Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-087

Randolph 138 kV Substation

December 2018

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.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B. 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group.

Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 2.2.2. of Manual 14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

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 install PJM Project #AD2-087, a 200 MW (35.2 MW Capacity) Wind generating facility in Randolph County, Indiana (Figure 2). The primary point of interconnection is a direct connection AEP's Randolph 138 kV Substation (see Figure 1). The Secondary point of interconnection is a direct connection to DP&L's Greenville 138 kV Substation.

The requested in service date is December 31, 2020.

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 maintaining the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (Randolph 138 kV Substation)

To accommodate the interconnection at the Randolph 138 kV Substation, the installation of two (2) new 138 kV circuit breakers will be required (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 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.

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

- Install two (2) new 138 kV circuit breakers at the Randolph 138 kV substation. Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required (see Figure 1).
    - **Estimated Station Cost: $2,500,000**

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	Total Cost
138 kV Revenue Metering	**$250,000**
Total	**$250,000**

Table 1

Secondary Point of Interconnection (Greenville 138 kV Substation)

DP&L to provide the necessary attachment facilities.

Interconnection Customer 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 new 138 kV switching station 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.

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- Option 1

The Queue Project AD2-087 was evaluated as a 200 MW (Capacity 35.2 MW) injection at Randolph 138 kV substation in the AEP area. Project AD2-087 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-087 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
'786_B3_05JAY 138-1_WOMOAB'	CONTINGENCY '786_B3_05JAY 138-1_WOMOAB' OPEN BRANCH FROM BUS 246018 TO BUS 243319 CKT 1 / 246018 05JAY EQ 999 243319 05JAY 138 1 OPEN BRANCH FROM BUS 246018 TO BUS 246016 CKT 1 / 246018 05JAY EQ 999 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246018 TO BUS 246015 CKT 1 / 246018 05JAY EQ 999 246015 05JAY 34.5 1 OPEN BRANCH FROM BUS 243253 TO BUS 243319 CKT 1 / 243253 05BLUFFP 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 243278 TO BUS 243319 CKT 1 / 243278 05DESOTO 138 243319 05JAY 138 1 OPEN BRANCH FROM BUS 243319 TO BUS 243358 CKT 1 / 243319 05JAY 138 243358 05PENNVI 138 1 OPEN BRANCH FROM BUS 246013 TO BUS 246016 CKT 1 / 246013 05ARMSTRON 69.0 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246024 TO BUS 246016 CKT 1 / 246024 05GREEN SW 69.0 246016 05JAY 69.0 1 OPEN BRANCH FROM BUS 246025 TO BUS 246026 CKT 1 / 246025 05ALBANY 34.5 246026 05BARLEY 34.5 1 OPEN BRANCH FROM BUS 246026 TO BUS 246015 CKT 1 / 246026 05BARLEY 34.5 246015 05JAY 34.5 1 END
'DEO&K P7-1 4561TODWOOD14562TODWOOD2'	CONTINGENCY 'DEO&K P7-1 4561TODWOOD14562TODWOOD2' OPEN BRANCH FROM BUS 249574 TO BUS 249576 CKT 1 OPEN BRANCH FROM BUS 249574 TO BUS 249576 CKT 2

Contingency Name	Description
	END
'DEO&K P7-1 DEO&K-AEP 4504MFTANNERS4512EBTANNERS'	CONTINGENCY 'DEO&K P7-1 DEO&K-AEP 4504MFTANNERS4512EBTANNERS' OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1 OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1 END
'AEP_P1-2_#349'	CONTINGENCY 'AEP_P1-2_#349' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
'AEP_P1-2_#8702'	CONTINGENCY 'AEP_P1-2_#8702' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 END
'AEP_P1-2_#8468'	CONTINGENCY 'AEP_P1-2_#8468' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 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)

