Generation Interconnection

Queue Project AE1-196

Hokes – Jackson 69 kV

Feasibility Study Report

Capacity : 12.6 MW / Energy : 20 MW

March, 2019

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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 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.

An Interconnection Customer entering the New Services Queue on or after October 1, 2018 (except those regulated by the United States Nuclear Regulatory Commission) shall provide primary frequency response in accordance with Section 4.7.2 of Appendix 2 to the Interconnection Service Agreement. See PJM Manual 14D Section 7.1.1 for more information.

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.

General

The Interconnection Customer has proposed a solar generating facility located in York County, Pennsylvania. The installed facilities will have a total capability of 20 MW Energy with 12.6 MW of this output being recognized by PJM as Capacity Interconnection Rights. The proposed in-service date for this project is April 1, 2021. **This study does not imply a Mid-Atlantic Interstate Transmission, LLC (Transmission Owner or MAIT) commitment to this in-service date.**

Point of Interconnection

The AE1-196 solar facility will interconnect with the MAIT 69 kV subtransmission system by taping the Jackson – Hokes 69 kV Line at a point located approximately 6.58 miles and 0.72 miles from Jackson and Hokes substations respectively. The Point of Interconnection (POI) will be located 1 span from the 69 kV line. Please refer to the one line diagram in Appendix 2 for system configuration.

Cost Summary

The following is a summary of the total costs for this AE1-196 project. A detailed cost breakdown is shown on the next page. The AE1-196 project will be responsible for the following total cost:

Description	**Total Cost**
Attachment Facilities	$ 249,767
Direct Connection Network Upgrade	$ 0.00
Non Direct Connection Network Upgrades	$ 2,252,400
Total Cost	$ 3,001,700

Cost allocations for the network upgrades (if applicable) will be provided in the System Impact Study Report.

The above shown costs do not include Contribution in Aid of Construction (CIAC) Federal Income Tax Gross Up charge. The tax amount of $ 611,400 may or may not be charged to the project based on whether or not this project meets the eligibility requirements of IRS Notice 88-129.

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
Install 1 span of 69 kV Attachment Facility line from the POI to the tap point at or near structure #79-127.	$ 249,767
Total Direct Connection Facility Costs	$ 249,767

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.

None.

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
Install two SCADA-capable disconnect switches at or near structure #79-127.	$ 499,533
System Reinforcement Network Upgrade: Reconductor the Jackson Hokes 69-kV line from the AE1-196 tap to Hokes substation with 795 kcmil ACSR.	$ 2,252,400
Total Non-Direct Connection Facility Costs	$ 2,751,933

Interconnection Customer Requirements

The proposed AE1-196 Customer Facilities must be designed in accordance with FirstEnergy's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, Interconnection Customer is responsible for the following:

1. The purchase and installation of fully rated 69 kV circuit breaker to protect the AE1-196 generator lead line. A single breaker must be used to protect this line. FirstEnergy does not approve for individual GSU transformer breakers (if applicable) to protect this line.
2. The purchase and installation of the minimum required FirstEnergy generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.
3. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FirstEnergy Transmission System Control Center.
4. Power factor and voltage control requirements: A compliance with the FirstEnergy and PJM generator power factor and voltage control requirements. Interconnection Customer shall design its solar-powered non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FirstEnergy transmission system.
5. The execution of a back-up service agreement to serve the customer load supplied from the AE1-196 generation project metering point when the units are out-of-service. This assumes the intent of the Interconnection Customer is to net the generation with the load.
6. Interconnection Customer is required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, Interconnection Customer will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FirstEnergy system.
7. System Protection Requirements: Interconnection Customer must design it's Customer Facilities in accordance with all applicable standards, including the standards in FirstEnergy's "Requirements for Transmission Connected Facilities" document located online at above shown link. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

The above FirstEnergy requirements apply in addition to any metering or other requirements of PJM.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

FirstEnergy Requirements

Interconnection Customer will be required to comply with all FirstEnergy revenue metering requirements for generation interconnection customers. The FirstEnergy revenue metering requirements may be found in the FirstEnergy "Requirements for Transmission Connected Facilities" document located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

Schedule

Based on above stated scope of work, it is expected to take a minimum of fifteen (15) months for the after the signing of an Interconnection Construction Service Agreement. This includes preliminary payment that compensates FirstEnergy for the first three months of the engineering design work that is related to the construction of the AE1-196 interconnection substation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that PJM will allow all transmission system outages when requested.

Network Impacts

The Queue Project AE1-196 was evaluated as a 20 MW (Capacity 12.6 MW) injection at HOKES-JACKSON 69 KV substation in the MAIT area. Project AE1-196 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-196 was studied with a commercial probability of 53%. Potential network impacts were as follows:

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

None

New System Reinforcements

None

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

None

New System Reinforcements (Multiple Facility)

None

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

Contribution to Previously Identified System Reinforcements

None

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

Short Circuit
None. (No overdutied circuit breakers identified)

