Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-358

HOWARD-MELMORE 138 KV

34.8 MW Capacity / 58 MW Energy

October 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 AEP.

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.

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.

The conduct of light load analysis 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 during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Crawford County, Ohio. The installed facilities will have a total capability of 58 MW with 34.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-358
Project Name	HOWARD-MELMORE 138 KV
State	Ohio
County	Crawford
Transmission Owner	AEP
MFO	58
MWE	58
MWC	34.8
Fuel	Solar
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

AG1-358 will interconnect with the AEP transmission system via a new station cut into the Howard - Melmore #1 138 kV circuit. The Howard – Melmore circuit #1 is one the west side of the double circuit tower.

To accommodate the interconnection on the Howard - Melmore #1 138 kV circuit, a new three (3) circuit breaker 138 kV switching station physically configured and operated as a ring-bus will be constructed (see Attachment). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Installation of the generator lead first span exiting the POI station, including the first structure outside the AEP fence, will also be included in AEP's scope. In the case where the generator lead is a single span, the structure in the customer station will be the customer's responsibility.

5 Cost Summary

The AG1-358 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$9,688,000
Total System Network Upgrade Costs	$77,700,000
Total Costs	**$87,388,000**

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 88-129. 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.

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

6 Transmission Owner Scope of Work

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

6.1 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
138 kV Revenue Metering	$388,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$400,000
Total Attachment Facility Costs	**$788,000**

6.2 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
A new three (3) circuit breaker 138 kV switching station physically configured and operated as a ring-bus will be constructed. Installation of associated protection and control equipment, 138 kV line risers, and SCADA will also be required.	$8,040,000
Total Direct Connection Facility Costs	**$8,040,000**

6.3 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
Howard - Melmore #1 138 kV T-Line Cut In	$770,000
Review Protection and Control Settings at the Howard 138 kV substation	$45,000
Review Protection and Control Settings at the Melmore 138 kV substation	$45,000
Total Non-Direct Connection Facility Costs	**$860,000**

7 Schedule

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

8 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

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

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 Meteorological Data Reporting Requirements

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

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)

- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

9.3 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/

10 Summer Peak Analysis

The Queue Project AG1-358 was evaluated as a 58.0 MW (Capacity 34.80 MW) injection tapping the Melmore to Howard 138 kV line in the AEP area. Project AG1-358 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-358 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

None.

10.2 Multiple Facility Contingency

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

None.

10.3 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
161745719	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	AEP_P2-2_#7725_05FREMCT 138_1	bus	167.0	164.23	171.68	AC	13.04
174067256	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	AEP_P4_#7725_05FREMCT 138_M	breaker	167.0	164.23	171.67	AC	13.04
174067325	243039	05MELMOR	138.0	AEP	243110	05STIFFI	138.0	AEP	1	AEP_P4_#7110_05MELMOR 138_B	breaker	167.0	134.2	136.86	AC	5.23
179700759	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	AEP_P4_#7728_05FREMCT 138_C	breaker	167.0	160.52	168.16	AC	13.22
179743095	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	155.31	161.54	AC	11.18
174067408	243110	05STIFFI	138.0	AEP	243137	05W.ENDFOS1	138.0	AEP	1	AEP_P4_#7110_05MELMOR 138_B	breaker	167.0	110.34	112.89	AC	5.01
179672535	964943	AG1-358 TP	138.0	AEP	243024	05HOWARD	138.0	ATSI	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	154.73	172.86	AC	32.19

