Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-127

LOCKWOOD ROAD 138 KV

24.9 MW Capacity / 38 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.

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.

3 General

The Interconnection Customer (IC) has proposed an uprate to a planned Solar generating facility located in Defiance, Ohio. This project is an increase to the Interconnection Customer's AF1-063 project, which will share the same point of interconnection. The AF2-127 queue position is a 38 MW uprate (24.9 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 68 MW with 44.2 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is March 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-127
Project Name	LOCKWOOD ROAD 138 KV
State	Ohio
County	Defiance
Transmission Owner	AEP
MFO	68
MWE	38
MWC	24.9
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 Point of Interconnection

AF2-127 will interconnect with the AEP transmission system via the Lockwood Road 138 kV substation proposed to be constructed by the Interconnection Customer's previous PJM Project AF1-063.

Note: It is assumed that the 138 kV revenue metering system, gen lead and Protection & Control Equipment that will be installed for AF1-063 will be adequate for the additional generation requested in AF2-127. Depending on the timing of the completion of the AF1-063 interconnection construction relative to the AF2-127 completion, there may (or may not) be a need to review and revise relay settings for the increased generation of AF2-127.

5 Cost Summary

The AF2-127 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$0
Total System Network Upgrade Costs	$0
Total Costs	$0

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
	$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
	$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
	$0
Total Non-Direct Connection Facility Costs	$0

7 Incremental Capacity Transfer Rights (ICTRs)

None

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

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)

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 AF2-127 was evaluated as a 38.0 MW (Capacity 24.9 MW) injection as an uprate to AF1-063 at the Lockwood Road 138 kV substation in the AEP area. Project AF2-127 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-127 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)

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
95279845	940840	AE2-072 TAP	138.0	ATSI	242993	05E.LPSC	138.0	AEP	1	ATSI-P7-1-TE-138-033	tower	223.0	97.32	101.13	DC	8.49

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)

None

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
100548615	238979	02NAPMUN	138.0	ATSI	238962	02MIDWAY	138.0	ATSI	1	ATSI-P1-2-TE-138-039	operation	179.0	119.39	120.4	DC	4.04
100548710	239070	02RICHLD	138.0	ATSI	239060	02RDGVL	138.0	ATSI	1	ATSI-P1-2-TE-138-001B	operation	179.0	95.72	100.16	DC	7.95

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100548641	239127	02STRYKE	138.0	ATSI	238979	02NAPMUN	138.0	ATSI	1	ATSI-P1-2-TE-138-039	operation	181.0	103.2	105.44	DC	4.04

10.5 System Reinforcements – Summer Peak Load Flow

ID	Idx	Facility	Upgrade Description	Cost
95279845	1	**AE2-072 TAP 138.0 kV - 05E.LPSC 138.0 kV Ckt 1**	**AEP** **AEPO0043a (492) : Perform Sag Study on 10.2 miles of line with ACSR " 636 " 26/7 " GROSBEAK-Conductor to mitigate the overload. Depending on sag study results, the cost for this upgrade is expected to be between $40,800 (no remediations required, just sag study) and $ 15.3 million (complete line reconductor/rebuild). New rating after sag study: S/N: 223 S/E: 310. 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 : CON** **Cost : $40,800** **Time Estimate : 6-12 Months**	$40,800
			TOTAL COST	**$40,800**

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
95279845	940840	AE2-072 TAP	ATSI	242993	05E.LPSC	AEP	1	ATSI-P7-1-TE-138-033	tower	223.0	97.32	101.13	DC	8.49

