Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-279

CARLISLE 345 KV

90 MW Capacity / 150 MW Energy

January, 2020

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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 American Transmission Systems, Incorporated (ATSI - Ohio Edison zone).

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 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.

3 General

The Interconnection Customer (IC), has proposed a Solar/Storage generating facility located in Lorain County, Ohio. The installed facilities will have a total capability of 150 MW with 90 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 15, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-279**
Project Name	CARLISLE 345 KV
State	Ohio
County	Lorain
Transmission Owner	ATSI
MFO	150
MWE	150
MWC	90
Fuel	Solar; Storage
Basecase Study Year	2023

3.1 Point of Interconnection

The interconnection of the project at the Primary POI in the ATSI transmission system will be accomplished by installing two 345 kV breaker at the FirstEnergy Carlisle 345 kV substation and a new line exit to the Primary POI. The project converts the Carlisle 345 kV substation into four breaker ring bus. The Carlisle substation is located approximately 18.22 miles from the FirstEnergy Beaver substation. The project will also require non-direct connection upgrades at Beaver and North Medina substations. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection tap line and the associated facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF1-279 generation project to connect to the FirstEnergy ("FE") transmission system. IC will be responsible for constructing all 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.

3.2 Cost Summary

The AF1-279 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$363,400
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$15,392,700
Total Costs	**$15,756,100**

In addition, the AF1-279 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$**620,000**

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

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 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 required Attachment Facilities and Direct and Non-Direct Connection work for the interconnection of the AF1-279 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.

4 Transmission Owner Scope of Work

The interconnection of the project at the Primary POI in the ATSI transmission system will be accomplished by installing two 345 kV breaker at the FirstEnergy Carlisle 345 kV substation and a new line exit to the Primary POI. The project converts the Carlisle 345 kV substation into four breaker ring bus. The Carlisle substation is located approximately 18.22 miles from the FirstEnergy Beaver substation. The project will also require non-direct connection upgrades at Beaver and North Medina substations. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection tap line and the associated facilities

5 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
Line terminal exit for the AF1-279 customer	$291,000
Customer drawing review and nameplates for the AF1-279 customer substation	$72,400
Total Attachment Facility Costs	**$363,400**

6 Direct Connection Cost Estimate

There is no Direct Connection scope of work.

7 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
New 345-kV 4-breaker ring bus for AF1-279 POI @ Carlisle	$15,131,400
Reterminate the Beaver-Carlisle 345kV line exit at the Carlisle Substation to accommodate the new 4-breaker ring bus. @ Beaver-Carlisle 345kV Retermination	$112,300

Description	Total Cost
Reterminate the Carlisle-North Medina 345kV line exit at the Carlisle Substation to accommodate the new 4-breaker ring bus. @ Carlisle-North Medina 345kV Retermination	$74,200
Update Relay Settings @ Beaver	$37,400
Update Relay Settings @ N Medina	$37.400
Total Non-Direct Connection Facility Costs	**$15,392,700**

8 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 **18 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 Attachment Facilities. Full initial deposit is required for the Non-Direct Connection work. 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 interconnection work and network upgrades, and that all transmission system outages will be allowed when requested.

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.

9 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF1-279 project did not contribute to any overloads on the FE transmission system.

10 Interconnection Customer Requirements

10.1 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 IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side.

Since this customer is using two transformers an additional high side breaker must be added between the two transformer breakers and the Carlisle 345kV generation line exit.

10.2 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 AF1-279 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 AF1-279 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.

10.3 Power Factor Requirements

The IC shall design its Solar non-synchronous Customer 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.1.1 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

11.2 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

12 Network Impacts – Primary POI

The Queue Project AF1-279 was evaluated as a 150.0 MW (Capacity 90.0 MW) injection at the Carlisle Tap 345 kV substation in the ATSI area. Project AF1-279 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-279 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

12.1 Generation Deliverability

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

None

12.2 Multiple Facility Contingency

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

None

12.3 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43594125	242936	05FOSTOR	345.0	AEP	242935	05ELIMA	345.0	AEP	1	AEP_P4_#6155_05FOSTOR 345_A2	breaker	1318.0	129.31	129.77	DC	13.4

12.4 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43594482	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	130.7	131.21	DC	11.51

12.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43594125	1	**05FOSTOR 345.0 kV - 05E LIMA 345.0 kV Ckt 1**	**AEPO0030a (367) : 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 (368) :Fostoria Ctl- East Lima 345 kV Line: 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 (369) : Replace sub Cond 2870 MCM ACSR at E Lima** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12- 18 months Months**	$620,000
			TOTAL COST	**$620,000**

12.6 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.

