that the units will always be online together.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

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

10.2 Meteorological Data Reporting Requirements

10.3 Interconnected Transmission Owner Requirements

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

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

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-500 was evaluated as a 406.4 MW (Capacity 385.5 MW) injection as an uprate to West Lorain Units 2-5 & AF2-004 which is a direct connection at the Beaver 345 kV substation in the ATSI area. Project AG1-500 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-500 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 Contribution to Previously Identified Overloads

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC/DC	MW IMPACT
164737307	238569	02BEAVER	345.0	ATSI	239725	02LAKEAVER	345.0	ATSI	2	ATSI-P2-3-OEC-345-002	breaker	1878.0	104.75	115.09	DC	193.36
164737242	238889	02LEMOYN	345.0	ATSI	242936	05FOSTOR	345.0	AEP	1	ATSI-P2-3-TE-345-034T	breaker	1390.0	130.51	132.05	DC	47.53
164737568	238889	02LEMOYN	345.0	ATSI	242936	05FOSTOR	345.0	AEP	1	AEP_P1-2_#768	single	1390.0	112.46	113.85	DC	43.27
164737653	241901	02LALLENDORF	345.0	ATSI	242936	05FOSTOR	345.0	AEP	1	AEP_P1-2_#770	single	1409.0	101.18	103.81	DC	37.22

11.4 Potential Congestion due to Local Energy Deliverability

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

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC DC	MW IMPACT
164737717	238569	02BEAVER	345.0	ATSI	239725	02LAKEAVE	345.0	ATSI	1	ATSI-P1-2-OEC-345-804	operation	1646.0	94.84	103.24	DC	137.66
164737567	238889	02LEMOYN	345.0	ATSI	242936	05FOSTOR	345.0	AEP	1	AEP_P1-2_#768	operation	1390.0	130.0	131.27	DC	45.62
164737652	241901	02LALLENDORF	345.0	ATSI	242936	05FOSTOR	345.0	AEP	1	AEP_P1-2_#770	operation	1409.0	113.7	114.98	DC	39.24
168265868	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	112.79	114.44	DC	37.11
168265869	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P1-2_#2749_554-A	operation	1318.0	111.1	112.58	DC	42.9

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
164737242,164737568	2	02LEMOYN 345.0 kV - 05FOSTOR 345.0 kV Ckt 1	<p><u>AEP</u> AEPO0032a (497) : Sag study is required on 19.5 mile double circuit line between Forstoria Central and Lemoyne . The cost is expected to be 78,000.New ratings after sag Mitigation S/N: 1409 MVA , S/E: 1887MVA. Rebuild/Reconductor cost: \$29.2 million. Project Type : FAC Cost : \$78,000 Time Estimate : Sag Study : 6 - 12 months Months</p> <p><u>ATSI</u> Not a violation for ATSI portion</p>	\$78,000
164737653	3	02LALLENDORF 345.0 kV - 05FOSTOR 345.0 kV Ckt 1	<p><u>AEP</u> AEPO0033a (498) : Sag Study will be required on 19.2 miles line between Fostoria and Lallendorf .The cost is expected to be 76,800.New Ratings after sag study : S/N: 1409MVA S/E: 1887MVA.Rebuild/Reconductor, cost : \$ 38.4 million Project Type : FAC Cost : \$76,800 Time Estimate : Sag Study : 6 - 12 months Months</p> <p><u>ATSI</u> Not a violation for ATSI portion</p>	\$76,800
164737307	1	02BEAVER 345.0 kV - 02LAKEAVE 345.0 kV Ckt 2	<p><u>ATSI</u> N6186/OEC-001A-R1 (927) : Reconductor the existing Beaver-Lake Ave #2 345 kV line. Reconductor substation conductor, line drop and switches at both terminals. The expected rating after the project is 2488MVA/SN 2864MVA/SE. Project Type : Facility Cost : \$51,400,000 Time Estimate : 48.0 Months</p>	\$51,400,000
			TOTAL COST	\$51,554,800

11.6 Flow Gate Details

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

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
164737307	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-002	breaker	1878.0	104.75	115.09	DC	193.36

