Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-176

Timber Switch 138 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 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 proposes to increase the generation of its previously proposed PJM queue position R49 (Timber Road II) by 58.7 MW (7.6 MW Capacity) in Paulding County, Ohio (see Figure 2). The point of interconnection is a direct connection to AEP's Timber Switch 138 kV Switching Station (see Figure 1).

The requested in service date is October 31, 2019.

Attachment Facilities

Point of Interconnection (Timber Switch 138 kV Substation)

Not required for an existing facility.

It is assume that the 138 kV revenue metering installed for Timber Road II will be adequate for the additional generation.

It is understood that The Interconnection Customer is responsible 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 Timber Switch switching station are not included in this report; these are assumed to be The Interconnection Customer'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:

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

Network Impacts

The Queue Project AC1-176 was evaluated as a 58.7 MW (Capacity 7.6 MW) injection at the Timber Switch 138kV substation in the AEP area. Project AC1-176 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-176 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**
7372	CONTINGENCY '7372' OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 247521 CKT 1 / 243242 05ALLEN 138 247521 T-131 C 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1 END
363_B2_TOR1682	CONTINGENCY '363_B2_TOR1682' OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 END

Option 1	
Contingency Name	**Description**
4812_B2_TOR8931	CONTINGENCY '4812_B2_TOR8931' OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 / 242921 05CORNU 765 242924 05HANG R 765 1 END
4839_B1_05ROCKPT 765-1	CONTINGENCY '4839_B1_05ROCKPT 765-1' OPEN BRANCH FROM BUS 243209 TO BUS 243442 CKT 1 / 243209 05ROCKPT 765 243442 05RKG1 26.0 1 REMOVE UNIT 1H FROM BUS 243442 / 243442 05RKG1 26.0 REMOVE UNIT 1L FROM BUS 243442 / 243442 05RKG1 26.0 END
697_B3_05HAVILN 138-3_WOMOAB	CONTINGENCY '697_B3_05HAVILN 138-3_WOMOAB' OPEN BRANCH FROM BUS 243017 TO BUS 243168 CKT 1 / 243017 05HAVILN 138 243168 05HAVILND1 69.0 1 END
7501_B2_TOR2516678	CONTINGENCY '7501_B2_TOR2516678' OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1 END
7528_C2_05ALLEN 138-H	CONTINGENCY '7528_C2_05ALLEN 138-H' OPEN BRANCH FROM BUS 243242 TO BUS 243383 CKT 1 / 243242 05ALLEN 138 243383 05TILLMA 138 1 OPEN BRANCH FROM BUS 243242 TO BUS 247521 CKT 1 / 243242 05ALLEN 138 247521 T-131 C 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246950 CKT 1 / 243383 05TILLMA 138 246950 05TIMBSS 138 1 OPEN BRANCH FROM BUS 243383 TO BUS 246265 CKT 1 / 243383 05TILLMA 138 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246254 TO BUS 246265 CKT 1 / 246254 05MONROEVI 34.5 246265 05TILLMAN 34.5 1 OPEN BRANCH FROM BUS 246264 TO BUS 246265 CKT 1 / 246264 05ST R14 8 34.5 246265 05TILLMAN 34.5 1 END
H1TH3	CONTINGENCY 'H1TH3' /* BATH CO. REMOVE MACHINE 5 FROM BUS 315205 /*BATH UNIT #5 REMOVE MACHINE 6 FROM BUS 315206 /*BATH UNIT #6 REMOVE MACHINE 1 FROM BUS 315201 /*BATH UNIT #1 REMOVE MACHINE 2 FROM BUS 315202 /*BATH UNIT #2 END

Option 1	
Contingency Name	**Description**
P04	CONTINGENCY 'P04' DISCONNECT BUS 200122 /* DISCONNECT BUS 200192 /* DISCONNECT BUS 200193 /* DISCONNECT BUS 200194 /* DISCONNECT BUS 200195 /* END

Table 1

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)