10.4 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
180198648	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_P1-2_#7105_8900707-A	operation	167.0	125.13	130.61	AC	9.64
168204894	243006	05FOSTOR	138.0	AEP	939160	AE1-146 TAP	138.0	AEP	2	AEP_P1-2_#7757_11500705-B	operation	204.0	122.22	123.67	AC	3.7
168204994	243006	05FOSTOR	138.0	AEP	960840	AF2-375 TAP	138.0	AEP	1	AEP_P1-2_#7761_20858-B	operation	245.0	105.04	106.3	AC	3.85
168204967	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	PJM_PLANT FREMONT	operation	251.0	113.39	117.35	AC	9.92
164565068	243024	05HOWARD	138.0	ATSI	241111	02ASHLAND	138.0	AEP	1	Base Case	operation	167.0	97.45	104.71	AC	12.46
168204838	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	AEP_P1-2_#15233	operation	167.0	147.51	154.37	AC	11.87
168204840	243039	05MELMOR	138.0	AEP	243006	05FOSTOR	138.0	AEP	1	Base Case	operation	167.0	117.04	122.56	AC	9.4
168204931	243039	05MELMOR	138.0	AEP	243110	05STIFFI	138.0	AEP	1	AEP_P1-2_#7104_8800707	operation	167.0	118.57	123.84	AC	9.25
179703846	243039	05MELMOR	138.0	AEP	242984	05CHATFL	138.0	AEP	1	AEP_P1-2_#7105_8900707-A	operation	167.0	161.52	167.87	AC	11.12
168205078	243110	05STIFFI	138.0	AEP	243137	05W.ENDFOS1	138.0	AEP	1	AEP_P1-2_#7104_8800707	operation	167.0	97.58	102.29	AC	8.3
179717517	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	ATSI	1	AEP_P1-2_#7105_8900707-A	operation	167.0	158.65	164.14	AC	9.64
169706855	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	AEP_P1-2_#7757_11500705-B	operation	204.0	144.98	146.43	AC	3.7
169994714	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	AEP_P1-2_#7761_20858-B	operation	245.0	118.21	119.47	AC	3.85
179715312	964943	AG1-358 TP	138.0	AEP	243024	05HOWARD	138.0	ATSI	1	AEP_P1-2_#15237	operation	167.0	147.07	164.77	AC	31.29
180177921	964943	AG1-358 TP	138.0	AEP	243024	05HOWARD	138.0	ATSI	1	Base Case	operation	136.0	107.22	131.69	AC	33.11

10.5 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost
174067408	3	05STIFFI 138.0 kV - 05W.END 138.0 kV Ckt 1	AEP AEPO0055a-c (205) : Current Station Rating: S/N: 167, S/E: 167 1) Line reconductor/rebuild. $9M 2) New relay packages at West End. $0.6M 3) New relay packages at South Tiffin. $0.6M Project Type : FAC Cost : $10,200,000 Time Estimate : 24-36 Months	$10,200,000
161745719,174067256,179700759,179743095	1	05MELMOR 138.0 kV - 05FOSTOR 138.0 kV Ckt 1	AEP AEPO0019b (205) : Current Station Rating: S/N: 167, S/E: 173 Rebuild 18 mile double circuit line between Melmore and Fostoria Central with 1590 ACSR (Replacing current 397.5 ACSR conductor) Project Type : FAC Cost : $54,000,000 Time Estimate : 24-36 Months	$54,000,000
179672535	4	AG1-358 TP 138.0 kV - 05HOWARD 138.0 kV Ckt 1	AEP AEPO0023a (205) : Current Station Rating: S/N: 167, S/E: 173 1) Relocate West End Fostoria- Melmore or the Howard- Melmore #2 line into a new breaker string at Melmore. $4M Project Type : CON Cost : $4,000,000 Time Estimate : 24-36 Months AEP AEPO0023e (205) : Current Station Rating: S/N: 167, S/E: 173 1) Replace five Sub cond 795 AAC 37 Str at Howard. $0.5M Project Type : FAC Cost : $4,500,000 Time Estimate : 24-36 Months	$9,500,000
174067325	2	05MELMOR 138.0 kV - 05STIFFI 138.0 kV Ckt 1	AEP AEPO0022a (205) : Current Station Rating: S/N: 167, S/E: 173 1) Relocate Fostoria Central- Melmore or the Howard- Melmore #1 line into a new breaker string at Melmore. $4M Project Type : CON Cost : $4,000,000 Time Estimate : 24-36 Months	$4,000,000
			TOTAL COST	**$77,700,000**

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

10.6 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".

