Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-109

Valley 138 kV

0 MW Energy / 25 MW Capacity

Storage Project (AC connected)

January 2021

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is 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 Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC) has proposed an uprate to a planned/existing Storage generating facility located in Van Buren, Michigan. This project is an increase to the Interconnection Customer's AF1-161 project, which will share the same point of interconnection. The AG1-109 queue position is a 0 MW uprate (25 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 50 MW with 50 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this uprate project is March 01, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-109
Project Name	VALLEY 138 KV
State	Michigan
County	Van Buren
Transmission Owner	AEP
MFO	50
MWE	0
MWC	25
Fuel	Storage
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

AG1-109 will interconnect with the AEP transmission system via a direct connection to the Valley 138 kV substation as an uprate to the PJM project AF1-161.

5 Cost Summary

The AG1-109 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$0
Total System Network Upgrade Costs	$115,200
Total Costs	$0

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

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

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
none	$ 0
Total Attachment Facility Costs	**$ 0**

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
none	$ 0
Total Direct Connection Facility Costs	**$ 0**

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
none	$ 0
Total Non-Direct Connection Facility Costs	**$ 0**

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 signing 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

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 - Load Flow Analysis

The Queue Project AG1-109 was evaluated as a 25.0 MW (Capacity 25.0 MW) injection at the Valley 138 kV substation in the AEP area. Project AG1-109 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-109 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
161473063	243265	05COREY	138.0	AEP	243346	05MOTTV	138.0	AEP	1	AEP_P2-2_#12306_05COREY 69.0_1	bus	185.0	144.76	146.78	DC	3.73
161473102	243346	05MOTTV	138.0	AEP	243287	05E.ELKHART	138.0	AEP	1	AEP_P2-2_#12429_05POKAGON 69.0_1	bus	185.0	130.65	132.65	DC	3.7

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
168101396	243212	05BENTON	345.0	AEP	243250	05BENTON	138.0	AEP	1	AEP_P1-2_#1242_1689	operation	521.0	113.7	120.57	DC	11.89
168101357	243265	05COREY	138.0	AEP	243346	05MOTTV	138.0	AEP	1	AEP_P2-1_246515 05COREY 69.0 246520 05FLORENCE 69.0 1	operation	185.0	144.26	146.3	DC	3.79
168101359	243265	05COREY	138.0	AEP	243346	05MOTTV	138.0	AEP	1	Base Case	operation	185.0	117.89	119.68	DC	3.32

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
168101540	243294	05FLWRFD8 SS	138.0	AEP	243345	05MOORPK	138.0	AEP	1	AEP_P2-1_243322 05KENZIE 138 939390 AE1-170 POI 138 1	operation	251.0	106.89	110.32	DC	8.59
168101410	243346	05MOTTV	138.0	AEP	243287	05E.ELKHART	138.0	AEP	1	AEP_P1-2_#11876_1797-A	operation	185.0	130.06	132.03	DC	3.65
168101412	243346	05MOTTV	138.0	AEP	243287	05E.ELKHART	138.0	AEP	1	Base Case	operation	185.0	102.82	104.72	DC	3.51
168101531	247330	05BRODY	138.0	AEP	243294	05FLWRFD8 SS	138.0	AEP	1	AEP_P2-1_243322 05KENZIE 138 939390 AE1-170 POI 138 1	operation	251.0	108.65	112.07	DC	8.59

10.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
161473102	2	05MOTTV 138.0 kV - 05E.ELKHART 138.0 kV Ckt 1	**AEP** **AEPI0031a (191) : A Sag Study will be required on the 7.8 mile section of ACSR 477 26/7 HAWK line to mitigate the overload . New Rating after the Sag Study : S/N: 185 MVA S/E: 257 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $31,200 (No remediations required just sag study) and $23.4 million (complete line reconductor/rebuild required). Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.** **Project Type : FAC** **Cost : $31,200** **Time Estimate : 6-12 months Months**	$31,200
161473063	1	05COREY 138.0 kV - 05MOTTV 138.0 kV Ckt 1	**AEP** **AEPI0030a (189) : A Sag Study will be required on the 8.5 mile section of ACSR 477 26/7 HAWK line to mitigate the overload . New Rating after the Sag Study : S/N: 185 MVA S/E: 257 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $34,000 (No remediations required just sag study) and $12.75 million (complete line reconductor/rebuild required). Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.** **Project Type : FAC** **Cost : $34,000** **Time Estimate : 6-12 months Months** **AEP** **AEPI0030b (190) : Replace 800A Wavetrap at Mottville** **Project Type : FAC** **Cost : $50,000** **Time Estimate : 12-18 months Months**	$84,000
			TOTAL COST	**$115,200**