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	4.4780	50/50	4.4780
238670	02DVBSG1 (Deactivation : 31/05/2020)	31.4213	50/50	31.4213
238979	02NAPMUN	5.8799	Adder	6.92
239171	02WLORG-2	5.6374	50/50	5.6374
239172	02WLORG-3	5.8175	50/50	5.8175
239173	02WLORG-4	5.6899	50/50	5.6899
239174	02WLORG-5	5.7200	50/50	5.7200
239276	02COLLW 11	-3.2143	Adder	-3.78
239293	02BS-PKR	0.4379	50/50	0.4379
239297	02CPPW41	-3.8730	Adder	-4.56
240968	02BG2 GEN	1.1982	Adder	1.41
240969	02BG4 G1	0.3015	Adder	0.35
240973	02BG6 AMPO	4.6848	Adder	5.51
240975	02PGE GEN	6.1865	Adder	7.28
240997	02BG10	3.3492	Adder	3.94
241898	02Y1-069_1A	8.5845	50/50	8.5845
241899	02Y1-069_1B	8.5845	50/50	8.5845
241900	02Y1-069_1S	11.1698	50/50	11.1698
241946	AB1-107 CT1 (Suspended)	48.6073	Adder	57.19
241947	AB1-107 CT2 (Suspended)	59.7077	50/50	59.7077
241948	AB1-107 ST1 (Suspended)	67.2390	50/50	67.2390
244357	05GRANGER EL	0.3700	Adder	0.44
247548	V4-010 C	3.4626	Adder	4.07
247551	U4-028 C (Suspended)	1.6154	Adder	1.9
247552	U4-029 C (Suspended)	1.6154	Adder	1.9
247940	U4-028 E (Suspended)	10.8108	Adder	12.72
247941	U4-029 E (Suspended)	10.8108	Adder	12.72
247947	V4-010 E	23.1730	Adder	27.26
925753	AC1-051 C (Withdrawn : 01/12/2021)	0.7878	Adder	0.93
925754	AC1-051 E (Withdrawn : 01/12/2021)	5.2720	Adder	6.2
932055	AC2-015 C	5.4653	Adder	6.43
932056	AC2-015 E	6.4757	Adder	7.62
932791	AC2-103 C	14.3915	50/50	14.3915
932792	AC2-103 E	96.3291	50/50	96.3291
934461	AD1-070 C O1	4.6472	Adder	5.47
934462	AD1-070 E O1	21.8161	Adder	25.67
934764	AD1-103 C1	7.3114	50/50	7.3114