Option 1 AD2-087 Multiple Facility Contingency															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Ckt	PF	Initial	Final	Type	MVA	Con.	App.
1	DCTL	'DEO&K P7-1 4561TODWOOD14	AEP – DEO&K	05COLLCO-08COLINV 138 kV	243262	250001	1	DC	90.2	102.7	ER	167	20.89	

Option 1 AD2-087 Multiple Facility Contingency															
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Ckt	PF	Initial	Final	Type	MVA	Con.	App.
		562TODWOOD2'		line										
2	DCTL	'DEO&K P7-1 DEO&K-AEP 4504MFTANNERS4 512EBTANNERS'	AEP – DEO&K	05COLLCO-08COLINV 138 kV line	243262	250001	1	DC	88.76	101.73	ER	167	21.66	

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

(Results of the steady-state voltage studies should be inserted here)

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.
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.

Option-1 AD2-087 Delivery of Energy Portion of Interconnection Request													
	Contingency		Affected	Facility	Bus				Loading		Rating		MW
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.
1	N-1	AEP_P1-2_#8702	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	DC	108.3	110.89	NR	897	23.17
2	N-1	'786_B3_05JAY 138-1_WOMOAB'	AEP - AEP	05BLUFFP 138/69 kV transformer	243253	246014	1	DC	105.06	148.77	ER	77	33.49
3	N-1	'786_B3_05JAY 138-1_WOMOAB'	AEP - AEP	05BLUFFPNT-05PORTLAND 69 kV line	246014	246022	1	DC	85.2	122.41	ER	90	33.49
4	N-1	'786_B3_05JAY 138-1_WOMOAB'	AEP - AEP	05PORTLAND-05N PORTLN 69 kV line	246022	246020	1	DC	70.84	119.37	ER	69	33.49
5	N-1	'AEP_P1-2_#8468'	OVEC-AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	104.76	105.18	NR	1017	14.83
6	N-1	'AEP_P1-2_#349'	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	139.6	140.17	NR	1017	14.83

Table 4

Note: FERC form 715 part 4 was updated to eliminate the normal rating requirement for single contingencies on EHV facilities.

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05COLLCO-08COLINV 138 kV Line	A Sag Study will be required on the 0.15 mile section of ACSR~397.5~30/7~LARK Conductor section1 to mitigate the overload. The estimated cost provided does not include mitigation of any clearance violations.	6 months	$20,000
			Total New Network Upgrades	**$20,000**

Table 5

Note: While the sag study and the mitigation identified in the sag study would be the minimal the IPP would be responsible for, AEP might be interested in rebuilding these two spans as this line is 1940's vintage. This will be determined during Facility study stage.

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 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 IC's 200 MW (35.2 MW Capacity) wind generating facility of (PJM Project #AD2-087) will require the following additional interconnection charges. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC generating facility.

Cost Breakdown for Primary Point of Interconnection (Randolph 138 kV Substation)		
Attachment Cost	Expand the Randolph 138 kV Substation to accommodate the interconnection of PJM Project #AD2-087 and installation of associated protection and controls equipment will be required.	$2,500,000
Non-Direct Connection Cost Estimate	138 kV Revenue Metering	$250,000
	New System Reinforcements *(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)*	$20,000
	Total Estimated Cost for Project AD2-087	**$2,770,000**

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.

Network Impacts – Option 2

The Queue Project AD2-087 was evaluated as a 200.0 MW (Capacity 138.0 MW) injection at the Greenville 138 kV substation in the Dayton area. Project AD2-087 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-087 was studied with a commercial probability of 53%.