10.6.1 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
17406725 6	24303 9	05MELMO R	AEP	24300 6	05FOSTO R	AEP	1	AEP_P4_#7725_05FREMC T 138_M	breake r	167.0	164.23	171.67	AC	13.04

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	-0.17	Adder	-0.2
247548	V4-010 C	7.98	80|50	7.98
247551	**U4-028 C (Suspended)**	**4.21**	**80|50**	**4.21**
247552	**U4-029 C (Suspended)**	**4.21**	**80|50**	**4.21**
247940	**U4-028 E (Suspended)**	**28.18**	**80|50**	**28.18**
247941	**U4-029 E (Suspended)**	**28.18**	**80|50**	**28.18**
247947	V4-010 E	53.4	80|50	53.4
932055	AC2-015 C	12.17	80|50	12.17
932056	AC2-015 E	14.42	80|50	14.42
937021	AD2-136 C O1	15.16	80|50	15.16
937022	AD2-136 E O1	101.45	80|50	101.45
941741	AE2-174 C	10.69	80|50	10.69
941742	AE2-174 E	50.07	80|50	50.07
964941	AG1-358 C	7.82	80|50	7.82
964942	AG1-358 E	5.21	80|50	5.21
LTFEXP_AA2-074	LTFEXP_AA2-074->LTFIMP_AA2-074	0.0072	Confirmed LTF	0.0072
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.2537	Confirmed LTF	0.2537
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.2952	Confirmed LTF	0.2952
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.0346	Confirmed LTF	0.0346
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.0032	Confirmed LTF	0.0032
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	0.1644	LTF/CBM	0.1644
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.0339	Confirmed LTF	0.0339
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	0.3093	Confirmed LTF	0.3093
LTFEXP_CPLE	LTFEXP_CPLE->LTFIMP_CPLE	0.0113	Confirmed LTF	0.0113
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	0.327	LTF/CMTX	0.327
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.1227	Confirmed LTF	0.1227
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0347	Confirmed LTF	0.0347
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	0.577	Confirmed LTF	0.577
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.094	Confirmed LTF	0.094

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	0.8811	Confirmed LTF	0.8811

10.6.2 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
174067325	243039	05MELMOR	AEP	243110	05STIFFI	AEP	1	AEP_P4_#7110_05MELMOR 138_B	breaker	167.0	134.2	136.86	AC	5.23

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	-0.16	Adder	-0.19
247548	V4-010 C	5.11	80|50	5.11
247551	**U4-028 C (Suspended)**	**3.37**	**80|50**	**3.37**
247552	**U4-029 C (Suspended)**	**3.37**	**80|50**	**3.37**
247940	**U4-028 E (Suspended)**	**22.58**	**80|50**	**22.58**
247941	**U4-029 E (Suspended)**	**22.58**	**80|50**	**22.58**
247947	V4-010 E	34.19	80|50	34.19
932055	AC2-015 C	8.2	80|50	8.2
932056	AC2-015 E	9.72	80|50	9.72
937021	AD2-136 C O1	12.15	80|50	12.15
937022	AD2-136 E O1	81.29	80|50	81.29
941741	AE2-174 C	6.85	80|50	6.85
941742	AE2-174 E	32.06	80|50	32.06
964941	AG1-358 C	2.67	Adder	3.14
964942	AG1-358 E	1.78	Adder	2.09
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.2718	Confirmed LTF	0.2718
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.0457	Confirmed LTF	0.0457
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.4213	Confirmed LTF	0.4213
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.0723	Confirmed LTF	0.0723
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.0313	Confirmed LTF	0.0313
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	0.1344	LTF/CBM	0.1344
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.0719	Confirmed LTF	0.0719
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	0.4156	Confirmed LTF	0.4156
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	0.264	LTF/CMTX	0.264
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.1469	Confirmed LTF	0.1469
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.0421	Confirmed LTF	0.0421
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0264	Confirmed LTF	0.0264
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	0.6519	Confirmed LTF	0.6519
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.135	Confirmed LTF	0.135

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	0.714	Confirmed LTF	0.714

10.6.3 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
174067408	243110	05STIFFI	AEP	243137	05W.END FOS1	AEP	1	AEP_P4_#7110_05MELMOR 138_B	breaker	167.0	110.34	112.89	AC	5.01

