

***Generation Interconnection
System Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-059***

Losantville-Tanners Creek 345 kV

May 2018

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. 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. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

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 or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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

NextEra Energy Resources, LLC (NextEra) proposes to install PJM Project #AC1-059, a 300 MW (39.0 MW Capacity) wind generating facility comprised of 130 – GE 2.3 MW wind turbines connecting to the AEP's Losantville (U2-090) – Tanners Creek 345 kV Circuit #2 (see Figure 1). The proposed location for the interconnection substation is in North Fayette County, Indiana.

The requested Backfeed date is September 15, 2018.

The requested in service date is December 15, 2018.

Attachment Facilities

Point of Interconnection (Losantville – Tanners Creek 345 kV Circuit #2)

To accommodate the interconnection on the Losantville – Tanners Creek 345 kV Circuit #2, 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 1). 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.

New Switching Station Work:

- Construct 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. Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required (see Figure 1).
- **Estimated Station Cost: \$8,000,000**

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
Losantville-Tanners Creek 345 kV T-Line Cut In	\$1,500,000
Total	\$1,500,000

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
345 kV Revenue Metering	\$450,000
Install line protection and controls at the new Esteban 345 kV switching station.	\$1,250,000
Upgrade line protection and controls at the Losantville 345 kV substation to coordinate with the new Esteban 345 kV switching station.	\$350,000
Upgrade line protection and controls at the Tanners Creek 345 kV substation to coordinate with the new Esteban 345 kV switching station.	\$350,000
Total	\$2,400,000

Table 2

Interconnection Customer Requirements

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

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:

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

Network Impacts

The Queue Project AC1-059 was evaluated as a 300.0 MW (Capacity 39.0 MW) injection into a tap of the Losantville – Tanners Creek 345 kV line in the AEP area. Project AC1-059 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-059 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies resulted in overloads:

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
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 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)

None

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Stability Analysis

No mitigation or system upgrades were identified to interconnect the AC1-059 generation. No additional costs associated with the addition of the AC1-059 were identified in the System Impact Study.

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

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

Duke, Progress & TVA Impacts:

None

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 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.

Delivery of Energy Portion of Interconnection Request													
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.
1	N-1	8702_B2_TOR2543	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	DC	101	106	NR	897	43.62
2	N-1	P1-#..B2 TERMINAL-EAST BEND 4516	AEP - DEO&K	05TANNER-08M.FORT 345 kV line	243233	249567	1	AC	103	108	NR	1409	91.3
3	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	AC	123	125	NR	1017	26.86
4	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	AC	129	131	NR	971	26.86

Table 4

Additional Limitations of Concern

None

Light Load Analysis

No light load thermal impacts

New System Reinforcements

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 System Impact Study, the construction of the 300 MW (39.0 MW Capacity) wind generating facility of NextEra (PJM Project #AC1-059) 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 NextEra generating facility.

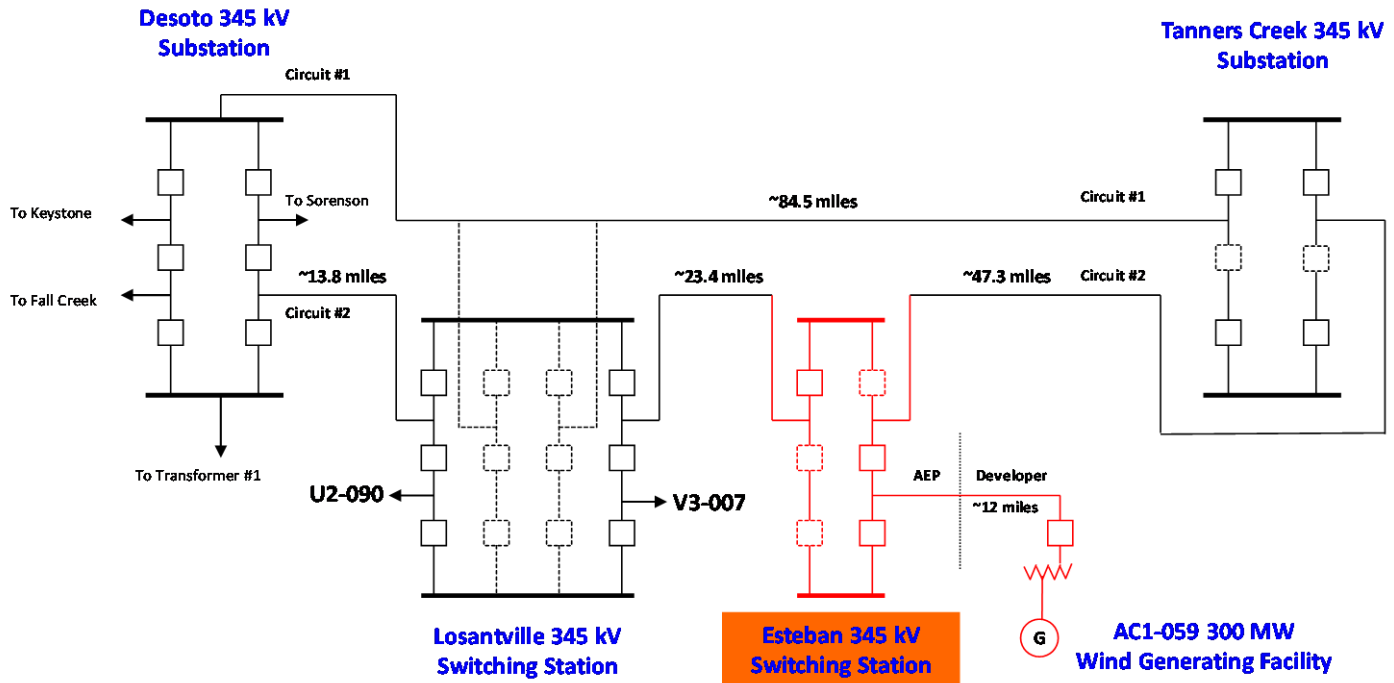
Cost Breakdown for Point of Interconnection (Losantville-Tanners Creek 345 kV)			
Type of Network Upgrade	Network Upgrade Number (NUN)	Description	Cost
Direct Connection	n5534	New 345 kV Switching Station	\$8,000,000
	n5535	Losantville-Tanners Creek 345 kV T-Line Cut In	\$1,500,000
Non-Direct Connection	n5536	345 kV Revenue Metering	\$450,000
	n5537	Install line protection and controls at the new Esteban 345 kV switching station.	\$1,250,000
	n5538	Upgrade line protection and controls at the Losantville 345 kV substation to coordinate with the new 345 kV switching station.	\$350,000
	n5539	Upgrade line protection and controls at the Tanners Creek 345 kV substation to coordinate with the new 345 kV switching station.	\$350,000
Total Estimated Cost for Project AC1-059			\$11,900,000

Table 5

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.

Figure 1: Point of Interconnection (Losantville - Tanners Creek 345 kV)

Single-Line Diagram



Legend

- Existing
- - - Future
- To be Constructed for AC1-059
- - - Future

Figure 2: Point of Interconnection (Losantville - Tanners Creek 345 kV)