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
'AEP_P1-2_#349'	CONTINGENCY 'AEP_P1-2_#349' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
'AEP_P1-3_#6190'	CONTINGENCY 'AEP_P1-3_#6190' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 OPEN BRANCH FROM BUS 242528 TO BUS 242808 CKT 4 / 242528 05SPORN 345 242808 05SPORNS 138 4 END
'AEP_P7-1_#8123'	CONTINGENCY 'AEP_P7-1_#8123' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453 05BEATTY 345 253248 09SCHARL 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 243469 CKT 3 / 243453 05BEATTY 345 243469 05BEATTY 138 3 END
'AEP_P1-2_#8468'	CONTINGENCY 'AEP_P1-2_#8468' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 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)

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)

Option -2 AD2-087 Contribution to Previously Identified Overloads															
	Contingency				Bus				Loading		Rating			FG	
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	App.	
1	N-1	'AEP_P1-2_#349'	OVEC - AEP	06KYGER-05SPORN 345 kV	248005	242528	1	DC	119.22	119.66	NR	1017	10.74		
2	N-1	'AEP_P1-3_#6190'	OVEC - AEP	06KYGER-05SPORN 345 kV	248005	242528	1	DC	118.52	118.96	NR	1017	10.75		
3	DCTL	'AEP_P7-1_#8123'	DAY - AEP	The 09KILLEN-05MARQUI 345 kV line	253038	242938	1	DC	103.74	104.27	ER	1374	16.09		

Table 8

Note: FERC form 715 part 4 was updated to eliminate the normal rating requirement for single contingencies on EHV facilities.

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined

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).

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.
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.

Option- 2 AD2-087 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	'AEP_P1-2_#8468'	OVEC-AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	104.79	105.24	NR	1294	15.56	
1	N-1	'AEP_P1-2_#349'	OVEC-AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	139.65	140.25	NR	1071	15.56	

Table 9

Note: FERC form 715 part 4 was updated to eliminate the normal rating requirement for single contingencies on EHV facilities.

Figure 1: Primary Point of Interconnection (Randolph 138 kV Substation)

