Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-149

SHARP ROAD 69 KV

32 MW Capacity / 80 MW Energy

July 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 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.

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 a Solar generating facility located in Knox County, Ohio. The installed facilities will have a total capability of 80 MW with 32 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	**AF2-149**
Project Name	SHARP ROAD 69 KV
State	Ohio
County	Knox
Transmission Owner	AEP
MFO	80
MWE	80
MWC	32
Fuel	Solar
Basecase Study Year	2023

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 Primary Point of Interconnection

AF2-149 will interconnect with the AEP transmission system via a direct connection to the Sharp Road 69 kV substation.

To accommodate the interconnection to the Sharp Road 69 kV substation, the substation will have to be expanded requiring the installation of one (1) 69 kV circuit breaker (Attachment 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 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 AF2-149 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$804,000
Total System Network Upgrade Costs	$12,500,000
Total Costs	$13,304,000

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 onsite 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.

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.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the tables 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
69kV Revenue Metering	$283,000
Total Attachment Facility Costs	$283,000

*Assumes that the generator lead conductor will consist of a single span extending directly from a structure within the POI station to a structure within the Collector station.

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
Expand the Sharp Road 69 kV substation: Install one (1) additional 69 kV circuit breaker. Installation of associated protection and control equipment, 69 kV line risers and SCADA will also be required.	$431,000
Total Direct Connection Facility Costs	$431,000

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
Review protection and controls at the remote end of the Commerce substation	$45,000
Reiview protection and controls at the remote end of Utica substation	$45,000
Total Non-Direct Connection Facility Costs	$90,000

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 Incremental Capacity Transfer Rights (ICTRs)

None

9 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.

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

Solar generation facilities shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter^2)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)
- Wind speed (meters/second) – (Accepted, not required)
- Wind direction (decimal degrees from true north) – (Accepted, not required)

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 – Primary POI

The Queue Project AF2-149 was evaluated as a 80.0 MW (Capacity 32.0 MW) injection at the Sharp Road 69 kV substation in the AEP area. Project AF2-149 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-149 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)

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
95300126	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7728_05FREMCT 138_C	breaker	245.0	99.49	100.55	DC	5.76

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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95299887	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P2-2_#7725_05FREMCT 138_1	bus	245.0	101.25	102.3	DC	5.71
95300125	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7725_05FREMCT 138_M	breaker	245.0	101.25	102.3	DC	5.71

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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95300353	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	Base Case	operation	167.0	111.94	113.36	DC	5.24

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
95299887,95300126,95300125	1	05HOWARD 138.0 kV - 02ASHLAND 138.0 kV Ckt 1	AEP **AEPO0029a (467) : 1) 8 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor Section 1 will need to be rebuilt/re-conductored. Estimated cost: $12 million.** **Project Type : FAC** **Cost : $12,000,000** **Time Estimate : 24-36 Months** **AEPO0029b (468) : 2) Replace five Sub cond 795 AAC 37 Str at Howard. Estimated cost: $100,000.** **Project Type : FAC** **Cost : $500,000** **Time Estimate : 12- 18 Months**	$12,500,000
			TOTAL COST	**$12,500,000**

11.6 Flow Gate Details – Primary POI

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
95300125	243024	05HOWARD	AEP	241111	02ASHLAND	ATSI	1	AEP_P4_#7725_05FREMCT 138_M	breaker	245.0	101.25	102.3	DC	5.71