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	-0.22	Adder	-0.26
247548	V4-010 C	4.73	80|50	4.73
247551	**U4-028 C (Suspended)**	**2.93**	**80|50**	**2.93**
247552	**U4-029 C (Suspended)**	**2.93**	**80|50**	**2.93**
247940	**U4-028 E (Suspended)**	**19.59**	**80|50**	**19.59**
247941	**U4-029 E (Suspended)**	**19.59**	**80|50**	**19.59**
247947	V4-010 E	31.68	80|50	31.68
932055	AC2-015 C	7.48	80|50	7.48
932056	AC2-015 E	8.87	80|50	8.87
937021	AD2-136 C O1	10.54	80|50	10.54
937022	AD2-136 E O1	70.52	80|50	70.52
941741	AE2-174 C	6.35	80|50	6.35
941742	AE2-174 E	29.71	80|50	29.71
964941	AG1-358 C	2.55	Adder	3.0
964942	AG1-358 E	1.7	Adder	2.0
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.2866	Confirmed LTF	0.2866
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.0409	Confirmed LTF	0.0409
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.4317	Confirmed LTF	0.4317
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.0717	Confirmed LTF	0.0717
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.0295	Confirmed LTF	0.0295
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	0.1439	LTF/CBM	0.1439
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.0712	Confirmed LTF	0.0712
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	0.4274	Confirmed LTF	0.4274
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	0.2831	LTF/CMTX	0.2831
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.1533	Confirmed LTF	0.1533
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.0387	Confirmed LTF	0.0387
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0295	Confirmed LTF	0.0295
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	0.683	Confirmed LTF	0.683
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.1382	Confirmed LTF	0.1382

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	0.7652	Confirmed LTF	0.7652

10.6.4 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
179672535	964943	AG1-358 TP	AEP	243024	05HOWARD	ATSI	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	154.73	172.86	AC	32.19

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	4.3	80|50	4.3
247551	**U4-028 C (Suspended)**	**2.71**	**80|50**	**2.71**
247552	**U4-029 C (Suspended)**	**2.71**	**80|50**	**2.71**
247940	**U4-028 E (Suspended)**	**18.16**	**80|50**	**18.16**
247941	**U4-029 E (Suspended)**	**18.16**	**80|50**	**18.16**
247947	V4-010 E	28.81	80|50	28.81
934461	AD1-070 C O1	1.69	Adder	1.99
934462	AD1-070 E O1	7.93	Adder	9.33
937021	AD2-136 C O1	9.77	80|50	9.77
937022	AD2-136 E O1	65.37	80|50	65.37
941741	AE2-174 C	5.77	80|50	5.77
941742	AE2-174 E	27.01	80|50	27.01
960841	AF2-375 C	3.42	Adder	4.02
960842	AF2-375 E	2.28	Adder	2.68
962281	AG1-076 C O1	2.16	Adder	2.54
964941	AG1-358 C	19.31	80|50	19.31
964942	AG1-358 E	12.88	80|50	12.88
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.069	Confirmed LTF	0.069
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.0054	Confirmed LTF	0.0054
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.0249	Confirmed LTF	0.0249
LTFEXP_CBM-S1	LTFEXP_CBM-S1->LTFIMP_CBM-S1	0.0207	LTF/CBM	0.0207
LTFEXP_CBM-W1	LTFEXP_CBM-W1->LTFIMP_CBM-W1	8.9563	LTF/CBM	8.9563
LTFEXP_CBM-W2	LTFEXP_CBM-W2->LTFIMP_CBM-W2	1.1671	LTF/CBM	1.1671
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.0064	Confirmed LTF	0.0064
LTFEXP_G-007	LTFEXP_G-007->LTFIMP_G-007	0.1611	LTF/CMTX NF	0.1611
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.0474	Confirmed LTF	0.0474
LTFEXP_LAGN	LTFEXP_LAGN->LTFIMP_LAGN	0.1503	Confirmed LTF	0.1503
LTFEXP_LGEE	LTFEXP_LGEE->LTFIMP_LGEE	0.0473	Confirmed LTF	0.0473
LTFEXP_MEC	LTFEXP_MEC->LTFIMP_MEC	0.4024	Confirmed LTF	0.4024
LTFEXP_NY	LTFEXP_NY->LTFIMP_NY	0.076	Confirmed LTF	0.076

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
LTFEXP_O-066	LTFEXP_O-066->LTFIMP_O-066	1.031	LTF/CMTX NF	1.031
LTFEXP_SIGE	LTFEXP_SIGE->LTFIMP_SIGE	0.0144	Confirmed LTF	0.0144
LTFEXP_TVA	LTFEXP_TVA->LTFIMP_TVA	0.07	Confirmed LTF	0.07
LTFEXP_WEC	LTFEXP_WEC->LTFIMP_WEC	0.1019	Confirmed LTF	0.1019