Single Line Diagram

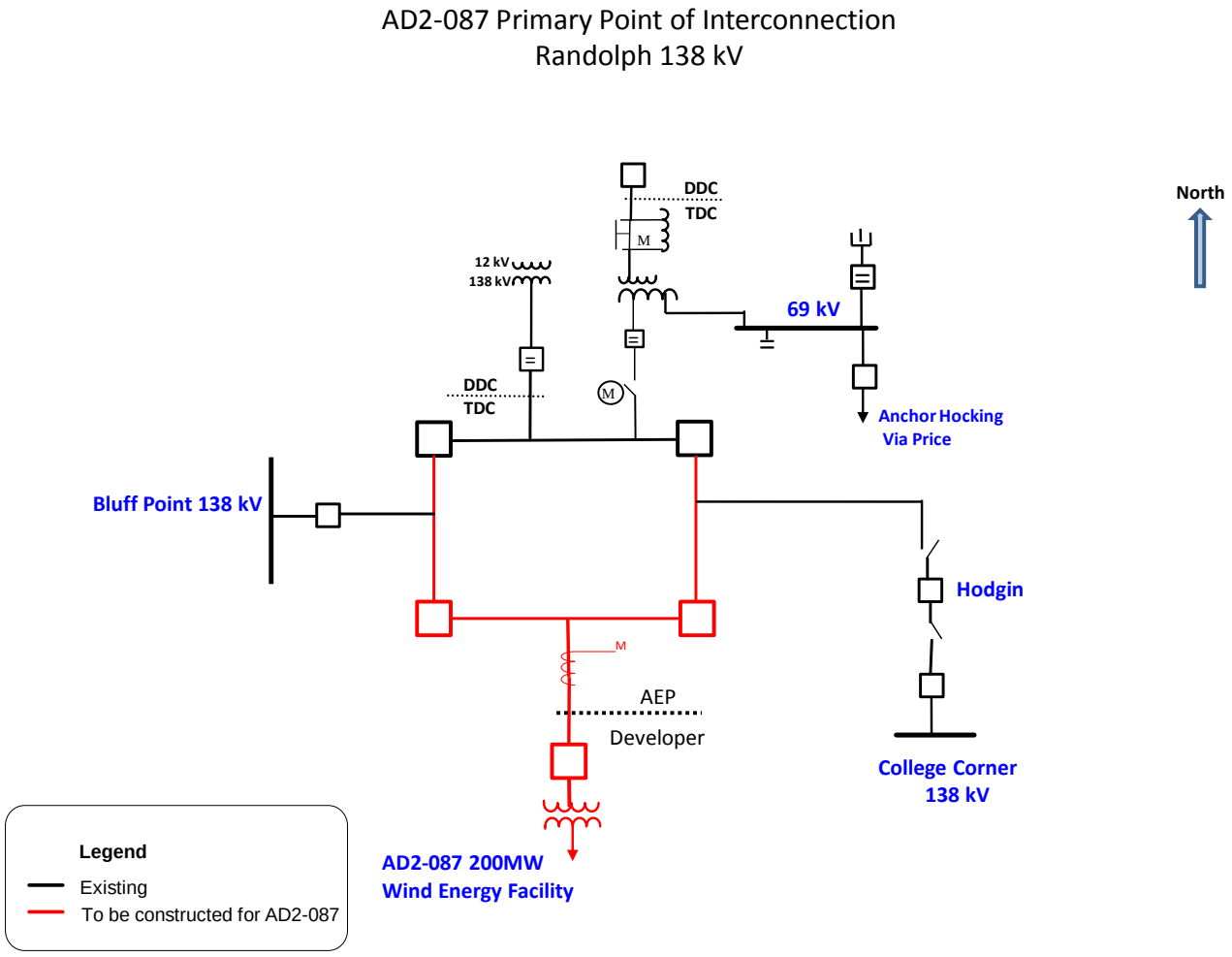
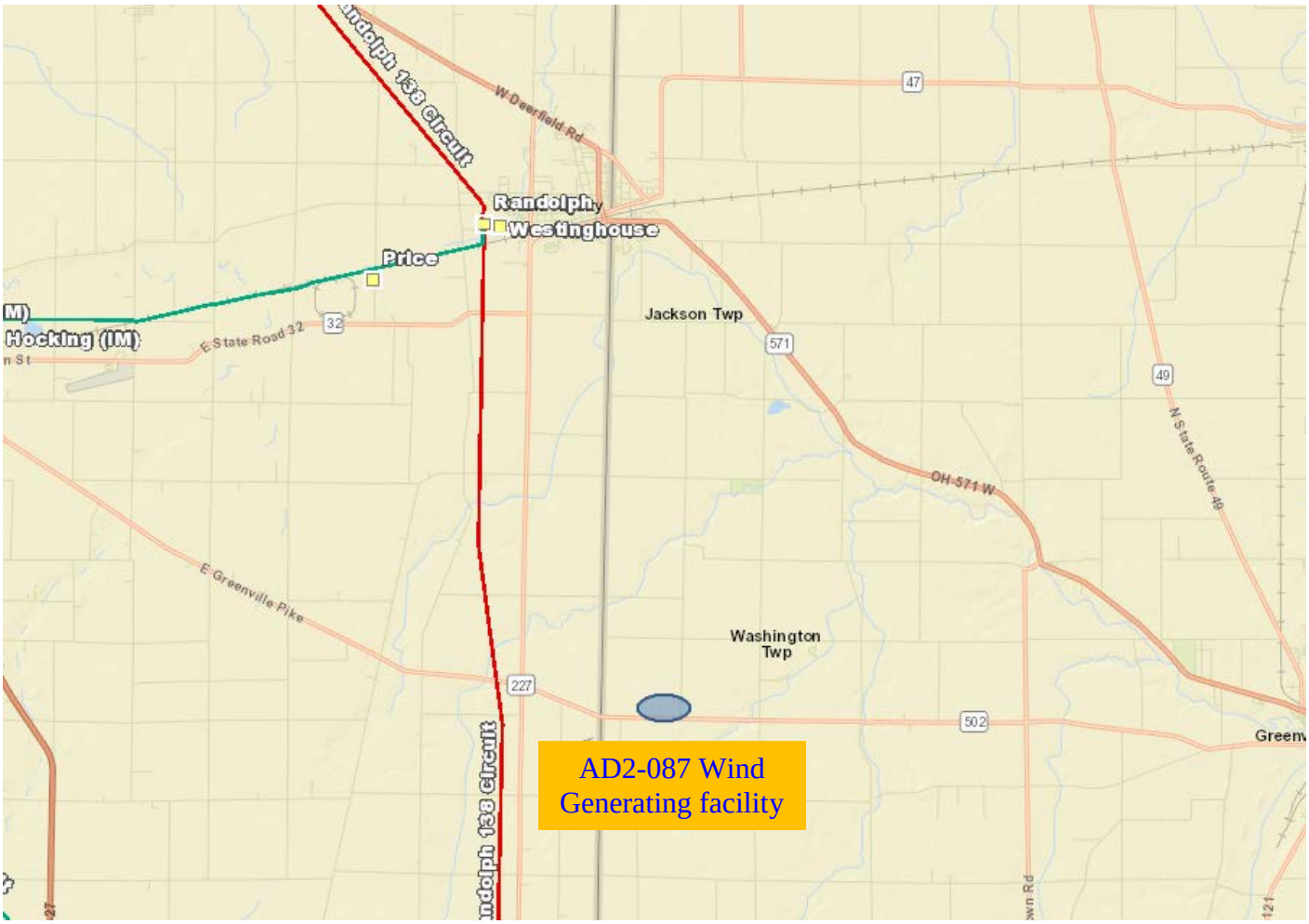


