Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-342

WOODSTOCK 69 KV

26.8 MW Capacity / 40 MW Energy

July, 2019

1 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of

way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

2 General

The Interconnection Customer (IC) has proposed a Solar generating facility located in Champaign County, Ohio. The installed facilities will have a total capability of 40 MW with 26.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 1, 2022. **This study does not imply a TO commitment to this in-service date.**

Queue Number	**AE2-342**
Project Name	WOODSTOCK 69 KV
State	Ohio
County	Champaign
Transmission Owner	Dayton
MFO	40
MWE	40
MWC	26.8
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

The AE2-342 project will interconnect with the Dayton Power and Light Company transmission system at the Woodstock Substation 69 kV bus. The physical Point of Interconnection (POI) will be the last takeoff structure leaving the Woodstock 69 kV yard. Dayton will own the takeoff structure and all attachment hardware. The Interconnection Customer will own the conductor terminating onto the structure.

Under the AE2-342 project, the IC will construct a single 69 kV line up to the POI in the Woodstock 69 kV yard.

See Attachment 1 for a one line of the physical interconnection point.

2.2 Cost Summary

The AE2-342 project will be responsible for the following costs:

Description	**Total Cost**
Attachment Facilities	$0
Direct Connection Network Upgrade	$3,200,000
Non Direct Connection Network Upgrades	$225,000
Total Costs	**$3,445,000**

In addition, the AE2-342 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	**$200,000**

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

3 Attachment Facilities

There are no Attachment Facilities to be constructed by the Transmission Owner. This report assumes that the Interconnection Customer will construct and own the attachment line from its generating facility into the proposed Point of Interconnection as depicted on the one line diagram in Attachment 1. The IC will also be responsible for the fiber/OPGW that Dayton requires on the generator line for the communication assisted trip scheme.

The metering may be classified as an Attachment Facility in future study reports.

4 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
Install a new 69 kV four breaker ring bus at the Woodstock Substation to interconnect the AE2-342 project. This will include the installation of all physical structures, P&C equipment, communications equipment, metering equipment, and associated facilities.	$3,200,000
Total Direct Connection Facility Costs	**$3,200,000**

The substation direct connection cost estimate for the AE2-342 project is approximately **$3,200,000**. The substation direct connection work for this project includes the addition of a new four breaker 69 kV ring bus to the Woodstock Substation. The Woodstock Substation is presently just a tap off the Kings Creek-Marysville 69 kV line. Thus, to create a reliable connection to the system will require a new four breaker ring bus.

The 69 kV generator lead line will be constructed by the developer and will be terminated onto the 69 kV takeoff structure leaving the Woodstock Substation. The new four breaker 69 kV ring bus will be equipped with the necessary communication systems to facilitate remote supervisory control of the breakers and status monitoring. Dayton will install the physical structures, line relaying, communications, and interconnection metering to accommodate the interconnection of the AE2-342 generator.

5 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
Protection System upgrades at Woodstock Substation	$75,000
Protection System upgrades at Kings Creek Substation	$75,000
Protection System upgrades at Marysville Substation	$75,000
Total Non-Direct Connection Facility Costs	**$225,000**

The substation non-direct connection cost estimate for the AE2-342 project is approximately **$225,000**. Remote end relaying will need to be evaluated for settings changes at Woodstock, Kings Creek, and Marysville Substations to facilitate the interconnection of the new generation.

6 Schedule

Based on the extent of the Dayton primary Direct Connection and Non-Direct Connection upgrades required to support the AE2-342 generation project, it is expected to take a minimum of **24 months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation subject to market conditions and vendor lead times. This includes the requirement for the Interconnection Customer to make a preliminary payment to Dayton which funds the first three months of engineering design that is related to the construction of the Non-Direct Connection facilities. It assumes that there will be no environmental or permitting issues to implement the Non-Direct Connection upgrades for this project and that all system outages will be allowed when requested.

7 Interconnection Customer Requirements

7.1 Dayton Interconnection Requirements

The Dayton Power and Light Company (DP&L) has prepared this Facilities Connection Requirements document to ensure compliance with North American Electric Reliability Council (NERC) Reliability Standards and applicable Regional Reliability Organization, sub regional, Power Pool, and individual Transmission Owner planning criteria and facility connection requirements in compliance to NERC Standard FAC-001-2. These connection requirements apply to all generation facilities, transmission facilities, and end-users connecting to the DP&L transmission system. Detailed information outlining DP&L interconnection requirements can be reviewed utilizing the following link:

https://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx

8 Revenue Metering and SCADA Requirements

8.1 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.