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
239064	02RICHG1	0.6333	50/50	0.6333
239065	02RICHG2&3	1.2858	50/50	1.2858
239067	02RICHG4	6.7936	50/50	6.7936
239068	02RICHG5	6.7936	50/50	6.7936
239069	02RICHG6	6.7936	50/50	6.7936
926941	AC1-181	0.2879	50/50	0.2879
940841	AE2-072 C	53.5608	50/50	53.5608
940842	AE2-072 E	35.7072	50/50	35.7072
943951	AF1-063 C O1	4.3143	50/50	4.3143
943952	AF1-063 E O1	2.3919	50/50	2.3919
958331	AF2-127 C	5.5661	50/50	5.5661
958332	AF2-127 E	2.9284	50/50	2.9284
959181	AF2-209 C O1	10.4244	50/50	10.4244
959182	AF2-209 E O1	4.8734	50/50	4.8734
WEC	WEC	0.1046	Confirmed LTF	0.1046
LGEE	LGEE	0.0200	Confirmed LTF	0.0200
CALDERWOOD	CALDERWOOD	0.0089	Confirmed LTF	0.0089
CBM-W2	CBM-W2	1.0647	Confirmed LTF	1.0647
NY	NY	0.0973	Confirmed LTF	0.0973
CBM-W1	CBM-W1	3.1525	Confirmed LTF	3.1525
TVA	TVA	0.0546	Confirmed LTF	0.0546
O-066	O-066	1.1491	Confirmed LTF	1.1491
CHEOAH	CHEOAH	0.0095	Confirmed LTF	0.0095
CBM-S1	CBM-S1	0.3238	Confirmed LTF	0.3238
G-007	G-007	0.1778	Confirmed LTF	0.1778
MADISON	MADISON	0.7439	Confirmed LTF	0.7439
MEC	MEC	0.4052	Confirmed LTF	0.4052
CATAWBA	CATAWBA	0.0245	Confirmed LTF	0.0245

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
AC1-181	Richland 138kV	In Service
AE2-072	East Leipsic-Richland 138 kV	Active
AF1-063	Lockwood Road 138 kV	Active
AF2-127	Lockwood Road 138 kV	Active
AF2-209	South Hicksville 138 kV	Active

10.8 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P1-2-TE-138-039	CONTINGENCY 'ATSI-P1-2-TE-138-039' /* LINE ALLEN JCT TO E FAYETTE 138 DISCONNECT BRANCH FROM BUS 238531 TO BUS 239345 CKT 1 /* 02ALLNJ 138 02SIL_AE+ 138 DISCONNECT BRANCH FROM BUS 239345 TO BUS 238517 CKT 1 /* 02SIL_AE+ 138 02LYONS 138 DISCONNECT BRANCH FROM BUS 238712 TO BUS 238517 CKT 1 /* 02FAYET 138 02LYONS 138 DISCONNECT BRANCH FROM BUS 238712 TO BUS 239351 CKT 1 /* 02FAYET 138 02EASTFAYT 138 REMOVE LOAD O FROM BUS 238517 /* 02LYONS 138 REMOVE LOAD O FROM BUS 238712 /* 02FAYET 138 END
ATSI-P7-1-TE-138-033	CONTINGENCY 'ATSI-P7-1-TE-138-033' /* RICHL-RIDGV JCT NO.1 138 (RICHLAND-WAUSEON & RICHLAND-STRYKER 138) DISCONNECT BUS 239060 /* 02RDGVL 138 DISCONNECT BRANCH FROM BUS 239070 TO BUS 239165 CKT 1 /* 02RICHLD 138 02WAUSEON 138 END
ATSI-P1-2-TE-138-001B	CONTINGENCY 'ATSI-P1-2-TE-138-001B' /* RICHLAND-WAUSEON 138 DISCONNECT BRANCH FROM BUS 239070 TO BUS 239165 CKT 1 /* 02RICHLD 138 02WAUSEO 138 END

11 Light Load Analysis

Light Load Studies (As applicable).

Not applicable

12 Short Circuit Analysis

The following Breakers are overdutied

To be determined during later study phases.

13 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.

14 Affected Systems

14.1 TVA

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

14.2 Duke Energy Progress

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

14.3 MISO

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

14.4 LG&E

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