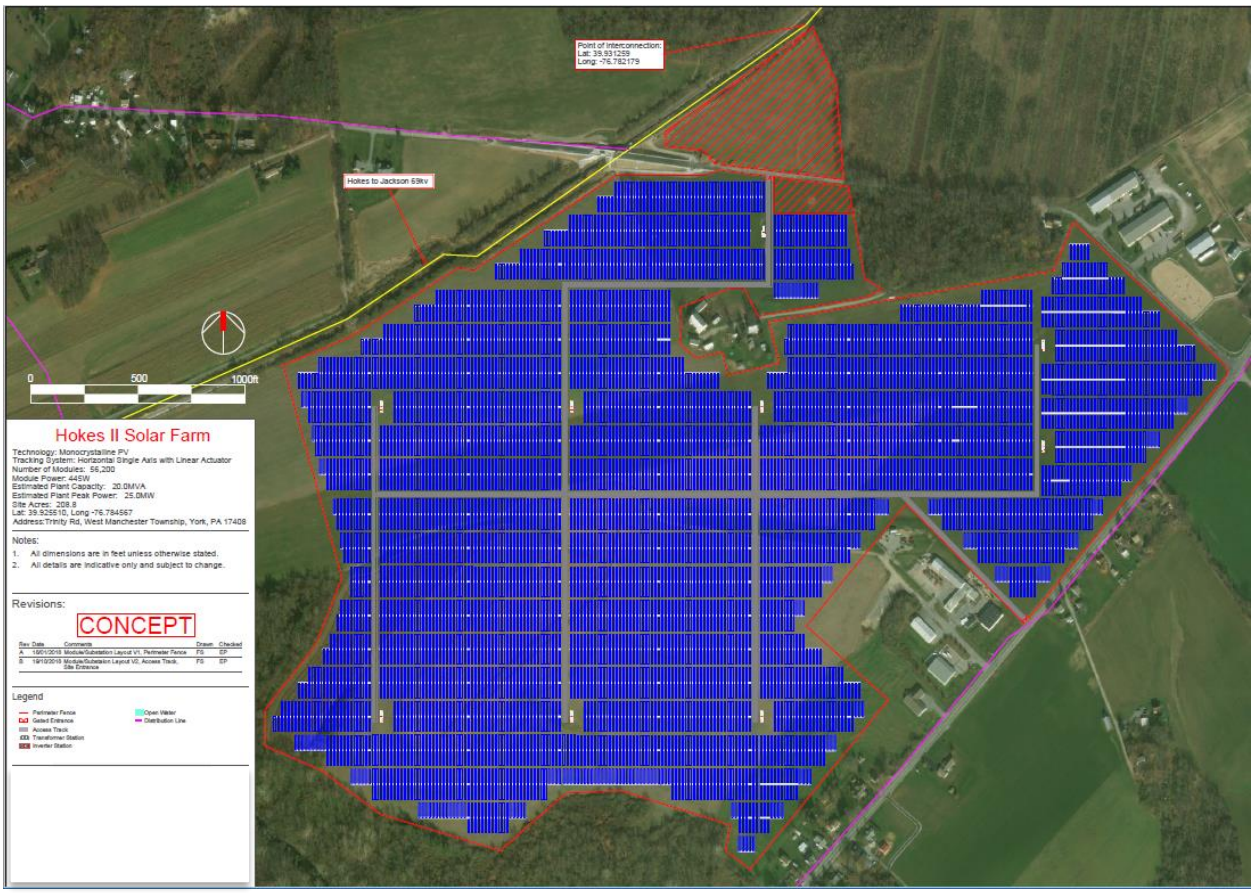
System Reinforcements

Short Circuit
None.

Stability and Reactive Power Requirement
Will be determined at a later study stages.

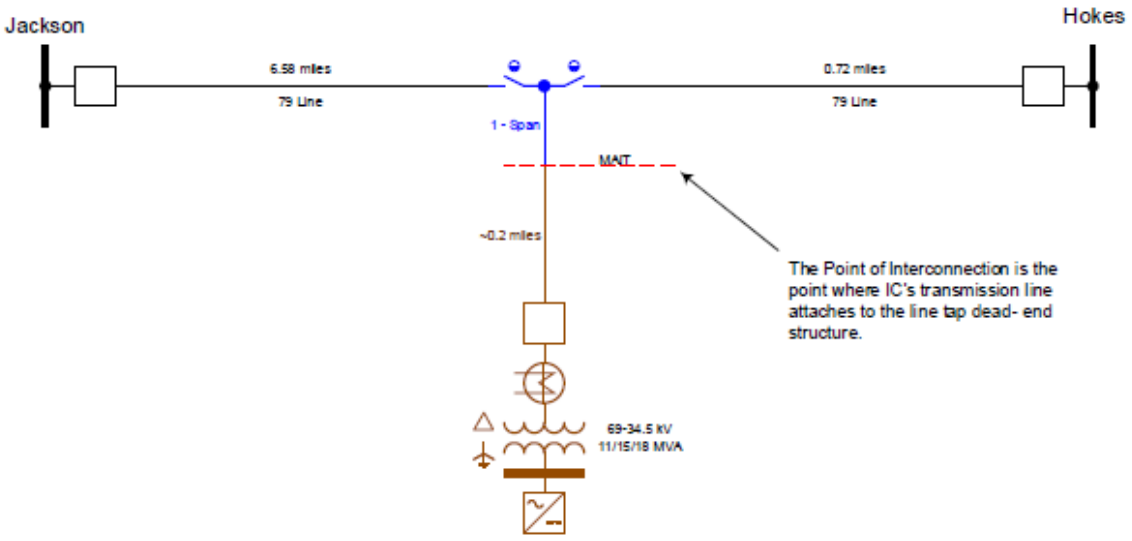
Appendix 1

Facility Location
PJM Queue Position: AE1-196



Appendix 2

Interconnection One-Line Diagram
PJM Queue Position: AE1-196



20 MW Solar Maximum Facility Output

Tap the 69 kV line at or near structure 79-127. Install disconnect switches with SCADA control and construct 1 span of 69 kV line towards the developer.

Customer facilities are shown for informational purposes only. The Customer is responsible for designing its facilities to comply with applicable FirstEnergy connection standards, including FE's "Requirements for Transmission Connected Facilities" document.

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