PJM Generator Interconnection Request
Queue AB2-083
Delano 138 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 #AB2-083, a 40 MW (27.2 MW Capacity) solar generating facility in Ross County, Ohio (see Figure 2). The generating facility will consist of eighteen (18) 2.2 MW inverters. The primary point of interconnection is at the Delano 138 kV substation (see Figure 1). The secondary point of interconnection will be to interconnect to a newly proposed three (3) circuit breaker 138 kV switching station connecting to AEP's Delano – Scioto Trail 138 kV line (see Figure 3).

The requested Backfeed date is September 30, 2017.
The requested in service date is October 31, 2017.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (Delano 138 kV Substation)

To accommodate the interconnection at the Delano 138 kV substation, the substation will have to be expanded requiring the installation of a new 138 kV circuit breaker, extending the two 138 kV buses, and starting a new string, associated protection and control equipment, SCADA, and 138 kV revenue metering.

Direct Connection to the Delano 138 kV Substation Work and Cost:

- Expand the substation, start a new string, install one new 138 kV circuit breaker, and extend the 138 kV buses (see Figure 1). Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.
- **Estimated Station Cost: $2,000,000**
- **Note:** An additional 138 kV circuit breaker may be required; Protection Engineering will determine that in later studies.

Protection and Relay Work and Cost:

- Install line protection and controls at the Delano 138 kV substation.
- **Estimated Cost: $200,000**

Secondary Point of Interconnection (Delano – Scioto Trail 138 kV Line)

To accommodate the interconnection on the Delano – Scioto Trail 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 north of the Delano 138 kV substation (see Figure 4). 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 (see Figure 3).

Protection and Relay Work:

- Install line protection and controls at the new 138 kV switching station.
- Upgrade line protection and controls at the Delano 138 kV substation to coordinate with the new 138 kV switching station.
- Upgrade line protection and controls at the Scioto Trail 138 kV substation to coordinate with the new 138 kV switching station.

It is understood that 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 715[1] and Connection Requirements for AEP Transmission System[2]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. The Queue Project AB2-083 was evaluated as a 40.0 MW (Capacity 27.2 MW) injection at the Delano 138kV substation in the AEP area. Project AB2-083 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-083 was studied with a commercial probability of 53%.

Potential network impacts were as follows:

Summer Peak Analysis – 2020 for Primary Point of Interconnection (Delano 138 kV Substation)

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[3] and Connection Requirements for AEP Transmission System[4]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. The Queue Project AB2-083 was evaluated as a 40.0 MW (Capacity 27.2 MW) injection tapping the Delano - Nevil Switch 138 kV line in the AEP area. Project AB2-083 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-083 was studied with a commercial probability of 53%.

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

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

Potential network impacts were as follows:

Summer Peak Analysis - 2020 for Secondary Point of Interconnection (Delano-Scioto Trail 138 kV Line)

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

1. (AEP - AEP) The 05HARRIS-05OBETZ 138 kV line (from bus 243522 to bus 243550 ckt 1) loads from 99.33% to 101.42% (**DC power flow**) of its emergency rating (179 MVA) for the single line contingency outage of '6763_B2_TOR5200548_B'. This project contributes approximately 3.73 MW to the thermal violation.

CONTINGENCY '6763_B2_TOR5200548_B'
OPEN BRANCH FROM BUS 924330 TO BUS 243454 CKT 1 / 924330 AB2-080 TAP OP2 345 243454 05BIXBY 345 1
END

- To relieve the Harrison – Obetz 138 kV line overload: Replace the bus work from CB Switches to Wavetrap (Sub cond 300 MCM CU 37 Str).

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

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.

1. (AEP - AEP) The AB2-080 TAP-05BIXBY 345 kV line (from bus 924330 to bus 243454 ckt 1) loads from 99.64% to 100.08% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of '762_B2_TOR8072'. This project contributes approximately 6.18 MW to the thermal violation.

CONTINGENCY '762_B2_TOR8072'
OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1
END

- To relieve the AB2-080 – Bixby 345 kV line overload: Rebuild/Reconductor the ACSR 954 45/7 Rail conductor section 1, ACSR 954 54/7 Cardinal conductor section 3, and the ACAR 983.1 30/7 Rail5 conductor section 2.

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 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 40.0 MW (27.2 MW Capacity) solar generating facility of IC (PJM Project #AB2-083) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC solar generating facility.

Cost Breakdown for the Primary Point of Interconnection (Delano 138 kV Substation):

Estimated Cost to connect to the Delano 138 kV Substation: $2,000,000
Estimated Protection and Relay Cost: $200,000

Total Estimated Cost for Project AB2-083: $2,200,000

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.

Appendices for Option 2 Interconnection

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.

Appendix 1 for Option 2 Interconnection

(AEP - AEP) The 05HARRIS-05OBETZ 138 kV line (from bus 243522 to bus 243550 ckt 1) loads from 99.33% to 101.42% (**DC power flow**) of its emergency rating (179 MVA) for the single line contingency outage of '6763_B2_TOR5200548_B'. This project contributes approximately 3.73 MW to the thermal violation.

CONTINGENCY '6763_B2_TOR5200548_B'
OPEN BRANCH FROM BUS 924330 TO BUS 243454 CKT 1 / 924330 AB2-080 TAP OP2 345 243454 05BIXBY 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
924331	*AB2-080 OP*	*60.11*
924351	*AB2-083 C OP*	*3.73*