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
934768	AD1-103 C2	9.5745	50/50	9.5745
934769	AD1-103 C3	7.3114	50/50	7.3114
934891	AD1-118	12.3986	Adder	14.59
937021	AD2-136 C O1	5.8154	Adder	6.84
937022	AD2-136 E O1	38.9187	Adder	45.79
938911	AE1-119	97.4176	Adder	114.61
939161	AE1-146 C O1	9.8503	Adder	11.59
939162	AE1-146 E O1	4.6000	Adder	5.41
940841	AE2-072 C	9.6849	Adder	11.39
940842	AE2-072 E	6.4566	Adder	7.6
941741	AE2-174 C	4.6413	Adder	5.46
941742	AE2-174 E	21.7280	Adder	25.56
941761	AE2-176 C	15.9532	50/50	15.9532
941762	AE2-176 E	6.3813	50/50	6.3813
941781	AE2-181 C	4.4335	Adder	5.22
941782	AE2-181 E	2.9557	Adder	3.48
942661	AE2-282 C	6.7745	Adder	7.97
942662	AE2-282 E	3.5647	Adder	4.19
943951	AF1-063 C O1	2.0045	Adder	2.36
943952	AF1-063 E O1	1.1113	Adder	1.31
943961	AF1-064 C O1	5.3368	Adder	6.28
943962	AF1-064 E O1	2.6524	Adder	3.12
944551	AF1-120 C	4.1048	Adder	4.83
944552	AF1-120 E	2.0679	Adder	2.43
945401	AF1-205 C	3.8140	Adder	4.49
945402	AF1-205 E	2.5427	Adder	2.99
945411	AF1-206 C O1	18.4255	Adder	21.68
945412	AF1-206 E O1	12.2837	Adder	14.45
945641	AF1-229 C	8.4413	Adder	9.93
945642	AF1-229 E	5.6275	Adder	6.62
957031	AF2-004 1	3.9253	50/50	3.9253
957041	AF2-004 2	3.9253	50/50	3.9253
957051	AF2-004 3	3.9253	50/50	3.9253
957061	AF2-004 4	3.9253	50/50	3.9253
957111	AF2-005	1.2570	Adder	1.48
958321	AF2-126 C	5.4326	Adder	6.39
958322	AF2-126 E	2.7163	Adder	3.2
958331	AF2-127 C	2.5862	Adder	3.04
958332	AF2-127 E	1.3606	Adder	1.6
960301	AF2-321 C	12.8867	Adder	15.16
960302	AF2-321 E	8.5911	Adder	10.11
960841	AF2-375 C	9.7538	Adder	11.48
960842	AF2-375 E	6.5025	Adder	7.65
962121	AG1-056 C	2.4920	Adder	5.53
962122	AG1-056 E	1.6613	Adder	3.69
962281	AG1-076 C O1	5.6102	Adder	12.45
962282	AG1-076 E O1	8.4153	Adder	18.68
963501	AG1-199	26.1488	Adder	58.04
964561	AG1-319 C	8.3889	Adder	18.62
964562	AG1-319 E	5.5926	Adder	12.41
964941	AG1-358 C	1.8824	Adder	4.18
964942	AG1-358 E	1.2549	Adder	2.79

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
965571	AG1-425	4.2542	50/50	4.2542
966311	AG1-500 C	183.4170	50/50	183.4170
966312	AG1-500 E	9.9440	50/50	9.9440
966321	AG1-501 C	0.8327	Adder	1.85
966322	AG1-501 E	0.1083	Adder	0.24
999763	AD1-103 E1	48.9304	50/50	48.9304
999764	AD1-103 E2	64.0755	50/50	64.0755
999765	AD1-103 E3	48.9304	50/50	48.9304
WEC	WEC	1.8938	Confirmed LTF	1.8938
LGEE	LGEE	2.6766	Confirmed LTF	2.6766
CPL	CPL	0.5883	Confirmed LTF	0.5883
CBM-W2	CBM-W2	37.6141	Confirmed LTF	37.6141
NY	NY	2.3198	Confirmed LTF	2.3198
TVA	TVA	4.6522	Confirmed LTF	4.6522
O-066	O-066	22.8012	Confirmed LTF	22.8012
SIGE	SIGE	0.8399	Confirmed LTF	0.8399
CBM-S2	CBM-S2	14.8561	Confirmed LTF	14.8561
CBM-S1	CBM-S1	1.3277	Confirmed LTF	1.3277
G-007	G-007	3.5301	Confirmed LTF	3.5301
MEC	MEC	8.5091	Confirmed LTF	8.5091
LAGN	LAGN	6.3630	Confirmed LTF	6.3630
CBM-W1	CBM-W1	120.5299	Confirmed LTF	120.5299

11.6.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
164737242	238889	02LEMOYN	ATSI	242936	05FOSTOR	AEP	1	ATSI-P2-3-TE-345-034T	breaker	1390.0	130.51	132.05	DC	47.53