Figure 2: Primary Point of Interconnection (Randolph 138 kV Substation)



Appendices- Primary POI

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. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(AEP - DEO&K) The 05COLLCO-08COLINV 138 kV line (from bus 243262 to bus 250001 ckt 1) loads from 90.2% to 102.7% (**DC power flow**) of its emergency rating (167 MVA) for the tower line contingency outage of 'DEO&K P7-1 4561TODWOOD14562TODWOOD2'. This project contributes approximately 20.89 MW to the thermal violation.

CONTINGENCY 'DEO&K P7-1 4561TODWOOD14562TODWOOD2'
OPEN BRANCH FROM BUS 249574 TO BUS 249576 CKT 1
OPEN BRANCH FROM BUS 249574 TO BUS 249576 CKT 2
END

Bus Number	*Bus Name*	*Full Contribution*
247288	*05RICHG1*	*0.95*
247289	*05RICHG2*	*0.95*
243415	*05WWVSTA*	*2.85*
932841	*AC2-111 C*	*6.95*
932842	*AC2-111 E*	*11.34*
934961	*AD1-128 C O1*	*6.82*
934962	*AD1-128 E O1*	*11.12*
936681	*AD2-087 C O1*	*3.68*
936682	*AD2-087 E O1*	*17.21*
LTF	*BLUEG*	*0.04*
LTF	*CALDERWOOD*	*< 0.01*
LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-S1*	*0.17*
LTF	*CBM-W1*	*4.62*
LTF	*CBM-W2*	*5.4*
LTF	*CELEVELAND*	*0.06*
LTF	*CHEOAH*	*< 0.01*
LTF	*CHILHOWEE*	*< 0.01*
LTF	*CIN*	*1.39*
LTF	*CLIFTY*	*1.61*
LTF	*G-007*	*0.09*
LTF	*HAMLET*	*0.07*
LTF	*IPL*	*1.18*
LTF	*MEC*	*1.93*
LTF	*MECS*	*1.27*
LTF	*O-066*	*0.58*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.15*
LTF	*ROWAN*	*0.05*
247929	*S-071 E*	*6.62*
LTF	*SANTEETLA*	*< 0.01*

LTF	*TRIMBLE*	*0.02*
LTF	*WEC*	*0.33*

Appendix 2

(OVEC - OVEC) The 06DEARB1-06PIERCE 345 kV line (from bus 248001 to bus 248013 ckt 1) loads from 104.43% to 105.28% (**DC power flow**) of its emergency rating (972 MVA) for the tower line contingency outage of 'DEO&K P7-1 DEO&K-AEP 4504MFTANNERS4512EBTANNERS'. This project contributes approximately 18.1 MW to the thermal violation.