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.9182	50/50	3.9182
247551	**U4-028 C (Suspended)**	**2.0021**	**50/50**	**2.0021**
247552	**U4-029 C (Suspended)**	**2.0021**	**50/50**	**2.0021**
247926	U1-059 E	2.0802	Adder	2.45
247940	**U4-028 E (Suspended)**	**13.3989**	**50/50**	**13.3989**
247941	**U4-029 E (Suspended)**	**13.3989**	**50/50**	**13.3989**
247942	W1-056 E	0.7651	Adder	0.9
247947	V4-010 E	26.2218	50/50	26.2218
925751	AC1-051 C	1.8186	50/50	1.8186
925752	AC1-051 E	12.1710	50/50	12.1710
932051	AC2-015 C	12.6266	50/50	12.6266
932052	AC2-015 E	14.9609	50/50	14.9609
934461	AD1-070 C O1	1.5851	Adder	1.86
934462	AD1-070 E O1	7.4411	Adder	8.75
934791	AD1-106 C O1	1.2901	Adder	1.52
934792	AD1-106 E O1	2.1049	Adder	2.48
937021	AD2-136 C O1	7.2077	50/50	7.2077
937022	AD2-136 E O1	48.2359	50/50	48.2359
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.4036**	**50/50**	**3.4036**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**22.7781**	**50/50**	**22.7781**
941741	AE2-174 C	5.2519	50/50	5.2519
941742	AE2-174 E	24.5867	50/50	24.5867
958581	AF2-149 C O1	1.0289	Adder	2.28
958582	AF2-149 E O1	1.5433	Adder	3.43
960841	AF2-375 C O1	1.8146	Adder	4.03
960842	AF2-375 E O1	1.2097	Adder	2.69
WEC	WEC	0.1786	Confirmed LTF	0.1786
LGEE	LGEE	0.2864	Confirmed LTF	0.2864
CPLE	CPLE	0.0913	Confirmed LTF	0.0913
CBM-W2	CBM-W2	3.7183	Confirmed LTF	3.7183
NY	NY	0.1958	Confirmed LTF	0.1958
CBM-W1	CBM-W1	7.4685	Confirmed LTF	7.4685
TVA	TVA	0.5278	Confirmed LTF	0.5278
O-066	O-066	2.0496	Confirmed LTF	2.0496
CBM-S2	CBM-S2	1.1387	Confirmed LTF	1.1387
CBM-S1	CBM-S1	3.4080	Confirmed LTF	3.4080
G-007	G-007	0.3141	Confirmed LTF	0.3141
MEC	MEC	0.8326	Confirmed LTF	0.8326

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
AC1-051	Willard-S. Greenwich 69kV	Active
AC2-015	Chatfield-Howard 138kV	Active
AD1-070	Fostoria Central 138 kV	Active
AD1-106	North Waldo-Wild Creek 138 kV	Active
AD2-136	Melmore Tap 138kV	Active
AD2-191	Melmore 138kV	Withdrawn
AE2-174	Seneca 138 kV	Active
AF2-149	SHARP ROAD 69 kV	Active
AF2-375	Fostoria Central 138 kV	Active
U1-059	Ada-Dunkirk 69kV	In Service
U4-028	Fostoria Central-Greenlawn-Howard 138kV	Suspended
U4-029	Fostoria Central-Greenlawn-Howard 138kV	Suspended
V4-010	Tiffin Center 138kV	Engineering and Procurement
W1-056	Ada-Dunkirk 69kV	In Service

11.8 Contingency Descriptions – Primary POI

Contingency Name	Contingency Definition
Base Case	
AEP_P4_#7728_05FREMCT 138_C	CONTINGENCY 'AEP_P4_#7728_05FREMCT 138_C' OPEN BRANCH FROM BUS 245616 TO BUS 243009 CKT 1 / 245616 05FREMNTEQ 999 243009 05FRMNT 138 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
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

Contingency Name	Contingency Definition
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

12 Light Load Analysis

Light Load Studies (As applicable)

Not applicable.

13 Short Circuit Analysis

The following Breakers are overdutied:

To be determined during later study phases.

14 Stability and Reactive Power Assessment

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during later study phases.

15 Affected Systems

15.1 LG&E

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

15.2 MISO

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

15.3 TVA

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

15.4 Duke Energy Progress

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

15 Secondary Point of Interconnection

AF2-149 will interconnect with the AEP transmission system at a new 69 kV switching station cut into the Commerce – Kokosing section of the Commerce – Mt. Vernon 69 kV circuit.

To accommodate the interconnection on the AEP-owned Commerce – Kokosing section of the Commerce – Mt. Vernon 69 kV circuit, a new three (3) circuit breaker 69 kV switching station configured as a ring-bus will be constructed (Figure 3). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 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.