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	4.9108	50/50	4.9108
238670	02DVBSG1 (Deactivation : 31/05/2020)	27.0881	50/50	27.0881
238885	02LEMOG1	8.4367	50/50	8.4367
238886	02LEMOG2	8.4367	50/50	8.4367
238887	02LEMOG3	8.4367	50/50	8.4367
238888	02LEMOG4	8.4367	50/50	8.4367
238979	02NAPMUN	8.4778	50/50	8.4778
240624	02GALON M2	-4.1426	Adder	-4.87
240968	02BG2 GEN	1.7009	50/50	1.7009
240969	02BG4 G1	0.4256	50/50	0.4256
240973	02BG6 AMPO	6.6427	50/50	6.6427
240975	02PGE GEN	8.7979	50/50	8.7979
240997	02BG10	4.7306	50/50	4.7306
241898	02Y1-069_1A	9.3337	50/50	9.3337
241899	02Y1-069_1B	9.3337	50/50	9.3337
241900	02Y1-069_1S	12.1446	50/50	12.1446
241946	AB1-107 CT1 (Suspended)	63.2647	50/50	63.2647
241947	AB1-107 CT2 (Suspended)	64.9181	50/50	64.9181
241948	AB1-107 ST1 (Suspended)	73.1066	50/50	73.1066
244357	05GRANGER EL	-0.4457	Adder	-0.52
927185	AC1-212 BAT (Withdrawn : 12/16/2020)	1.3707	Merchant Transmission	1.3707
932791	AC2-103 C	5.9169	Adder	6.96
932792	AC2-103 E	39.6048	Adder	46.59
934764	AD1-103 C1	3.0060	Adder	3.54
934768	AD1-103 C2	3.9365	Adder	4.63
934769	AD1-103 C3	3.0060	Adder	3.54
934891	AD1-118	23.3954	50/50	23.3954
936722	AD2-091 BAT	5.6460	Merchant Transmission	5.6460
938911	AE1-119	183.8210	50/50	183.8210
941761	AE2-176 C	8.7114	Adder	10.25
941762	AE2-176 E	3.4846	Adder	4.1
941781	AE2-181 C	5.0037	Adder	5.89
941782	AE2-181 E	3.3358	Adder	3.92
942042	AE2-216 BAT	6.2106	Merchant Transmission	6.2106
942661	AE2-282 C	7.8380	Adder	9.22
942662	AE2-282 E	4.1243	Adder	4.85
943012	AE2-324 BAT	2.2460	Merchant Transmission	2.2460
943951	AF1-063 C O1	1.1397	Adder	1.34
943952	AF1-063 E O1	0.6318	Adder	0.74

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
943961	AF1-064 C O1	6.2963	Adder	7.41
943962	AF1-064 E O1	3.1293	Adder	3.68
944551	AF1-120 C	4.7492	Adder	5.59
944552	AF1-120 E	2.3925	Adder	2.81
945401	AF1-205 C	5.4991	50/50	5.4991
945402	AF1-205 E	3.6661	50/50	3.6661
945411	AF1-206 C O1	21.3180	Adder	25.08
945412	AF1-206 E O1	14.2120	Adder	16.72
945623	AF1-227 BAT	7.7050	Merchant Transmission	7.7050
946052	AF1-270 BAT	4.3040	Merchant Transmission	4.3040
946141	AF1-279 C	7.2484	Adder	8.53
946142	AF1-279 E	4.8323	Adder	5.69
946203	AF1-285 BAT	2.0982	Merchant Transmission	2.0982
950351	J466	3.8385	PJM External (MISO)	3.8385
950791	J201 C	0.4637	PJM External (MISO)	0.4637
950792	J201 E	1.8549	PJM External (MISO)	1.8549
950871	J246 C	0.1521	PJM External (MISO)	0.1521
950872	J246 E	0.6082	PJM External (MISO)	0.6082
950942	J325 E	0.5270	PJM External (MISO)	0.5270
952201	J589 C	3.0202	PJM External (MISO)	3.0202
952202	J589 E	16.3398	PJM External (MISO)	16.3398
952312	J646 E	0.2269	PJM External (MISO)	0.2269
952401	J752 C	1.9562	PJM External (MISO)	1.9562
952402	J752 E	10.5838	PJM External (MISO)	10.5838
952611	J717 C	3.2723	PJM External (MISO)	3.2723
952612	J717 E	17.7042	PJM External (MISO)	17.7042
952761	J728 C	3.0432	PJM External (MISO)	3.0432
952762	J728 E	16.4866	PJM External (MISO)	16.4866
952881	J758	15.6880	PJM External (MISO)	15.6880
952971	J793	187.6050	PJM External (MISO)	187.6050
953071	J794 C	0.1971	PJM External (MISO)	0.1971
953072	J794 E	1.0662	PJM External (MISO)	1.0662
953271	J701 C	0.9586	PJM External (MISO)	0.9586
953272	J701 E	5.1860	PJM External (MISO)	5.1860
953291	J796	25.9578	PJM External (MISO)	25.9578
953321	J799	32.1886	PJM External (MISO)	32.1886
953361	J806	14.4143	PJM External (MISO)	14.4143
953771	J832	8.9910	PJM External (MISO)	8.9910
953781	J833	17.4120	PJM External (MISO)	17.4120
953941	J857	11.5179	PJM External (MISO)	11.5179
954111	J875	23.2755	PJM External (MISO)	23.2755
955071	J984 C	2.5768	PJM External (MISO)	2.5768
955072	J984 E	13.9412	PJM External (MISO)	13.9412
955181	J996	14.4904	PJM External (MISO)	14.4904
955591	J1043 C	1.4040	PJM External (MISO)	1.4040
955592	J1043 E	24.8789	PJM External (MISO)	24.8789
955781	J1062	35.4495	PJM External (MISO)	35.4495
956011	J1088	16.4520	PJM External (MISO)	16.4520
956021	J1089	18.7969	PJM External (MISO)	18.7969
956031	J1090	10.9260	PJM External (MISO)	10.9260
956741	J1172	5.9040	PJM External (MISO)	5.9040
956801	J1178	7.1260	PJM External (MISO)	7.1260