CONTINGENCY 'DEO&K P7-1 DEO&K-AEP 4504MFTANNERS4512EBTANNERS'
OPEN BRANCH FROM BUS 243233 TO BUS 249567 CKT 1
OPEN BRANCH FROM BUS 243233 TO BUS 249565 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
243795	*05HDWTR1G C*	*0.75*
247963	*05HDWTR1G E*	*9.69*
247264	*05LAWG1A*	*9.28*
247265	*05LAWG1B*	*9.28*
247266	*05LAWG1S*	*14.81*
247267	*05LAWG2A*	*9.28*
247268	*05LAWG2B*	*9.28*
247269	*05LAWG2S*	*14.81*
247914	*05WLD G1 E*	*8.04*
247958	*05WLD G2 E*	*8.43*
932461	*AC2-066 C*	*-1.76*
932681	*AC2-090 C*	*5.88*
932682	*AC2-090 E*	*9.59*
932841	*AC2-111 C*	*2.78*
932842	*AC2-111 E*	*4.53*
933591	*AC2-176 C*	*1.76*
933592	*AC2-176 E*	*11.78*
933601	*AC2-177 C*	*4.02*
933602	*AC2-177 E*	*26.92*
934161	*AD1-043 C O1*	*4.48*
934162	*AD1-043 E O1*	*7.31*
LTF	*AD1-092*	*3.99*
LTF	*AD1-093*	*6.82*
LTF	*AD1-094*	*1.3*
934961	*AD1-128 C O1*	*5.54*
934962	*AD1-128 E O1*	*9.04*
936561	*AD2-071 C*	*5.97*
936562	*AD2-071 E*	*2.94*
936681	*AD2-087 C O1*	*3.19*
936682	*AD2-087 E O1*	*14.92*
LTF	*CARR*	*0.3*

LTF	*CATAWBA*	*0.08*
LTF	*CBM-S1*	*4.01*
LTF	*CBM-W1*	*33.75*
LTF	*CBM-W2*	*52.63*
LTF	*CELEVELAND*	*0.19*
LTF	*CIN*	*11.76*
LTF	*CLIFTY*	*4.18*
LTF	*G-007*	*0.9*
LTF	*HAMLET*	*0.35*
LTF	*IPL*	*12.56*
940161	*J401*	*1.32*
939781	*J851 C*	*0.63*
939782	*J851 E*	*2.51*
LTF	*LGEE*	*0.73*
LTF	*MEC*	*15.61*
LTF	*MECS*	*7.5*
LTF	*O-066*	*5.77*
LTF	*RENSSELAER*	*0.23*
LTF	*ROSETON*	*1.69*
LTF	*ROWAN*	*0.23*
247929	*S-071 E*	*8.61*
247543	*V3-007 C*	*4.02*
247935	*V3-007 E*	*26.92*
247588	*W4-004 C*	*1.82*
247946	*W4-004 E*	*12.2*
247589	*W4-008 C*	*1.82*
247953	*W4-008 E*	*12.2*
LTF	*WEC*	*2.47*
913222	*Y1-054 E*	*-1.49*
915662	*Y3-099 E*	*0.2*
915672	*Y3-100 E*	*0.2*
LTF	*Z1-043*	*9.91*
916182	*Z1-065 E*	*0.38*
917722	*Z2-115 E*	*0.09*
920501	*AA2-148 C*	*3.55*
920502	*AA2-148 E*	*23.73*
LTF	*AB2-013*	*5.69*
923881	*AB2-028 C*	*2.92*
923882	*AB2-028 E*	*19.53*
925242	*AB2-178 E*	*1.97*
925801	*AC1-059 C*	*8.09*
925802	*AC1-059 E*	*54.17*
926091	*AC1-088*	*1.89*
926691	*AC1-152*	*15.74*