8.2 Dayton Requirements

The Interconnection Customer will be required to comply with all Dayton Revenue Metering Requirements for Generation Interconnection Customers as outlined in the link below. The Revenue Metering Requirements may be found within the Dayton Power & Light Co. "Requirements for the Connection of Facilities to the Dayton Power & Light Co. Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx
http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

9 Network Impacts

The Queue Project AE2-342 was evaluated as a 40.0 MW (Capacity 26.8 MW) injection at the Woodstock 69kV substation in the Dayton area. Project AE2-342 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-342 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

10 Generation Deliverability

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

None

11 Multiple Facility Contingency

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

None

12 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	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
7469805	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P2-3-OES-138-010A	breaker	242.0	122.19	122.84	DC	3.48
7469806	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P2-3-OES-138-011	breaker	242.0	119.59	120.24	DC	3.48

13 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	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
7470715	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	Base Case	operation	200.0	119.92	120.45	DC	2.38

14 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
7469805, 7469806	1	AE2-180 TAP 138.0 kV - 05BEATTY 138.0 kV Ckt 1	**AEPO0002a (105)** : AEP Only: Upgrade relaying at Beatty **Project Type** : FACILITY **Cost** : $200,000 **Time Estimate** : 12-18 Months	$200,000
			TOTAL COST	$200,000

15 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

15.1 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
7469805	941770	AE2-180 TAP	AEP	243469	05BEATTY	AEP	1	ATSI-P2-3-OES-138-010A	breaker	242.0	122.19	122.84	DC	3.48

Bus #	Bus	MW Impact
290286	R-052A C	2.16
290287	R-052A E	8.65
926011	AC1-078 C O1	44.64
926012	AC1-078 E O1	74.39
934561	AD1-081 C	8.93
934562	AD1-081 E	4.6
935041	AD1-140 C O1	12.19
935042	AD1-140 E O1	10.08
937241	AD2-163 C	30.1
937242	AD2-163 E	14.79
941771	AE2-180 C	37.43
941772	AE2-180 E	24.96
942051	AE2-217 C	48.29
942052	AE2-217 E	32.19
942621	AE2-278 C	17.05
942622	AE2-278 E	11.38
942861	AE2-305 C O1	7.25
942862	AE2-305 E O1	4.83
943131	AE2-342 C	2.33
943132	AE2-342 E	1.15
CARR	CARR	0.05
CBM-S1	CBM-S1	0.75
CBM-S2	CBM-S2	0.06
CBM-W1	CBM-W1	1.14
CBM-W2	CBM-W2	5.75
CIN	CIN	0.91
CPLE	CPLE	0.0
G-007	G-007	0.13
IPL	IPL	0.63
LGEE	LGEE	0.31
MEC	MEC	1.05
MECS	MECS	0.46
O-066	O-066	0.87
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.15

Affected Systems

16 Affected Systems

16.1 LG&E

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

16.2 MISO

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

16.3 TVA

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

16.4 Duke Energy Progress

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

16.5 NYISO

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

Contingency Name	Contingency Definition
ATSI-P2-3-OES-138-010A	CONTINGENCY 'ATSI-P2-3-OES-138-010A' /* TANGY B-155 FAILURE TO TRIP DISCONNECT BRANCH FROM BUS 239134 TO BUS 239264 CKT 1 /* 02TANGY 138 02DBP 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239218 CKT 1 /* 02TANGY 138 02SSCIOT 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 238574 CKT 1 /* 02TANGY 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 238964 TO BUS 238574 CKT 1 /* 02MLCRK+ 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 240706 CKT 1 /* 02TANGY 138 02NATIONAL 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 3 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 4 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 5 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 1 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 2 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 937240 TO BUS 238964 CKT 1 /* AD2-163 TAP 138 02MLCRK+ 138 /* CONTINGENCY LINE ADDED FOR AE1 BUILD REMOVE LOAD O FROM BUS 238574 /* 02BELPT+ 138 REMOVE LOAD O FROM BUS 238964 /* 02MLCRK+ 138 DISCONNECT BUS 239134 /* 02TANGY 138 DISCONNECT BUS 238964 /* 02MLCRK+ 138 DISCONNECT BUS 238574 /* 02BELPT+ 138 END
ATSI-P2-3-OES-138-011	CONTINGENCY 'ATSI-P2-3-OES-138-011' /* TANGY B-2 FAILURE TO TRIP DISCONNECT BRANCH FROM BUS 239134 TO BUS 239264 CKT 1 /* 02TANGY 138 02DBP 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239218 CKT 1 /* 02TANGY 138 02SSCIOT 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 238574 CKT 1 /* 02TANGY 138 02BELPT+ 138 DISCONNECT BRANCH FROM BUS 239264 TO BUS 238640 CKT 1 /* 02DBP 138 02CRISS 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 240706 CKT 1 /* 02TANGY 138 02NATIONAL 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 3 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 4 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239133 TO BUS 239134 CKT 5 /* 02TANGY 345 02TANGY 138 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 1 /* 02TANGY 138 02TANGY 69 DISCONNECT BRANCH FROM BUS 239134 TO BUS 239135 CKT 2 /* 02TANGY 138 02TANGY 69 REMOVE LOAD R FROM BUS 239264 /* 02DBP 138 DISCONNECT BUS 239134 /* 02TANGY 138 DISCONNECT BUS 239264 /* 02DBP 138 END
Base Case	

Short Circuit

17 Short Circuit

The following Breakers are over duty:

None