Generation Interconnection

System Impact Study Report

for

Queue Project AE2-318

FORD-CEDARVILLE 138 KV

67.2 MW Capacity / 100 MW Energy

February 2020

1 Preface

The intent of the System Impact 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 reinforcement costs may be shared with other projects, and the allocations tables are included in this report, if applicable.

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.

The System Impact 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 Clermont County, Ohio. The installed facilities will have a total capability of 100 MW with 67.2 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	**AE2-318**
Project Name	FORD-CEDARVILLE 138 KV
Interconnection Customer	Clermont County Solar Project, LLC
State	Ohio
County	Clermont
Transmission Owner	DEOK
MFO	100

Queue Number	AE2-318
MWE	100
MWC	67.2
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-318 will interconnect with the DEOK transmission system by direct injection into a new 138 kV substation located on the feeder between the Ford and Cedarville substations. The new substation will have a three-breaker ring bus configuration. The Point of Interconnection is located where Duke Energy's overhead lines from the new substation terminate to the Interconnection Customer's pole mounted switches, approximately 25 feet outside the new substation fence; please refer to the single-line diagram in Appendix 2.

2.2 Cost Summary

The AE2-318 project will be responsible for the following costs (class 4 range of +50%/-30%):

Description	Total Cost
Attachment Facilities	$ 425,411
Direct Connection Network Upgrade	$ 7,475,413
Non Direct Connection Network Upgrades	$ 1,152,888
Total Costs	$ 9,053,712

3 Attachment Facilities

The attachment facilities Duke Energy will install include, but are not limited to, a revenue metering package, relaying, a take-off structure, a set of disconnect switches, bus work, a line tuner, a wave trap, arresters, CCVTs, and overhead conductors from the new substation to the Interconnect Customer's pole mounted switches.

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 attachment facilities	$ 425,411
Total Attachment Facility Costs	$ 425,411 (class 4 range of +50%/-30%)

4 Direct Connection Cost Estimate

Duke Energy will build a new 138 kV substation on Interconnection Customer supplied land. The substation will include, but is not limited to, a three-breaker ring bus configuration, three 138 kV breakers, eight sets of disconnect switches, relaying, metering, direct transfer trip equipment, control building, two take-off structures, line tuners, wave traps, arresters, CCVTs, lighting, fencing, gravel, cable trench, bus work, and foundations as necessary to form a complete substation installation.

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
Construct a new 138 kV three breaker ring bus on Interconnection Customer Supplied land	$ 7,475,413
Total Direct Connection Facility Costs	$ 7,475,413 (class 4 range of +50%/-30%)

5 Non-Direct Connection Cost Estimate

Duke Energy will reconfigure the Ford to Cedarville 138 kV feeder to loop through the new 138 kV three breaker ring bus substation. Relay and protection work will also be performed at the Ford and Cedarville substations to account for this new system configuration.

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
Reconfigure the Ford to Cedarville 138 kV feeder to loop through the new 138 kV three breaker ring bus substation and perform protection and relay work at Ford and Cedarville.	$ 1,152,888
Total Non-Direct Connection Facility Costs	$ 1,152,888 (class 4 range of +50%/-30%)

6 Schedule

The tentative schedule below is given based on months from when a kickoff meeting happens. The kickoff meeting will begin after receiving a signed ISA and CSA.

Task	Months From Kickoff Meeting
Order Long Lead Items	3
Engineering Complete	11
Release Bid Package	13
Construction Mobilization	15
Construction Completion	24

This tentative schedule assumes no issues obtaining right of way, no issues getting a PJM outage on the line or adjacent line on tower, and no major interruptions for weather.

7 Transmission Owner Analysis

A Summer Peak 2023 load flow study was performed by the Transmission Owner evaluating AE2-318 for compliance with applicable reliability planning criteria (NERC, NERC Regional Reliability Council, and Transmission Owner). AE2-318 was studied as a 100 MW injection onto the 138 kV line between Ford and Cedarville. The transmission owner found that no adverse impacts caused by this generator were found at this time.

8 Interconnection Customer Requirements

Interconnection Customer will be required to procure and provide land for the new substation. The land will be ceded to Duke Energy prior to construction of the new substation. The land must be near the Ford - Cedarville 138 kV feeder path and have direct access to publicly maintained roadway. The land shall be environmentally permitted, graded and ready for construction. Final size and location are 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 Point of Interconnection. This includes, but is not limited to, a pole and switches to be installed approximately 25 feet outside the new substation fence.

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.