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
957031	AF2-004 1	0.8201	Adder	0.96
957041	AF2-004 2	0.8201	Adder	0.96
957051	AF2-004 3	0.8201	Adder	0.96
957061	AF2-004 4	0.8201	Adder	0.96
957111	AF2-005	0.6911	Adder	0.81
958321	AF2-126 C	6.4094	Adder	7.54
958322	AF2-126 E	3.2047	Adder	3.77
958331	AF2-127 C	1.4703	Adder	1.73
958332	AF2-127 E	0.7735	Adder	0.91
960301	AF2-321 C	13.7555	Adder	16.18
960302	AF2-321 E	9.1703	Adder	10.79
962121	AG1-056 C	2.6600	Adder	5.9
962122	AG1-056 E	1.7733	Adder	3.94
963501	AG1-199	76.7880	50/50	76.7880
964561	AG1-319 C	22.8213	50/50	22.8213
964562	AG1-319 E	15.2142	50/50	15.2142
964602	AG1-323 BAT	1.7074	Merchant Transmission	1.7074
965432	AG1-411 BAT	4.4287	Merchant Transmission	4.4287
965571	AG1-425	1.2312	Adder	2.73
966132	AG1-482 BAT	1.0680	Merchant Transmission	1.0680
966311	AG1-500 C	20.3104	Adder	45.08
966312	AG1-500 E	1.1011	Adder	2.44
966321	AG1-501 C	0.4578	Adder	1.02
966322	AG1-501 E	0.0595	Adder	0.13
999763	AD1-103 E1	20.1173	Adder	23.67
999764	AD1-103 E2	26.3441	Adder	30.99
999765	AD1-103 E3	20.1173	Adder	23.67
G-007A	G-007A	0.2350	Confirmed LTF	0.2350
VFT	VFT	0.6837	Confirmed LTF	0.6837
CALDERWOOD	CALDERWOOD	0.8598	Confirmed LTF	0.8598
PRAIRIE	PRAIRIE	3.1228	Confirmed LTF	3.1228
CHEOAH	CHEOAH	0.8629	Confirmed LTF	0.8629
CBM-N	CBM-N	0.1500	Confirmed LTF	0.1500
COTTONWOOD	COTTONWOOD	2.9904	Confirmed LTF	2.9904
HAMLET	HAMLET	0.8518	Confirmed LTF	0.8518
GIBSON	GIBSON	0.9451	Confirmed LTF	0.9451
BLUEG	BLUEG	3.8504	Confirmed LTF	3.8504
TRIMBLE	TRIMBLE	1.2471	Confirmed LTF	1.2471
CATAWBA	CATAWBA	0.5527	Confirmed LTF	0.5527
CBM-W1	CBM-W1	55.1266	Confirmed LTF	55.1266