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
161473063	243265	05COREY	AEP	243346	05MOTTV	AEP	1	AEP_P2-2_#12306_05COREY 69.0_1	bus	185.0	144.76	146.78	DC	3.73

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247966	05WTRV SLR E	0.1380	Adder	0.16
936141	AD2-020 C O1	9.2367	50/50	9.2367
936142	AD2-020 E O1	5.6853	50/50	5.6853
939395	AE1-170 C	3.7983	Adder	4.47
939396	AE1-170 E	5.2453	Adder	6.17
943021	AE2-325 C	4.6736	50/50	4.6736
943022	AE2-325 E	3.1157	50/50	3.1157
944161	AF1-084 C	6.8902	50/50	6.8902
944162	AF1-084 E	3.9354	50/50	3.9354
944961	AF1-161 C	3.7305	50/50	3.7305
944962	AF1-161 E	3.7305	50/50	3.7305
945111	AF1-176 C O1	64.0266	50/50	64.0266
945112	AF1-176 E O1	59.3514	50/50	59.3514
957891	AF2-083 C O1	17.0430	50/50	17.0430
957892	AF2-083 E O1	8.5215	50/50	8.5215
960981	AF2-389 C	4.8345	50/50	4.8345
960982	AF2-389 E	3.2230	50/50	3.2230
961051	AF2-396 O1	48.8260	50/50	48.8260
962601	AG1-109	3.7305	50/50	3.7305
WEC	WEC	0.0359	Confirmed LTF	0.0359
CALDERWOOD	CALDERWOOD	0.0099	Confirmed LTF	0.0099
CBM-W2	CBM-W2	0.0269	Confirmed LTF	0.0269
NY	NY	0.0182	Confirmed LTF	0.0182
O-066	O-066	0.2221	Confirmed LTF	0.2221
SIGE	SIGE	0.0002	Confirmed LTF	0.0002
CHEOAH	CHEOAH	0.0100	Confirmed LTF	0.0100
G-007	G-007	0.0347	Confirmed LTF	0.0347
HAMLET	HAMLET	0.0150	Confirmed LTF	0.0150
MEC	MEC	0.1176	Confirmed LTF	0.1176
GIBSON	GIBSON	0.0180	Confirmed LTF	0.0180
BLUEG	BLUEG	0.0660	Confirmed LTF	0.0660
TRIMBLE	TRIMBLE	0.0211	Confirmed LTF	0.0211
LAGN	LAGN	0.0105	Confirmed LTF	0.0105
CATAWBA	CATAWBA	0.0088	Confirmed LTF	0.0088
CBM-W1	CBM-W1	1.8927	Confirmed LTF	1.8927

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
1614731002	243346	05MOTTV	AEP	243287	05E.ELKHART	AEP	1	AEP_P2-2_#12429_05POKAGON 69.0_1	bus	185.0	130.65	132.65	DC	3.7

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
246536	05MOTTVILL	0.1224	50/50	0.1224
247966	05WTRV SLR E	0.1333	Adder	0.16
936141	AD2-020 C O1	9.1668	50/50	9.1668
936142	AD2-020 E O1	5.6422	50/50	5.6422
939395	AE1-170 C	3.4411	Adder	4.05
939396	AE1-170 E	4.7520	Adder	5.59
943021	AE2-325 C	4.6382	50/50	4.6382
943022	AE2-325 E	3.0921	50/50	3.0921
944161	AF1-084 C	6.9129	50/50	6.9129
944162	AF1-084 E	3.9484	50/50	3.9484
944961	AF1-161 C	3.7023	50/50	3.7023
944962	AF1-161 E	3.7023	50/50	3.7023
945111	AF1-176 C O1	62.5678	50/50	62.5678
945112	AF1-176 E O1	57.9992	50/50	57.9992
957891	AF2-083 C O1	38.9810	50/50	38.9810
957892	AF2-083 E O1	19.4905	50/50	19.4905
960981	AF2-389 C	11.6943	50/50	11.6943
960982	AF2-389 E	7.7962	50/50	7.7962
961051	AF2-396 O1	48.9160	50/50	48.9160
962601	AG1-109	3.7023	50/50	3.7023
WEC	WEC	0.0054	Confirmed LTF	0.0054
CALDERWOOD	CALDERWOOD	0.0134	Confirmed LTF	0.0134
NY	NY	0.0050	Confirmed LTF	0.0050
PRAIRIE	PRAIRIE	0.0568	Confirmed LTF	0.0568
O-066	O-066	0.0740	Confirmed LTF	0.0740
CHEOAH	CHEOAH	0.0135	Confirmed LTF	0.0135
COTTONWOOD	COTTONWOOD	0.0462	Confirmed LTF	0.0462
G-007	G-007	0.0116	Confirmed LTF	0.0116
HAMLET	HAMLET	0.0133	Confirmed LTF	0.0133
GIBSON	GIBSON	0.0273	Confirmed LTF	0.0273
BLUEG	BLUEG	0.0781	Confirmed LTF	0.0781
TRIMBLE	TRIMBLE	0.0250	Confirmed LTF	0.0250
CATAWBA	CATAWBA	0.0084	Confirmed LTF	0.0084
CBM-W1	CBM-W1	1.4300	Confirmed LTF	1.4300