10.7 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
AA2-074	CPLE-PJM	Confirmed
AC1-056	PJM-AMIL	Confirmed
AC1-131	PJM-CPLE	Confirmed
AC2-015	Chatfield-Howard 138kV	Active
AD1-070	Fostoria Central 138 kV	Active
AD2-136	Melmore Tap 138kV	Active
AE2-174	Seneca 138 kV	Active
AF2-375	Ebersole-Fostoria 138 kV	Active
AG1-076	Fostoria Central 138 kV	Active
AG1-358	Howard-Melmore 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

10.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P4_#7112_05MELMOR 138_C	CONTINGENCY 'AEP_P4_#7112_05MELMOR 138_C' OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 243110 TO BUS 243137 CKT 1 / 243110 05STIFFI 138 243137 05W.END
AEP_P1-2_#7757_11500705-B	CONTINGENCY 'AEP_P1-2_#7757_11500705-B' OPEN BRANCH FROM BUS 960840 TO BUS 247172 CKT 1 / 960840 AF2-375 TAP 138 247172 05EBERSO 138 1 END
AEP_P1-2_#7761_20858-B	CONTINGENCY 'AEP_P1-2_#7761_20858-B' OPEN BRANCH FROM BUS 939160 TO BUS 247172 CKT 2 / 939160 AE1-146 TAP 138 247172 05EBERSO 138 2 END
AEP_P4_#7110_05MELMOR 138_B	CONTINGENCY 'AEP_P4_#7110_05MELMOR 138_B' OPEN BRANCH FROM BUS 243006 TO BUS 243039 CKT 1 / 243006 05FOSTOR 138 243039 05MELMOR 138 1 /* OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 964943 TO BUS 243039 CKT 1 / 964943 AG1-358 TAP 138 243039 05MELMOR 138 1 END
AEP_P1-2_#15233	CONTINGENCY 'AEP_P1-2_#15233' OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 243110 TO BUS 243137 CKT 1 / 243110 05STIFFI 138 243137 05W.END
AEP_P1-2_#7105_8900707-A	CONTINGENCY 'AEP_P1-2_#7105_8900707-A' OPEN BRANCH FROM BUS 243024 TO BUS 964943 CKT 1 / 243024 05HOWARD 138 964943 AG1-358 TP 138 1 END
PJM_PLANT FREMONT	CONTINGENCY 'PJM_PLANT FREMONT' REMOVE MACHINE 1 FROM BUS 238601 REMOVE MACHINE 2 FROM BUS 238602 REMOVE MACHINE 3 FROM BUS 238603 END

Contingency Name	Contingency Definition
AEP_P1-2_#15237	CONTINGENCY 'AEP_P1-2_#15237' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 245655 TO BUS 245656 CKT 1 / 245655 05CARROTHR 69.0 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 245656 TO BUS 247380 CKT 1 / 245656 05CHATFIEL 69.0 247380 05NEW WASHSS69.0 1 OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 END
AEP_P1-2_#7104_8800707	CONTINGENCY 'AEP_P1-2_#7104_8800707' OPEN BRANCH FROM BUS 243006 TO BUS 243039 CKT 1 / 243006 05FOSTOR 138 243039 05MELMOR 138 1 END
AEP_P4_#7728_05FREMCT 138_C	CONTINGENCY 'AEP_P4_#7728_05FREMCT 138_C' OPEN BRANCH FROM BUS 243009 TO BUS 245616 CKT 1 / 243009 05FRMNT 138 245616 05FREMNTEQ 999 1 OPEN BRANCH FROM BUS 245616 TO BUS 245617 CKT 1 / 245616 05FREMNTEQ 999 245617 05FREMONT 69.0 1 OPEN BRANCH FROM BUS 245616 TO BUS 245618 CKT 1 / 245616 05FREMNTEQ 999 245618 05FREMONT- 12.0 1 OPEN BRANCH FROM BUS 239154 TO BUS 243009 CKT 1 / 239154 02W.FREM 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END

Contingency Name	Contingency Definition
AEP_P4_#7725_05FREMCT 138_M	CONTINGENCY 'AEP_P4_#7725_05FREMCT 138_M' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
AEP_P2-2_#7725_05FREMCT 138_1	CONTINGENCY 'AEP_P2-2_#7725_05FREMCT 138_1' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
Base Case	

11 Short Circuit Analysis

The following Breakers are overdutied

None

12 Affected Systems

12.1 TVA

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

12.2 Duke Energy Progress

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

12.3 MISO

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

12.4 LG&E

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