11.6.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
164737653	241901	02LALENDORF	ATSI	242936	05FOSTOR	AEP	1	AEP_P1-2_#770	single	1409.0	101.18	103.81	DC	37.22

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	4.7288	80/20	4.7288
238572	02BEAVGB	0.6730	80/20	0.6730
238601	02FRMENG 1	2.6601	80/20	2.6601
238602	02FRMENG 2	2.6038	80/20	2.6038
238603	02FRMENG 3	5.6988	80/20	5.6988
238670	02DVBSG1 (Deactivation : 31/05/2020)	22.5467	80/20	22.5467
238885	02LEMOG1	4.4418	80/20	4.4418
238886	02LEMOG2	4.4418	80/20	4.4418
238887	02LEMOG3	4.4418	80/20	4.4418
238888	02LEMOG4	4.4418	80/20	4.4418
238979	02NAPMUN	5.4956	80/20	5.4956
239171	02WLORG-2	1.1440	80/20	1.1440
239172	02WLORG-3	1.1805	80/20	1.1805
239173	02WLORG-4	1.1546	80/20	1.1546
239174	02WLORG-5	1.1607	80/20	1.1607
239175	02WLORG-6	1.0036	80/20	1.0036
239202	02STRYCT	0.2540	80/20	0.2540
239293	02BS-PKR	0.4625	80/20	0.4625
240624	02GALON M2	-3.5013	Adder	-4.12
240968	02BG2 GEN	1.1355	80/20	1.1355
240969	02BG4 G1	0.2888	80/20	0.2888
240973	02BG6 AMPO	4.4696	80/20	4.4696
240975	02PGE GEN	5.8856	80/20	5.8856
241898	02Y1-069_1A	11.8718	80/20	11.8718
241899	02Y1-069_1B	11.8718	80/20	11.8718
241900	02Y1-069_1S	15.4470	80/20	15.4470
241912	02EL_AA1-006	0.0378	80/20	0.0378
241946	AB1-107 CT1 (Suspended)	59.8398	80/20	59.8398
241947	AB1-107 CT2 (Suspended)	82.5713	80/20	82.5713
241948	AB1-107 ST1 (Suspended)	92.9865	80/20	92.9865
932791	AC2-103 C	5.7795	80/20	5.7795
934764	AD1-103 C1	2.9362	80/20	2.9362
934768	AD1-103 C2	3.8450	80/20	3.8450
934769	AD1-103 C3	2.9362	80/20	2.9362
934891	AD1-118	12.3172	80/20	12.3172
938911	AE1-119	96.7780	80/20	96.7780
941761	AE2-176 C	8.1870	80/20	8.1870
941781	AE2-181 C	3.9619	80/20	3.9619
942661	AE2-282 C	6.3875	80/20	6.3875
943961	AF1-064 C O1	4.9025	80/20	4.9025
944551	AF1-120 C	3.8703	80/20	3.8703