12.7 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
43594125	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	AEP_P4_#6155_05FOSTOR 345_A2	breaker	1318.0	129.31	129.77	DC	13.4

Bus #	Bus	MW Impact
238564	02BAYSG1	4.5005
238670	**02DVBSG1 (Deativation : 05/31/20)**	**18.6841**
238885	02LEMOG1	5.4038
238886	02LEMOG2	5.4038
238887	02LEMOG3	5.4038
238888	02LEMOG4	5.4038
238979	02NAPMUN	5.5965
239293	02BS-PKR	0.3929
241902	Y1-069 GE	27.6717
247548	V4-010 C	1.5704
247947	V4-010 E	10.5098
927181	AC1-212 C	-0.1421
927182	AC1-212 E	-1.3464
927183	AC1-212 BAT	1.7512
931951	AB1-107 1	56.0225
931961	AB1-107 2	139.0064
932791	AC2-103 C	5.2049
932792	AC2-103 E	34.8391
934252	AD1-052 E1	0.7255
934262	AD1-052 E2	0.7255
934761	AD1-103 C O1	8.7514
934762	AD1-103 E O1	58.5671
934891	AD1-118	16.9372
936722	AD2-091 BAT	8.1270
936752	AD2-096 BAT	3.4360
938911	AE1-119	133.0780
941741	AE2-174 C	1.1156
941742	AE2-174 E	5.2228
941761	AE2-176 C	8.9174
941762	AE2-176 E	5.9449
941781	AE2-181 C	3.8687
941782	AE2-181 E	2.5791
942042	AE2-216 BAT	8.9397
942661	AE2-282 C O1	6.1301
942662	AE2-282 E O1	3.2256
943961	AF1-064 C O1	6.4298
943962	AF1-064 E O1	3.1957
944551	AF1-120 C	1.9686
944552	AF1-120 E	0.9917
945341	AF1-199	0.1497
945401	AF1-205 C O1	1.9240
945402	AF1-205 E O1	1.2827

Bus #	Bus	MW Impact
945411	AF1-206 C O1	8.8366
945412	AF1-206 E O1	5.8910
945623	AF1-227 BAT	8.1750
946141	AF1-279 C O1	3.6211
946142	AF1-279 E O1	2.4140
946203	AF1-285 BAT	2.9656
950311	G934 C	2.3178
950312	G934 E	9.2712
950351	J466	3.7266
950791	J201 C	0.4457
950792	J201 E	1.7829
950871	J246 C	0.1181
950872	J246 E	0.4724
950942	J325 E	0.5128
951531	J533 C	3.3740
951532	J533 E	13.4960
951571	J538 C	3.3978
951572	J538 E	13.5912
951941	J602 C	3.3094
951942	J602 E	17.9046
952201	J589 C	2.7958
952202	J589 E	15.1262
952312	J646 E	0.2231
952401	J752 C	1.8962
952402	J752 E	10.2588
952611	J717 C	3.1172
952612	J717 E	16.8648
952761	J728 C	2.8989
952762	J728 E	15.7050
952881	J758	13.9060
952971	J793	183.8638
953071	J794 C	0.1839
953072	J794 E	0.9950
953271	J701 C	0.9230
953272	J701 E	4.9937
953291	J796	24.8393
953321	J799	30.2117
953361	J806	12.8512
953421	J841	73.2748
953771	J832	8.5410
953781	J833	16.0890
953811	J839	13.5060
953941	J857	9.7411
954111	J875	20.5980
955021	J978 C	1.0986
955022	J978 E	5.9434
955071	J984 C	2.4105
955072	J984 E	13.0415
955121	J989	9.4336
955181	J996	12.4528
955261	J1005	20.8000
955341	J1013	4.5888

