Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-267

WOODSDALE 345 KV

30.9 MW Capacity / 50 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 Butler County, Ohio. The installed facilities will have a total capability of 50 MW with 30.9 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 20, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AE2-267
Project Name	WOODSDALE 345 KV
State	Ohio
County	Butler
Transmission Owner	DEOK
MFO	50
MWE	50
MWC	30.9
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-267 will interconnect with the DEOK transmission system via one of the following:

Option 1: via a direct connection into the Woodsdale 345 kV substation

Option 2: via a direct connection into the Woodsdale 69 kV substation

For Option 1, AE2-267 will interconnect with the Duke Energy transmission system by direct injection into the Woodsdale 345 kV bus. The generator will connect to the 345 kV bus via a Duke Energy Owned (Transmission Owner) series breaker. The Point of Interconnection (POI) is located where Duke Energy's overhead line from the Woodsdale 345 kV substation terminates to a structure mounted switch approximately 25 feet outside of the Woodsdale 345 kV substation fence; please refer to the single-line diagram.

2.2 Cost Summary

The AE2-267 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 2,803,779
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ 0
Total Costs	$ 2,803,779

In addition, the AE2-267 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$ 0

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

3 Attachment Facilities

Duke Energy will install a 345 kV circuit breaker, revenue metering package, a take-off structure, associated bus work, and overhead conductors from the existing substation to the POI structure mounted switch.

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
Install 345 KV Attachment Facilities	$ 2,803,779
Total Attachment Facility Costs	$ 2,803,779

4 Direct Connection Cost Estimate

None

5 Non-Direct Connection Cost Estimate

None

6 Interconnection Customer Requirements

Interconnection Customer will be required to procure and provide land for the POI structure and the line right of way for the line from the Woodsdale 345 kV substation to the POI structure. The land will be ceded to Duke Energy prior to construction of the line and POI structure. Final location is to be approved by Duke Energy.

Interconnection Customer will be required to engineer, procure, and construct the connecting circuit from the Interconnection Customer's substation to the POI.

Interconnection Customer will be responsible for meeting all criteria as specified in the applicable sections of the "Duke Energy Midwest transmission systems Facility Connection Requirements" document, Version 7, effective October 31, 2018, which can be found under this link:

http://www.pjm.com/~/media/planning/plan-standards/deok/deok-facility-connection-requirements.ashx

7 Revenue Metering and SCADA Requirements

7.1 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.

7.2 DEOK Requirements

The Interconnection Customer will be required to comply with all Duke Energy revenue metering requirements for generation interconnection customers. The revenue metering requirements may be found within the "Duke Energy Midwest transmission systems Facility Connection Requirements" document, Version 7, effective October 31, 2018.

8 OPTION 1: Network Impacts

The Queue Project AE2-267 was evaluated as a 50.0 MW (Capacity 30.9 MW) injection at Woodsdale 345kV substation in the DEOK area. Project AE2-267 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-267 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

9 Generation Deliverability

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

None

10 Multiple Facility Contingency

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

None

11 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

12 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.

None

13 System Reinforcements

None.

Affected Systems

14 Affected Systems

14.1 LG&E

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

14.2 MISO

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

14.3 TVA

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

14.4 Duke Energy Progress

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

14.5 NYISO

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

Short Circuit

15 Short Circuit

The following Breakers are over duty:

None

16 OPTION 2: Network Impacts

The Queue Project AE2-267 was evaluated as a 50.0 MW (Capacity 30.9 MW) injection at the Woodsdale 69kV substation in the DEOK area. Project AE2-267 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-267 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

17 Generation Deliverability

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

None

18 Multiple Facility Contingency

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

None

19 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

20 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.

None

Affected Systems

21 Affected Systems

21.1 LG&E

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

21.2 MISO

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

21.3 TVA

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

21.4 Duke Energy Progress

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

21.5 NYISO

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

Short Circuit

22 Short Circuit

The following Breakers are over duty:

None