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
945401	AF1-205 C	3.5647	80/20	3.5647
945411	AF1-206 C O1	17.3727	80/20	17.3727
946141	AF1-279 C	5.9586	Adder	7.01
950351	J466	3.6663	PJM External (MISO)	3.6663
950791	J201 C	0.4381	PJM External (MISO)	0.4381
950871	J246 C	0.1430	PJM External (MISO)	0.1430
952201	J589 C	2.8167	PJM External (MISO)	2.8167
952401	J752 C	1.8656	PJM External (MISO)	1.8656
952611	J717 C	3.0735	PJM External (MISO)	3.0735
952761	J728 C	2.8583	PJM External (MISO)	2.8583
952881	J758	13.0480	PJM External (MISO)	13.0480
952971	J793	181.1140	PJM External (MISO)	181.1140
953071	J794 C	0.1845	PJM External (MISO)	0.1845
953271	J701 C	0.9141	PJM External (MISO)	0.9141
953291	J796	24.4115	PJM External (MISO)	24.4115
953321	J799	28.2820	PJM External (MISO)	28.2820
953361	J806	11.9796	PJM External (MISO)	11.9796
953771	J832	8.3460	PJM External (MISO)	8.3460
953781	J833	14.8210	PJM External (MISO)	14.8210
953941	J857	9.5099	PJM External (MISO)	9.5099
954111	J875	18.4635	PJM External (MISO)	18.4635
955071	J984 C	2.3768	PJM External (MISO)	2.3768
955181	J996	10.6984	PJM External (MISO)	10.6984
955591	J1043 C	1.2760	PJM External (MISO)	1.2760
955781	J1062	21.6330	PJM External (MISO)	21.6330
955861	J1071	5.3600	PJM External (MISO)	5.3600
956011	J1088	15.2160	PJM External (MISO)	15.2160
956021	J1089	17.4573	PJM External (MISO)	17.4573
956031	J1090	9.1917	PJM External (MISO)	9.1917
956741	J1172	5.5630	PJM External (MISO)	5.5630
956801	J1178	6.0729	PJM External (MISO)	6.0729
957031	AF2-004 1	0.7965	80/20	0.7965
957041	AF2-004 2	0.7965	80/20	0.7965
957051	AF2-004 3	0.7965	80/20	0.7965
957061	AF2-004 4	0.7965	80/20	0.7965
957111	AF2-005	0.5677	Adder	0.67
958321	AF2-126 C	4.9905	80/20	4.9905
960301	AF2-321 C	10.6782	80/20	10.6782
962121	AG1-056 C	3.8961	80/20	3.8961
963501	AG1-199	52.4100	80/20	52.4100
964561	AG1-319 C	14.7936	80/20	14.7936
965571	AG1-425	2.1832	80/20	2.1832
966311	AG1-500 C	37.2200	80/20	37.2200
966321	AG1-501 C	0.3761	Adder	0.83
G-007A	G-007A	0.0911	Confirmed LTF	0.0911
VFT	VFT	0.2838	Confirmed LTF	0.2838
CALDERWOOD	CALDERWOOD	0.7097	Confirmed LTF	0.7097
PRAIRIE	PRAIRIE	2.4203	Confirmed LTF	2.4203
CHEOAH	CHEOAH	0.7127	Confirmed LTF	0.7127
CBM-N	CBM-N	0.0720	Confirmed LTF	0.0720
COTTONWOOD	COTTONWOOD	2.4024	Confirmed LTF	2.4024
HAMLET	HAMLET	0.7144	Confirmed LTF	0.7144

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
GIBSON	GIBSON	0.7595	Confirmed LTF	0.7595
BLUEG	BLUEG	3.1595	Confirmed LTF	3.1595
TRIMBLE	TRIMBLE	1.0240	Confirmed LTF	1.0240
CATAWBA	CATAWBA	0.4617	Confirmed LTF	0.4617
CBM-W1	CBM-W1	56.6268	Confirmed LTF	56.6268