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 DEOK Requirements

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

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

10 Network Impacts

The Queue Project AE2-318 was evaluated as a 100.0 MW (Capacity 67.2 MW) injection into a tap of the Ford – Cedarville 138 kV line in the DEOK area. Project AE2-318 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-318 was studied with a commercial probability of 1.00. Potential network impacts were as follows:

Summer Peak Load Flow

11 Generation Deliverability

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

None

12 Multiple Facility Contingency

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

None

13 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

14 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

15 System Reinforcements

None required

Affected Systems

16 Affected Systems

16.1 LG&E

None

16.2 MISO

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

16.3 TVA

None

16.4 Duke Energy Progress

None

16.5 NYISO

None

17 Short Circuit

The following Breakers are over duty:

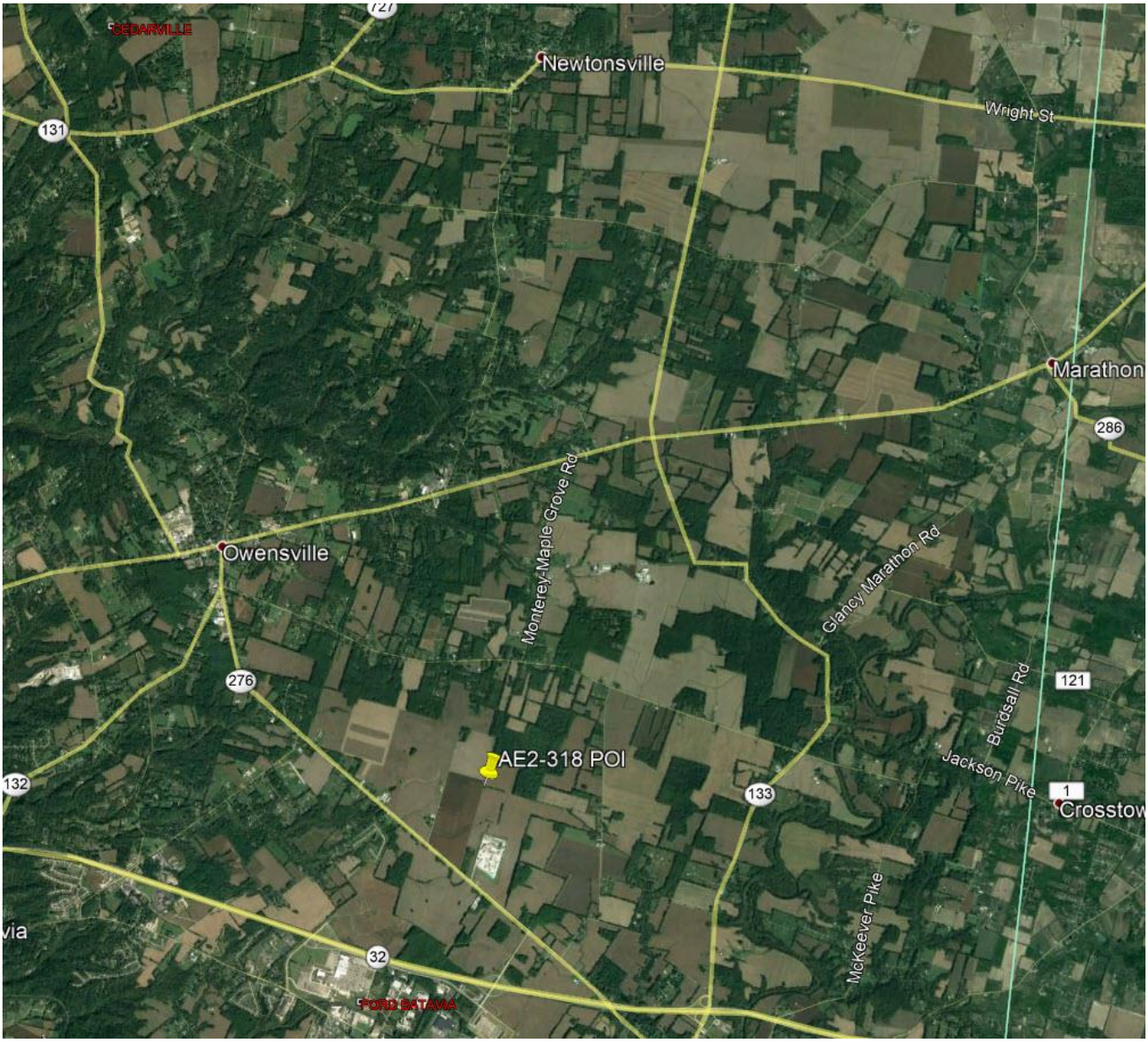
None

18 Stability and Reactive Power Capability Assessment

In progress and will be completed as part of the Facilities Study.

Attachment 1

Facility Location
PJM Queue Position: AE2-318



Attachment 2

Interconnection Single-Line Diagram
PJM Queue Position: AE2-318