Bus #	Bus	MW Impact
955351	J1014 C	5.7035
955352	J1014 E	3.4221
955591	J1043 C	1.2916
955592	J1043 E	22.8872
955621	J1046	9.4120
955721	J1056 C	5.2485
955722	J1056 E	28.3955
955781	J1062	37.6480
955801	J1064 C	1.8380
955802	J1064 E	9.9440
955811	J1065 C	2.5050
955812	J1065 E	13.5530
955831	J1068 C	4.8781
955832	J1068 E	26.3919
955861	J1071	5.7200
955961	J1083	6.9769
956011	J1088	15.6015
956021	J1089	17.8704
956031	J1090	9.8955
956161	J1103	2.4150
956291	J1117	8.2056
956301	J1119	67.5240
956741	J1172	5.6735
956751	J1173	11.3616
956801	J1178	6.4786
DUCKCREEK	DUCKCREEK	1.7457
NEWTON	NEWTON	2.1554
FARMERCITY	FARMERCITY	0.0931
G-007A	G-007A	1.2875
VFT	VFT	3.5217
CBM-W1	CBM-W1	40.5074
PRAIRIE	PRAIRIE	4.8819
COFFEEN	COFFEEN	0.9809
EDWARDS	EDWARDS	0.5131
CHEOAH	CHEOAH	0.9504
TILTON	TILTON	1.2165
MADISON	MADISON	4.4876
GIBSON	GIBSON	1.3306
CALDERWOOD	CALDERWOOD	0.9503
BLUEG	BLUEG	4.7358
TRIMBLE	TRIMBLE	1.5287
CATAWBA	CATAWBA	0.5474

Affected Systems

12.8 Affected Systems

12.8.1 LG&E

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

12.8.2 MISO

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

12.8.3 TVA

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

12.8.4 Duke Energy Progress

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

12.8.5 NYISO

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

12.9 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
AEP_P4_#6155_05FOSTOR 345_A2	CONTINGENCY 'AEP_P4_#6155_05FOSTOR 345_A2' OPEN BRANCH FROM BUS 242936 TO BUS 242942 CKT 1 / 242936 05FOSTOR 345 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 243006 CKT 1 / 242936 05FOSTOR 345 243006 05FOSTOR 138 1 END

Short Circuit

12.10 Short Circuit

The following Breakers are overduty:

None

13 Network Impacts – Secondary POI

The Queue Project AF1-279 was evaluated as a 150.0 MW (Capacity 90.0 MW) injection at the Carlisle Tap 138 kV substation in the ATSI area. Project AF1-279 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-279 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

13.1 Generation Deliverability

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

None

13.2 Multiple Facility Contingency

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

None

13.3 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
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13.4 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43594482	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	130.83	131.36	DC	12.22
43594483	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI-P1-2-OES-345-934T-B	operation	1318.0	127.25	127.73	DC	13.88

13.5 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.

13.6 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
43594125	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	AEP_P4_#6155_05FOSTOR 345_A2	breaker	1318.0	129.43	129.91	DC	14.03

Bus #	Bus	MW Impact
238564	02BAYSG1	4.5005
238670	**02DVBSG1 (Deativation : 05/31/20)**	**18.6841**
238885	02LEMOG1	5.4038
238886	02LEMOG2	5.4038
238887	02LEMOG3	5.4038
238888	02LEMOG4	5.4038
238979	02NAPMUN	5.5965
239293	02BS-PKR	0.3929
241902	Y1-069 GE	27.6717
247548	V4-010 C	1.5704
247947	V4-010 E	10.5098
927181	AC1-212 C	-0.1421
927182	AC1-212 E	-1.3464
927183	AC1-212 BAT	1.7512
931951	AB1-107 1	56.0225
931961	AB1-107 2	139.0064
932791	AC2-103 C	5.2049
932792	AC2-103 E	34.8391
934252	AD1-052 E1	0.7255
934262	AD1-052 E2	0.7255
934761	AD1-103 C O1	8.7514
934762	AD1-103 E O1	58.5671
934891	AD1-118	16.9372
936722	AD2-091 BAT	8.1270
936752	AD2-096 BAT	3.4360
938911	AE1-119	133.0780
941741	AE2-174 C	1.1156
941742	AE2-174 E	5.2228
941761	AE2-176 C	8.9174
941762	AE2-176 E	5.9449
941781	AE2-181 C	3.8687
941782	AE2-181 E	2.5791
942042	AE2-216 BAT	8.9397
942661	AE2-282 C O1	6.1301
942662	AE2-282 E O1	3.2256
943961	AF1-064 C O2	6.4298
943962	AF1-064 E O2	3.1957
944551	AF1-120 C	1.9686
944552	AF1-120 E	0.9917
945341	AF1-199	0.1497
945401	AF1-205 C O2	1.8922
945402	AF1-205 E O2	1.2615

