

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-177***

Losantville 345 kV

October 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 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 #AC2-177, a 200.0 MW (26.0 MW Capacity) wind generating facility in Losantville, Indiana (see Figure 2). The point of interconnection will be a direct connection to AEP's Losantville 345 kV substation (see Figure 1). The secondary point of interconnection is to AEP's Losantville – Desoto 345 kV circuit (see Figure 1).

The requested in service date is 12/31/2019.

Attachment Facilities

Primary Point of Interconnection (Losantville 345 kV Substation)

To accommodate the interconnection at the Losantville 345 kV substation, the substation will have to be expanded requiring the installation of one (1) 345 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.

Losantville Station Work:

- Expand the Losantville 345 kV substation; install one (1) 345 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.
- **Estimated Station Cost: \$1,500,000**

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
345 kV Revenue Metering	\$350,000
Upgrade line protection and control settings at the Desoto 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	\$50,000
Upgrade line protection and control settings at the Tanners Creek 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	\$50,000
Total	\$450,000

Table 1

Secondary Point of Interconnection (Losantville – Desoto 345 kV)

To accommodate the interconnection on the Losantville – Desoto 345 kV circuit, a new three (3) circuit breaker 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 3). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

It is understood that the IC is responsible for all costs associated with this interconnection. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Losantville 345 kV substation are not included in this report; these are assumed to be the 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.

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 Resource. 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:

Option 1 Network Impacts

The Queue Project AC2-177 was evaluated as a 200.0 MW (Capacity 26.0 MW) injection at the Losantville 345 kV substation in the AEP area. Project AC2-177 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-177 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 resulted in overloads:

Option 1	
Contingency Name	Description
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
678_B3_05TANNER 345-5	CONTINGENCY '678_B3_05TANNER 345-5' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FTHS 345 1 OPEN BRANCH FROM BUS 243233 TO BUS 243382 CKT 5 / 243233 05TANNER 345 243382 05TANNER 138 5 END
6873_B	CONTINGENCY '6873_B' OPEN BRANCH FROM BUS 925800 TO BUS 243233 CKT 2 / 925800 AC1-059 TAP 345 243233 05TANNER 345 2 END
6931_B2_TOR6801701	CONTINGENCY '6931_B2_TOR6801701' OPEN BRANCH FROM BUS 243218 TO BUS 243792 CKT 2 / 243218 05DESOTO 345 243792 05LOSANTVILL 345 2 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
8702_B2_TOR2543	CONTINGENCY '8702_B2_TOR2543' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 END
P1-#.B2 TERMINAL-EAST BEND 4516	CONTINGENCY 'P1-#.B2 TERMINAL-EAST BEND 4516' OPEN BRANCH FROM BUS 249575 TO BUS 249565 CKT 1 END

Table 2**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)

AC2-177 Multiple Facility Contingency														
Contingency			Affected Area	Facility Description	Bus		PF	Loading		Rating		MW Con.	FG App.	
#	Type	Name			From	To		Cir.	Initial	Final	Type			MVA
1	DCTL	6873_B	AEP - AEP	05LOSANTVILL-05DESOTO 345 kV line	243792	243218	2	DC	85.68	102.83	ER	1166	199.97	2

Table 3**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

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

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.

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.

AC2-177 Delivery of Energy Portion of Interconnection Request														
#	Type	Contingency Name	Affected Area	Facility Description	From	Bus To	Cir.	PF	Initial	Loading Final	Rating Type	MVA	MW Con.	FG App.
1	N-1	8702_B2_TOR2543	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	DC	101.32	106.14	NR	897	43.28	
2	N-1	P1-#.B2 TERMINAL-EAST BEND 4516	AEP - DEO&K	05TANNER-08M.FORT 345 kV line	243233	249567	1	DC	133.51	134.78	NR	1409	39.59	
3	N-1	678_B3_05TANNER 345-5	AEP - AEP	05LOSANTVILL-05DESOTO 345 kV line	243792	243218	2	DC	91.79	106.75	NR	1016	152.05	
4	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	125.03	125.69	NR	1017	14.93	
5	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	130.95	131.64	NR	971	14.93	
6	N-1	6931_B2_TOR6801701	AEP - AEP	AC1-059 TAP-05TANNER 345 kV line	925800	243233	2	DC	98.33	118.01	NR	1016	199.97	

Table 4

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05LOSANTVILL-0DESOTO 345 kV line	A Sag Study will be required on the 14.0 mile section of ACAR 2303.5 54/37 conductor section 1 to mitigate the overload.	Sag Study: 6 to 12 months. If line rebuild is required: The standard time required for construction differs from state to state. An approximate construction time would be 36 to 48 months after signing an interconnection agreement.	\$56,000
Total New Network Upgrades				\$56,000

Table 5

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

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 In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the IC's 200.0 MW (26.0 MW Capacity) wind generating facility (PJM Project #AC2-177) 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 IC's generating facility.