AC1-176 Contribution to Previously Identified Overloads

	Contingency				Bus				Loading		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	FG App.
1	LFFB	7528_C2_05ALLEN 138-H	AEP - AEP	05HAVILN 138/69 kV transformer	243017	243168	1	DC	116.86	130.38	ER	90	12.17	1
2	DCTL	7372	AEP - AEP	05HAVILN 138/69 kV transformer	243017	243168	1	DC	116.86	130.38	ER	90	12.17	
3	LFFB	7528_C2_05ALLEN 138-H	AEP - AEP	05N MID PT-05DELPHOS 69 kV line	245891	245871	1	DC	137.03	156.73	ER	40	7.88	2
4	DCTL	7372	AEP - AEP	05N MID PT-05DELPHOS 69 kV line	245891	245871	1	DC	137.03	156.73	ER	40	7.88	
5	LFFB	7528_C2_05ALLEN 138-H	AEP - AEP	05VAN WERT-05N MID PT 69 kV line	245907	245891	1	DC	147.03	166.73	ER	40	7.88	3
6	DCTL	7372	AEP - AEP	05VAN WERT-05N MID PT 69 kV line	245907	245891	1	DC	147.03	166.73	ER	40	7.88	

7	N-1	363_B2_TOR1682	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	174.06	174.06	ER	1370	0	4
8	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	120.55	120.55	NR	1134	0	
9	N-1	4812_B2_TOR8931	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	106.48	106.48	ER	1370	0	
10	Non	Non	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	110.79	110.79	NR	1200	0	5
11	LFFB	H1TH3	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.49	106.49	ER	1319	0	
12	N-1	P04	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.32	106.32	ER	1319	0	
13	N-1	4839_B1_05ROCKPT 765-1	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.13	106.13	ER	1319	0	

Table 2

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, Progress & TVA Impacts:

Duke Carolina, Progress, & 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 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.

AC1-176 Delivery of Energy Portion of Interconnection Request

	Contingency				Bus				Loading		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	FG App.
1	N-1	7501_B2_TOR2516678	AEP - AEP	05HAVILN-05E LIMA 138 kV line	243017	242989	1	DC	100.78	117.14	ER	220	35.98	
2	N-1	7501_B2_TOR2516678	AEP - AEP	05HAVILN 138/69 kV transformer	243017	243168	1	DC	115.28	128.95	ER	90	12.31	
3	Non	Non	AEP - AEP	05HAVILN 138/69 kV transformer	243017	243168	1	DC	112.06	114.44	NR	69	3.65	
4	N-1	697_B3_05HAVILN 138-3_WOMOAB	AEP - AEP	05HAVILN 138/69 kV transformer	243017	243169	1	DC	113.22	115.54	ER	90	4.63	
5	N-1	7501_B2_TOR2516678	AEP - AEP	05HAVILND2-05PAULDING 69 kV line	243169	245898	1	DC	123.47	138.82	ER	50	7.68	
6	N-1	7501_B2_TOR2516678	AEP - AEP	05N MID PT-05DELPHOS 69 kV line	245891	245871	1	DC	128.42	149.03	ER	40	8.24	
7	N-1	7501_B2_TOR2516678	AEP - AEP	05VAN WERT-05N MID PT 69 kV line	245907	245891	1	DC	138.42	159.03	ER	40	8.24	
8	N-1	363_B2_TOR1682	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	185.09	185.09	ER	1370	0	
9	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	117.28	117.28	NR	1134	0	
10	Non	Non	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	110.79	110.79	NR	1200	0	
11	N-1	4839_B1_05ROCKPT 765-1	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.13	106.13	ER	1319	0	

Table 3

New System Reinforcements

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05HAVILN 138/69 kV transformer	Replace the Haviland Riser Replace the 138/69kV Transformer #4	An approximate construction time will be 12 months after signing of an interconnection agreement.	**$1,600,000**
#2	05N MID PT-05DELPHOS 69 kV line	Rebuild 6.0 miles of Copper 2/0 and Copper 4/0 conductors	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	**$7,200,000**
#3	05VAN WERT-05N MID PT 69 kV line	Rebuild 5.30 miles of Copper 2/0 conductor	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	**$6,340,000**
			Total New Network Upgrades	**$15,140,000**

Table 4

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.

Conclusion

Based upon the results of this Feasibility Study, the increase of 58.7 MW (7.6 MW Capacity) wind generation of The Interconnection Customer (PJM Project #AC1-176) 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.

Note: The customer should review the capability of the lead from the point of ownership transition into the generating plant to ensure that it is sufficient to accommodate the increase generation output.