11.7 Queue Dependencies

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

Queue Number	Project Name	Status
AA1-006	Erie County Landfill	In Service
AB1-107	Bayshore-GM Powertrain 138 kV & Lallendorf 345kV	Suspended
AC1-051	Willard-S. Greenwich 69kV	Withdrawn
AC1-212	Minster 69kV	Withdrawn
AC2-015	Chatfield-Howard 138kV	Active
AC2-103	Beaver-Davis Besse 345 kV I	Engineering and Procurement
AD1-070	Fostoria Central 138 kV	Active
AD1-103	Beaver-Davis Besse 345 kV II	Active
AD1-118	Lemoyne	Active
AD2-091	Hardin Tap 345kV	Active
AD2-136	Melmore Tap 138kV	Active
AE1-119	Lemoyne 345 kV	Active
AE1-146	Ebersole #2-Fostoria Central 138 kV	Active
AE2-072	East Leipsic-Richland 138 kV	Active
AE2-174	Seneca 138 kV	Active
AE2-176	Groton 138 kV Solar	Active
AE2-181	Snyder 69kV	Active
AE2-216	Hardin Switch 345 kV	Active
AE2-282	East Fayette 138 kV	Active
AE2-324	Galion-Roberts South II 138 kV	Active
AF1-063	Lockwood Road 138 kV	Active
AF1-064	Weston 69 kV	Active
AF1-120	East Fayette 2 138 kV	Active
AF1-205	Napolean Muni 138 kV	Active
AF1-206	East Fayette 138 kV	Active
AF1-227	Marysville-East Lima 345 kV	Active
AF1-229	Galion-South Berwick 345 kV	Active
AF1-270	Blue Jacket-Kirby 138 kV	Active
AF1-279	Carlisle 138 kV	Active
AF1-285	Gunn Road 345 kV	Active
AF2-004	Beaver 345 kV	Active
AF2-005	Beaver 138 kV	Active
AF2-126	Weston 69 kV II	Active
AF2-127	Lockwood Road 138 kV	Active
AF2-321	Stryker-Ridgeville 138 kV	Active
AF2-375	Ebersole-Fostoria 138 kV	Active
AG1-056	Stryker-Ridgeville 138 kV	Active
AG1-076	Fostoria Central 138 kV	Active

Queue Number	Project Name	Status
AG1-199	Allen Junction 345 kV	Active
AG1-319	Northside 138 kV	Active
AG1-323	Blue Jacket 138 kV	Active
AG1-358	Howard-Melmore 138 kV	Active
AG1-411	Maddox Creek-RP Mone 345 kV	Active
AG1-425	Groton 138 kV	Active
AG1-482	Hamilton 115 kV	Active
AG1-500	Beaver 345 kV	Active
AG1-501	Beaver 138 kV	Active
U4-028	Fostoria Central-Greenlawn-Howard 138kV	Suspended
U4-029	Fostoria Central-Greenlawn-Howard 138kV	Suspended
V4-010	Tiffin Center 138kV	Engineering and Procurement
Y1-069	Bay Shore-Fostoria Central 345kV & Bayshore-Monroe 345kV	In Service
J1043	MISO	MISO
J1062	MISO	MISO
J1071	MISO	MISO
J1088	MISO	MISO
J1089	MISO	MISO
J1090	MISO	MISO
J1172	MISO	MISO
J1178	MISO	MISO
J201	MISO	MISO
J246	MISO	MISO
J325	MISO	MISO
J466	MISO	MISO
J589	MISO	MISO
J646	MISO	MISO
J701	MISO	MISO
J717	MISO	MISO
J728	MISO	MISO
J752	MISO	MISO
J758	MISO	MISO
J793	MISO	MISO
J794	MISO	MISO
J796	MISO	MISO
J799	MISO	MISO
J806	MISO	MISO
J832	MISO	MISO
J833	MISO	MISO
J857	MISO	MISO
J875	MISO	MISO
J984	MISO	MISO
J996	MISO	MISO

11.8 Contingency Descriptions

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-345-002	CONTINGENCY 'ATSI-P2-3-OEC-345-002' /* 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_P1-2_#2749_554-A	CONTINGENCY 'AEP_P1-2_#2749_554-A' OPEN BRANCH FROM BUS 238745 TO BUS 945640 CKT 1 / 238745 02GALION 345 945640 AF1-229 TAP 345 1 END
Base Case	
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-P2-3-TE-345-034T	CONTINGENCY 'ATSI-P2-3-TE-345-034T' /* LALLEND
ATSI-P1-2-OEC-345-804	CONTINGENCY 'ATSI-P1-2-OEC-345-804' /* LINE 02LAKEAVE TO 02BEAVER 345 CK 2 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238569 CKT 2 /* 02LAKEAVE 345 02BEAVER 345 END

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

12.1 System Reinforcements - Short Circuit

None.

13 Affected Systems

13.1 NYISO

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

13.2 MISO

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

14 Attachment 1: One Line Diagram