Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-195

Ada-Dunkirk 69 kV

April 2017

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 the Interconnection Customer ource or as an energy-only the Interconnection Customer ource. As a requirement for interconnection, the Interconnection Customer may be the Interconnection Customer ponsible 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 the Interconnection Customer ponsible 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 the Interconnection Customer ponsible 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 proposes to connect PJM Project #AC1-195, a 75.0 MW (9.0 MW Capacity) wind generating facility comprised of 2.0 MW Vestas V100S wind turbine generators in Hardin County, Ohio between the cities of Ada and Dunkirk (see Figure 2). The point of interconnection is to AEP's Ada – Dunkirk 69 kV section of the Dunkirk – East Lima 69 kV circuit (see Figure 1).

The requested in service date is December 31, 2018.

Attachment Facilities

Point of Interconnection (Ada – Dunkirk 69 kV)

To accommodate the interconnection on the Ada – Dunkirk 69 kV section of the Dunkirk – East Lima 69 kV circuit, a new three (3) circuit breaker 69 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required. AEP the Interconnection Customer erves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

<u>New Switching Station Work:</u>

- Construct a new three (3) circuit breaker 69 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, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required (see Figure 1).
    - **Estimated Station Cost: $3,000,000**

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the following tables below.

For AEP building Direct Connection cost estimates:

Description	Total Cost
Ada-Dunkirk 69 kV T-Line Cut In	**$500,000**
Total	**$500,000**

Table 1

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following tables below:

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
69 kV Revenue Metering	**$250,000**
Upgrade line protection and controls at the Dunkirk 69 kV substation to coordinate with the new 69 kV switching station.	**$860,000**
Upgrade line protection and controls at the East Lima 69 kV substation to coordinate with the new 69 kV switching station.	**$220,000**
Total	**$1,330,000**

Table 2

It is understood that THE INTERCONNECTION CUSTOMER is the Interconnection Customer ponsible for all costs associated with this interconnection. The cost of THE INTERCONNECTION CUSTOMER 's generating plant and the costs for the line connecting the generating plant to THE INTERCONNECTION CUSTOMER ' switching station are not included in this report; these are assumed to be THE INTERCONNECTION CUSTOMER ' the Interconnection Customer ponsibility.

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 the Interconnection Customer ponsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Interconnection Customer Requirements

Requirement from the PJM Open Access Transmission Tariff:

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.

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 The Interconnection Customer ource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Network Impacts

The Queue Project AC1-195 was evaluated as a 75.0 MW (Capacity 9.0 MW) injection at a new 69 kV substation between Ada and Dunkirk in the AEP area. Project AC1-195 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-195 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies the Interconnection Customer ulted in overloads:

Option 1	
Contingency Name	**Description**
716_B3_05HOWARD 138-1_WOMOAB	CONTINGENCY '716_B3_05HOWARD 138-1_WOMOAB' OPEN BRANCH FROM BUS 245666 TO BUS 243024 CKT 1 / 245666 05HOWRD1EQ 999 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 245666 TO BUS 245663 CKT 1 / 245666 05HOWRD1EQ 999 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1

	OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 END
8681_B3_05SBERWI 345-1_MOAB	CONTINGENCY '8681_B3_05SBERWI 345-1_MOAB' OPEN BRANCH FROM BUS 242917 TO BUS 242942 CKT 1 / 242917 05SBERW EQ 999 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242917 TO BUS 243180 CKT 1 / 242917 05SBERW EQ 999 243180 05SBERWICK 69.0 1 OPEN BRANCH FROM BUS 242917 TO BUS 243199 CKT 1 / 242917 05SBERW EQ 999 243199 05SBERW1-L 12.0 1 END

Table 3

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)

AC1-195 Contribution to Previously Identified Overloads

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	N-1	716_B3_05HOWARD 138-1_WOMOAB	AEP - AEP	05U SANDSK-05NEVADA SS 69 kV line	245715	247379	1	DC	120.99	122.85	ER	31	0.57	1
2	N-1	716_B3_05HOWARD 138-1_WOMOAB	AEP - AEP	05NEVADA SS-05BROK SWR 69 kV line	247379	245687	1	DC	115.19	117.04	ER	31	0.57	2

Table 4

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

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

MISO Impacts:

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

Duke, Progthe Interconnection Customer s & TVA Impacts:

Duke Carolina, Progthe Interconnection Customer s, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

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

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 the Interconnection Customer ult in operational the Interconnection Customer trictions to the project under study. The developer can proceed with network upgrades to eliminate the operational the Interconnection Customer triction 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.

AC1-195 Delivery of Energy Portion of Interconnection Request

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	N-1	716_B3_05HOWARD 138-1_WOMOAB	AEP - AEP	05U SANDSK-05NEVADA SS 69 kV line	245715	247379	1	DC	138.6	145.55	ER	31	4.79	
2	N-1	716_B3_05HOWARD 138-1_WOMOAB	AEP - AEP	05NEVADA SS-05BROK SWR 69 kV line	247379	245687	1	DC	132.79	139.75	ER	31	4.79	

3	Non	Non	AEP - AEP	U1-059 C-05DUNKIRK 69 kV line	247522	245692	1	DC	70.89	137.01	NR	69	45.62	
4	N-1	8681_B3_05SBERWI 345-1_MOAB	AEP - AEP	U1-059 C-05DUNKIRK 69 kV line	247522	245692	1	DC	73	134.95	ER	73	45.22	

Table 5

New System Reinforcements

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05U SANDSK-05NEVADA SS 69 kV line	Rebuild 11.16 mile section of the Copper #1 conductor.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	**$13,400,000**
#2	05NEVADA SS-05BROK SWR 69 kV line	Rebuild 3.0 mile section of the Copper #1 conductor.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	**$3,600,000**
			Total New Network Upgrades	**$17,000,000**

Table 6

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 the Interconnection Customer ults of this Feasibility Study, the construction of the 75.0 MW (9.0 MW Capacity) wind generating facility of THE INTERCONNECTION CUSTOMER (PJM Project #AC1-195) 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 THE INTERCONNECTION CUSTOMER generating facility.

Cost Breakdown for Point of Interconnection (Ada-Dunkirk 69 kV)		
Attachment Cost	New 69 kV Switching Station	**$3,000,000**
Direct Connection Cost Estimate	Ada-Dunkirk 69 kV T-Line Cut In	**$500,000**
Non-Direct Connection Cost Estimate	69 kV Revenue Metering	**$250,000**

	Upgrade line protection and controls at the Dunkirk 69 kV substation to coordinate with the new 69 kV switching station.	**$860,000**
	Upgrade line protection and controls at the East Lima 69 kV substation to coordinate with the new 69 kV switching station.	**$220,000**
	Rebuild 11.16 mile section of the Copper #1 conductor (Upper Sandusky – Nevada 69 kV section).	**$13,400,000**
	Rebuild 3.0 mile section of the Copper #1 conductor (Broken Sword – Nevada 69 kV section).	**$3,600,000**
	Total Estimated Cost for Project AC1-195	**$21,830,000**

Table 7

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.