Cost Breakdown for Point of Interconnection (Timber Switch 138 kV Substation)		
	Replace the Haviland Riser Replace the 138/69kV Transformer #4	**$1,600,000**
	Rebuild 5.30 miles of Copper 2/0 conductor	**$6,340,000**
	Rebuild 6.0 miles of Copper 2/0 and Copper 4/0 conductors	**$7,200,000**
	Total Estimated Cost for Project AC1-176	**$15,140,000**

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. The allocation to the AC1-176 queue position, if any, of costs associated with these upgrades, will be determined during the System Impact Study.

Figure 1: Point of Interconnection (Timber Switch 138 kV Substation)

Single-Line Diagram

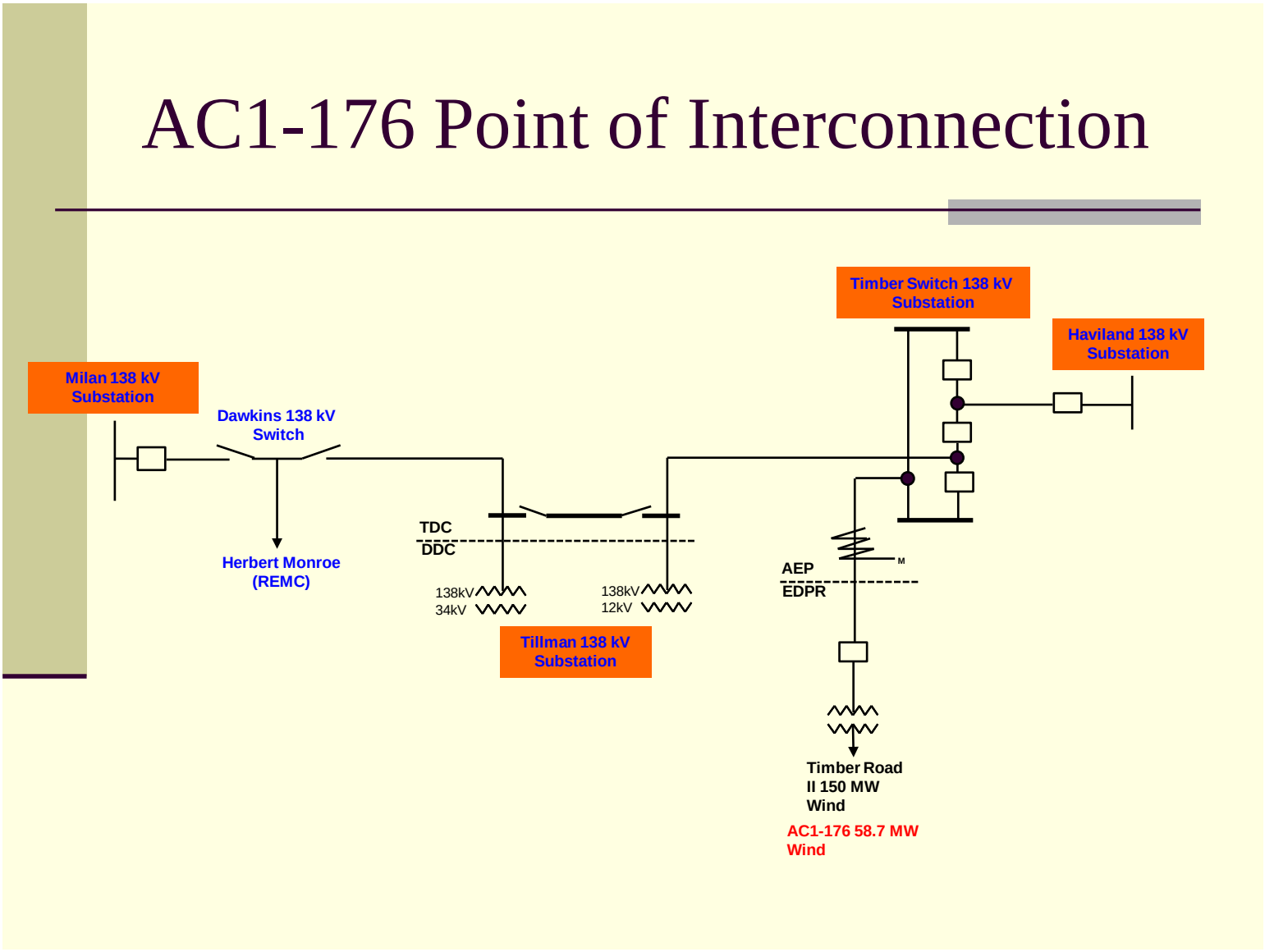

Figure 2: Point of Interconnection (Timber Switch 138 kV Substation)