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
AD2-020	Valley 138 kV	Active
AE1-170	Kenzie Creek-Colby 138 kV	Active
AE2-325	Valley 138 kV	Active
AF1-084	East Hartford-Murch 69 kV	Active
AF1-161	Valley 138 kV	Active
AF1-176	Corey 138 kV	Active
AF2-083	Ed Lowe-Kenzie Creek 138 kV	Active
AF2-389	Pokagon-Corey 69 kV	Active
AF2-396	Stinger 138 kV	Active
AG1-109	Valley 138 kV	Active

10.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P2-2_#12429_05POKAGON 69.0_1	CONTINGENCY 'AEP_P2-2_#12429_05POKAGON 69.0_1' OPEN BRANCH FROM BUS 243360 TO BUS 246480 CKT 1 / 243360 05POKAGO 138 246480 05POKAGON 69.0 1 OPEN BRANCH FROM BUS 246480 TO BUS 246506 CKT 1 / 246480 05POKAGON 69.0 246506 05BARRETTZ 69.0 1 OPEN BRANCH FROM BUS 246480 TO BUS 246516 CKT 1 / 246480 05POKAGON 69.0 246516 05DAILEY 8 69.0 1 OPEN BRANCH FROM BUS 246464 TO BUS 246480 CKT 1 / 246464 05LAKE ST 69.0 246480 05POKAGON 69.0 1 REMOVE SWSHUNT FROM BUS 246480 / 246480 05POKAGON 69.0 END
AEP_P2-1_246515 05COREY 69.0 246520 05FLORENCE 69.0 1	CONTINGENCY 'AEP_P2-1_246515 05COREY 69.0 246520 05FLORENCE 69.0 1' OPEN BRANCH FROM BUS 246515 TO BUS 246520 CKT 1 END
AEP_P1-2_#11876_1797-A	CONTINGENCY 'AEP_P1-2_#11876_1797-A' OPEN BRANCH FROM BUS 244216 TO BUS 246516 CKT 1 / 244216 05HOSP TAPSS69.0 246516 05DAILEY 8 69.0 1 OPEN BRANCH FROM BUS 246480 TO BUS 246516 CKT 1 / 246480 05POKAGON 69.0 246516 05DAILEY 8 69.0 1 OPEN BRANCH FROM BUS 244216 TO BUS 960980 CKT 1 / 244216 05HOSP TAPSS69.0 960980 AF2-389 TAP 69.0 1 OPEN BRANCH FROM BUS 244216 TO BUS 246555 CKT 1 / 244216 05HOSP TAPSS69.0 246555 05WOLVERIN 69.0 1 REMOVE LOAD T1 FROM BUS 246516 / 246516 05DAILEY 8 69.0 T1 END
AEP_P2-2_#12306_05COREY 69.0_1	CONTINGENCY 'AEP_P2-2_#12306_05COREY 69.0_1' OPEN BRANCH FROM BUS 243201 TO BUS 243265 CKT 1 / 243201 05COREY 1EQ 999 243265 05COREY 138 1 OPEN BRANCH FROM BUS 243201 TO BUS 246515 CKT 1 / 243201 05COREY 1EQ 999 246515 05COREY 69.0 1 OPEN BRANCH FROM BUS 243201 TO BUS 246514 CKT 1 / 243201 05COREY 1EQ 999 246514 05COREY 34.5 1 OPEN BRANCH FROM BUS 246515 TO BUS 246520 CKT 1 / 246515 05COREY 69.0 246520 05FLORENCE 69.0 1 OPEN BRANCH FROM BUS 244519 TO BUS 246515 CKT 1 / 244519 05RIPPLE 69.0 246515 05COREY 69.0 1 END
AEP_P2-1_243322 05KENZIE 138 939390 AE1-170 POI 138 1	CONTINGENCY 'AEP_P2-1_243322 05KENZIE 138 939390 AE1-170 POI 138 1' OPEN BRANCH FROM BUS 243322 TO BUS 939390 CKT 1 END

Contingency Name	Contingency Definition
AEP_P1-2_#1242_1689	CONTINGENCY 'AEP_P1-2_#1242_1689' OPEN BRANCH FROM BUS 243212 TO BUS 243215 CKT 1 / 243212 05BENTON 345 243215 05COOK 345 1 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).