

***PJM Generator Interconnection Request
Queue AB2-170
East Lima-Marysville 345 kV
Feasibility Study Report***

August 2016

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. 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 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 (IC) proposes to install PJM Project #AB2-170, a 130.0 MW (49.4 MW Capacity) solar generating facility in Hardin County, OH. The generating facility will consist of thirty-seven (37) 4.0 MVA inverters. The primary point of interconnection for the generating facility will be to interconnect to the proposed 345 kV switching station connecting to AEP's East Lima – Marysville 345 kV line being built for PJM Project #U2-041. The secondary point of interconnection for the generating facility will be to interconnect to a newly proposed three (3) circuit breaker 138 kV switching station connecting to AEP's Sterling – South Kenton 138 kV line between the Lynn and West Newton Switches.

The requested Backfeed date is October 31, 2018.

The requested in-service date is December 31, 2018.

Attachment Facilities

Primary Point of Interconnection (East Lima – Marysville 345 kV Line)

To accommodate the interconnection at the proposed 345 kV substation for U2-041, the substation will have to be expanded requiring the installation of two (2) new 345 kV circuit breakers. Installation of associated protection and control equipment, SCADA, and 345 kV revenue metering will also be required.

New Switching Station Work and Cost:

- Expand the substation, install two (2) new 345 kV circuit breakers. Installation of associated protection and control equipment, SCADA, and 345 kV revenue metering will also be required.
- **Estimated Station Cost: \$5,000,000**

Protection and Relay Work and Cost:

- Install line protection and controls at the proposed 345 kV switching station.
- **Estimated Cost: \$1,000,000**
- Adjust relay settings at the Marysville 345 kV substation.
- **Estimated Cost: \$25,000**
- Adjust relay settings at the East Lima 345 kV substation.
- **Estimated Cost: \$25,000**

Secondary Point of Interconnection (Sterling – South Kenton 138 kV Line)

To accommodate the interconnection on the Sterling – South Kenton 138 kV line a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed between the Lynn and West Newton Switches. Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. The new interconnection switching station will be expandable to accommodate future projects in the area.

New Switching Station Work:

- Construct a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus. Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required.
- Additional work maybe required because of adjacent taps not having any circuit breakers for line protection, engineering will determine that in later studies.

Protection and Relay Work:

- Install line protection and controls at the new 138 kV switching station.
- Upgrade line protection and controls at the Sterling 138 kV substation to coordinate with the new 138 kV switching station.
- Upgrade line protection and controls at the South Kenton 138 kV substation to coordinate with the new 138 kV switching station.

It is understood that the IC is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of IC's generating plant and the costs for the line connecting the generating plant to IC's switching station are not included in this report; these are assumed to be IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power 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.

Local and Network Impacts for the Primary Point of Interconnection

The impact of the proposed wind generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715¹ and Connection Requirements for AEP Transmission System². Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. The Queue Project AB2-170 was evaluated as a 130.0 MW (Capacity 49.4 MW) injection at the U2-041 345kV substation (tapping the East Lima-Marysville 345kV line) in the AEP area. Project AB2-170 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-170 was studied with a commercial probability of 53%.

Potential network impacts for the Primary point of interconnection were as follows:

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

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

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

¹

https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/GuideLines/AEP_East_FERC_715_2016_Final_Part_4.pdf

²

https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/Requirements/AEP_Interconnection_Requirements_rev1.pdf

Short Circuit

(Summary of impacted circuit breakers)

None

Stability Analysis

To be determined in the System Impact Study

Voltage Variations

None

Delivery of Energy Portion of Interconnection Request

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.

Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

None

Local and Network Impacts for the Secondary Point of Interconnection

The impact of the proposed wind generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715 and Connection Requirements for AEP Transmission System. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. The Queue Project AB2-170 was evaluated as a 130.0 MW (Capacity 49.4 MW) injection tapping the Lynn-West Newtown 138kV line in the AEP area. Project AB2-170 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-170 was studied with a commercial probability of 53%.

Potential network impacts for the Secondary point of interconnections were as follows:

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

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

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

Short Circuit

(Summary of impacted circuit breakers)

None

Stability Analysis

To be determined in the System Impact Study

Voltage Variations

None

Delivery of Energy Portion of Interconnection Request

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Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

None

Additional Limitations of Concern

None

Local/Network Upgrades

None

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 18 to 24 months if no line work is required. If line work is required, construction time would be between 36 to 48 months after signing an interconnection agreement.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 130.0 MW (49.4 MW Capacity) solar generating facility of Invenenergy Solar (PJM Project #AB2-170) will require the following additional interconnection charges. This plan of service will interconnect the proposed wind generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Invenenergy Solar solar generating facility.

Cost Breakdown for the Primary Point of Interconnection (East Lima – Marysville 345 kV Line):

Estimated Cost to connect to the proposed 345 kV Switching Station for U2-041:
\$5,000,000

Estimated Protection and Relay Cost: \$1,050,000

Total Estimated Cost for Project AB2-170: \$6,050,000

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Additional Interconnection Customer Responsibilities:

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.
3. 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 item 5.iv. of Schedule H to the Interconnection Service Agreement.