Bus #	Bus	MW Impact
945411	AF1-206 C O2	8.9130
945412	AF1-206 E O2	5.9420
945623	AF1-227 BAT	9.8680
946141	AF1-279 C O2	3.7934
946142	AF1-279 E O2	2.5289
946203	AF1-285 BAT	2.9656
950311	G934 C	2.3178
950312	G934 E	9.2712
950351	J466	3.7266
950791	J201 C	0.4457
950792	J201 E	1.7829
950871	J246 C	0.1181
950872	J246 E	0.4724
950942	J325 E	0.5128
951531	J533 C	3.3740
951532	J533 E	13.4960
951571	J538 C	3.3978
951572	J538 E	13.5912
951941	J602 C	3.3094
951942	J602 E	17.9046
952201	J589 C	2.7958
952202	J589 E	15.1262
952312	J646 E	0.2231
952401	J752 C	1.8962
952402	J752 E	10.2588
952611	J717 C	3.1172
952612	J717 E	16.8648
952761	J728 C	2.8989
952762	J728 E	15.7050
952881	J758	13.9060
952971	J793	183.8638
953071	J794 C	0.1839
953072	J794 E	0.9950
953271	J701 C	0.9230
953272	J701 E	4.9937
953291	J796	24.8393
953321	J799	30.2117
953361	J806	12.8512
953421	J841	73.2748
953771	J832	8.5410
953781	J833	16.0890
953811	J839	13.5060
953941	J857	9.7411
954111	J875	20.5980
955021	J978 C	1.0986
955022	J978 E	5.9434
955071	J984 C	2.4105
955072	J984 E	13.0415
955121	J989	9.4336
955181	J996	12.4528
955261	J1005	20.8000
955341	J1013	4.5888

Bus #	Bus	MW Impact
955351	J1014 C	5.7035
955352	J1014 E	3.4221
955591	J1043 C	1.2916
955592	J1043 E	22.8872
955621	J1046	9.4120
955721	J1056 C	5.2485
955722	J1056 E	28.3955
955781	J1062	37.6480
955801	J1064 C	1.8380
955802	J1064 E	9.9440
955811	J1065 C	2.5050
955812	J1065 E	13.5530
955831	J1068 C	4.8781
955832	J1068 E	26.3919
955861	J1071	5.7200
955961	J1083	6.9769
956011	J1088	15.6015
956021	J1089	17.8704
956031	J1090	9.8955
956161	J1103	2.4150
956291	J1117	8.2056
956301	J1119	67.5240
956741	J1172	5.6735
956751	J1173	11.3616
956801	J1178	6.4786
DUCKCREEK	DUCKCREEK	1.7457
NEWTON	NEWTON	2.1554
FARMERCITY	FARMERCITY	0.0931
G-007A	G-007A	1.2875
VFT	VFT	3.5217
CBM-W1	CBM-W1	40.5074
PRAIRIE	PRAIRIE	4.8819
COFFEEN	COFFEEN	0.9809
EDWARDS	EDWARDS	0.5131
CHEOAH	CHEOAH	0.9504
TILTON	TILTON	1.2165
MADISON	MADISON	4.4876
GIBSON	GIBSON	1.3306
CALDERWOOD	CALDERWOOD	0.9503
BLUEG	BLUEG	4.7358
TRIMBLE	TRIMBLE	1.5287
CATAWBA	CATAWBA	0.5474

Affected Systems

13.7 Affected Systems

13.7.1 LG&E

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

13.7.2 MISO

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

13.7.3 TVA

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

13.7.4 Duke Energy Progress

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

13.7.5 NYISO

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

13.8 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
AEP_P4_#6155_05FOSTOR 345_A2	CONTINGENCY 'AEP_P4_#6155_05FOSTOR 345_A2' OPEN BRANCH FROM BUS 242936 TO BUS 242942 CKT 1 / 242936 05FOSTOR 345 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 243006 CKT 1 / 242936 05FOSTOR 345 243006 05FOSTOR 138 1 END
ATSI-P1-2-OES-345-934T-B	CONTINGENCY 'ATSI-P1-2-OES-345-934T-B' /* LINE 02GALION - 05SBERWI(AEP) 345 CK 1 DISCONNECT BRANCH FROM BUS 945640 TO BUS 238745 CKT 1 /* AF1-229 TAP 345 02GALION 345 END

Short Circuit

13.9 Short Circuit

The following Breakers are overduty:

None

14 Attachment One: One Line Diagram