Cost Breakdown for Primary Point of Interconnection (Losantville 345 kV Substation)		
Attachment Cost	Expand Losantville 345 kV Substation	\$1,500,000
Non-Direct Connection Cost Estimate	345 kV Revenue Metering	\$350,000
	Upgrade line protection and control settings at the Desoto 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	\$50,000
	Upgrade line protection and control settings at the Tanners Creek 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	\$50,000
	A Sag Study will be required on the 14.0 mile section of ACAR 2303.5 54/37 conductor section 1 to mitigate the overload on the Desoto – Losantville 345 kV line.	\$56,000
	Total Estimated Cost for Project AC2-177	\$2,006,000

Table 6

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. The cost of remediation for sag limited conductors is not included in this estimate. Final estimates will require an on-site review and coordination to determine final construction requirements.

Option 2

Network Impacts

The Queue Project AC2-177 was evaluated as a 200.0 MW (Capacity 26.0 MW) injection tapping the Losantville – Desoto 345 kV line in the AEP area. Project AC2-177 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-177 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 resulted in overloads:

Option 2	
Contingency Name	Description
8823	CONTINGENCY '8823' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
678_B3_05TANNER 345-5	CONTINGENCY '678_B3_05TANNER 345-5' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 / 243233 05TANNER 345 249567 08M.FTHS 345 1 OPEN BRANCH FROM BUS 243233 TO BUS 243382 CKT 5 / 243233 05TANNER 345 243382 05TANNER 138 5 END
6873_B	CONTINGENCY '6873_B' OPEN BRANCH FROM BUS 925800 TO BUS 243233 CKT 2 / 925800 AC1-059 TAP 345 243233 05TANNER 345 2 END
6931_B2_TOR6801701_A	CONTINGENCY '6931_B2_TOR6801701_A' OPEN BRANCH FROM BUS 243218 TO BUS 932600 CKT 2 / 243218 05DESOTO 345 932600 AC2-177 TAP 345 2 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
8702_B2_TOR2543	CONTINGENCY '8702_B2_TOR2543' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2

Option 2	
Contingency Name	Description
	END
P1-#.B2 TERMINAL-EAST BEND 4516	CONTINGENCY 'P1-#.B2 TERMINAL-EAST BEND 4516' OPEN BRANCH FROM BUS 249575 TO BUS 249565 CKT 1 END

Table 7

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)

AC2-177 Multiple Facility Contingency - Option 2														
Contingency			Affected Area	Facility Description	Bus			PF	Loading		Rating		MW Con.	FG App.
#	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
1	DCTL	8823	AEP - AEP	05DESOTO-05JAY 138 kV line	243278	243319	1	DC	99.37	101.19	ER	393	15.94	1
2	DCTL	6873_B	AEP - AEP	AC2-177 TAP-05DESOTO 345 kV line	932600	243218	2	DC	85.66	102.81	ER	1166	199.97	2

Table 8

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

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

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.

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.

AC2-177 Delivery of Energy Portion of Interconnection Request - Option 2														
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
					From	To			Initial	Final	Type	MVA		
1	N-1	8702_B2_TOR2543	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	DC	101.46	106.59	NR	897	45.99	
2	N-1	P1-#..B2 TERMINAL-EAST BEND 4516	AEP - DEO&K	05TANNER-08M.FORT 345 kV line	243233	249567	1	DC	133.57	134.71	NR	1409	35.6	
3	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	124.49	125.12	NR	1017	14.31	
4	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	130.38	131.05	NR	971	14.31	
5	N-1	6931_B2_TOR6801701_A	AEP - AEP	AC1-059 TAP-05TANNER 345 kV line	925800	243233	2	DC	98.31	117.99	NR	1016	199.97	
6	N-1	678_B3_05TANNER 345-5	AEP - AEP	AC2-177 TAP-05DESOTO 345 kV line	932600	243218	2	DC	91.78	107.98	NR	1016	164.66	

Table 9

Figure 1: Primary Point of Interconnection (Losantville 345 kV Substation)
Single-Line Diagram

Figure 2: Primary Point of Interconnection (Losantville 345 kV Substation)

Figure 3: Secondary Point of Interconnection (Losantville – Desoto 345 kV)
Single-Line Diagram

Figure 4: Secondary Point of Interconnection (Losantville – Desoto 345 kV)