16 Summer Peak – Load Flow Analysis – Secondary POI

The Queue Project AF2-149 was evaluated as a 80.0 MW (Capacity 32.0 MW) injection tapping the Kokosingss to Martinsburg Road Switching Station 69 kV line in the AEP area. Project AF2-149 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-149 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

16.1 Generation Deliverability

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

None

16.2 Multiple Facility Contingency

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

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
95300126	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7728_05FREMCT 138_C	breaker	245.0	99.49	100.64	DC	6.27

16.3 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
95299887	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P2-2_#7725_05FREMCT 138_1	bus	245.0	101.25	102.39	DC	6.22
95300125	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7725_05FREMCT 138_M	breaker	245.0	101.25	102.39	DC	6.22

16.4 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
95300353	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	Base Case	operation	167.0	111.94	113.48	DC	5.71

16.5 Flow Gate Details – Secondary POI

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".

16.5.1 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
95300125	243024	05HOWARD	AEP	241111	02ASHLAND	ATSI	1	AEP_P4_#7725_05FREMCT 138_M	breaker	245.0	101.25	102.39	DC	6.22

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.9182	50/50	3.9182
247551	**U4-028 C (Suspended)**	**2.0021**	**50/50**	**2.0021**
247552	**U4-029 C (Suspended)**	**2.0021**	**50/50**	**2.0021**
247926	U1-059 E	2.0802	Adder	2.45
247940	**U4-028 E (Suspended)**	**13.3989**	**50/50**	**13.3989**
247941	**U4-029 E (Suspended)**	**13.3989**	**50/50**	**13.3989**
247942	W1-056 E	0.7651	Adder	0.9
247947	V4-010 E	26.2218	50/50	26.2218
925751	AC1-051 C	1.8186	50/50	1.8186
925752	AC1-051 E	12.1710	50/50	12.1710
932051	AC2-015 C	12.6266	50/50	12.6266
932052	AC2-015 E	14.9609	50/50	14.9609
934461	AD1-070 C O1	1.5851	Adder	1.86
934462	AD1-070 E O1	7.4411	Adder	8.75
934791	AD1-106 C O1	1.2901	Adder	1.52
934792	AD1-106 E O1	2.1049	Adder	2.48
937021	AD2-136 C O1	7.2077	50/50	7.2077
937022	AD2-136 E O1	48.2359	50/50	48.2359
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.4036**	**50/50**	**3.4036**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**22.7781**	**50/50**	**22.7781**
941741	AE2-174 C	5.2519	50/50	5.2519
941742	AE2-174 E	24.5867	50/50	24.5867
958581	AF2-149 C O2	1.1204	Adder	2.49
958582	AF2-149 E O2	1.6806	Adder	3.73
WEC	WEC	0.1786	Confirmed LTF	0.1786
LGEE	LGEE	0.2864	Confirmed LTF	0.2864
CPLE	CPLE	0.0913	Confirmed LTF	0.0913
CBM-W2	CBM-W2	3.7183	Confirmed LTF	3.7183
NY	NY	0.1958	Confirmed LTF	0.1958
CBM-W1	CBM-W1	7.4685	Confirmed LTF	7.4685
TVA	TVA	0.5278	Confirmed LTF	0.5278
O-066	O-066	2.0496	Confirmed LTF	2.0496
CBM-S2	CBM-S2	1.1387	Confirmed LTF	1.1387
CBM-S1	CBM-S1	3.4080	Confirmed LTF	3.4080
G-007	G-007	0.3141	Confirmed LTF	0.3141
MEC	MEC	0.8326	Confirmed LTF	0.8326

16.6 Contingency Descriptions – Secondary POI

Contingency Name	Contingency Definition
Base Case	
AEP_P4_#7728_05FREMCT 138_C	CONTINGENCY 'AEP_P4_#7728_05FREMCT 138_C' OPEN BRANCH FROM BUS 245616 TO BUS 243009 CKT 1 / 245616 05FREMNTEQ 999 243009 05FRMNT 138 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
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

Contingency Name	Contingency Definition
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

17 Light Load Analysis

Light Load Studies (As applicable)

Not applicable.

18 Short Circuit Analysis

The following Breakers are overdutied:

To be determined during later study phases.

19 Stability and Reactive Power Assessment

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during later study phases.

20 Affected Systems

20.1 LG&E

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

20.2 MISO

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

20.3 TVA

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

20.4 Duke Energy Progress

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