926851	*AC1-172*	*15.74*
926871	*AC1-174 C*	*5.88*
926872	*AC1-174 E*	*9.59*
926881	*AC1-175 C*	*5.88*
926882	*AC1-175 E*	*9.59*

Appendices Alternate POI

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. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(DAY - AEP) The 09KILLEN-05MARQUI 345 kV line (from bus 253038 to bus 242938 ckt 1) loads from 103.74% to 104.27% (**DC power flow**) of its emergency rating (1372 MVA) for the tower line contingency outage of 'AEP_P7-1_#8123'. This project contributes approximately 16.09 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#8123'
OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1
OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453 05BEATTY 345 253248 09SCHARL 345 1
OPEN BRANCH FROM BUS 243453 TO BUS 243469 CKT 3 / 243453 05BEATTY 345 243469 05BEATTY 138 3
END

Bus Number	*Bus Name*	*Full Contribution*
253038	*09KILLEN*	*297.64*
253077	*09STUART*	*633.04*
932131	*AC2-020 C*	*0.51*
932132	*AC2-020 E*	*0.82*
932381	*AC2-055 C*	*1.1*
932382	*AC2-055 E*	*1.8*
932421	*AC2-060 C*	*3.91*
932422	*AC2-060 E*	*2.2*
932431	*AC2-061 C*	*3.86*
932432	*AC2-061 E*	*3.91*
932461	*AC2-066 C*	*5.*
932462	*AC2-066 E*	*8.16*
932481	*AC2-068 C*	*2.38*
932482	*AC2-068 E*	*3.9*
932551	*AC2-075 C*	*1.7*
932552	*AC2-075 E*	*0.84*
932641	*AC2-085 C*	*1.85*
932642	*AC2-085 E*	*1.58*
932651	*AC2-087 C*	*2.9*
932652	*AC2-087 E*	*2.3*
932661	*AC2-088 C*	*7.54*
932662	*AC2-088 E*	*6.21*
932841	*AC2-111 C*	*2.06*
932842	*AC2-111 E*	*3.36*
934491	*AD1-073 C*	*0.81*
934492	*AD1-073 E*	*0.42*

935011	*AD1-134*	*7.97*
935031	*AD1-136 C*	*1.06*
935032	*AD1-136 E*	*0.9*
935041	*AD1-140 C1*	*7.47*
935043	*AD1-140 C2*	*0.48*
935042	*AD1-140 E1*	*6.17*
935044	*AD1-140 E2*	*1.47*
936091	*AD2-012 C*	*13.17*
936092	*AD2-012 E*	*8.78*
936251	*AD2-031 C O2*	*2.23*
936252	*AD2-031 E O2*	*3.64*
936281	*AD2-036 C*	*5.08*
936282	*AD2-036 E*	*2.54*
936381	*AD2-048 C*	*5.75*
936382	*AD2-048 E*	*2.87*
936571	*AD2-072 C O2*	*5.23*
936572	*AD2-072 E O2*	*2.56*
936681	*AD2-087 C O2*	*11.1*
936682	*AD2-087 E O2*	*4.99*
937111	*AD2-147 C O2*	*3.86*
937112	*AD2-147 E O2*	*5.33*
937151	*AD2-151 C O2*	*7.2*
937152	*AD2-151 E O2*	*9.95*
LTF	*CARR*	*0.44*
LTF	*CATAWBA*	*0.07*
LTF	*CBM-S1*	*7.96*
LTF	*CBM-W1*	*20.5*
LTF	*CBM-W2*	*43.*
LTF	*CELEVELAND*	*0.13*
LTF	*CIN*	*9.8*
LTF	*G-007*	*1.33*
LTF	*HAMLET*	*0.41*
LTF	*IPL*	*6.13*
LTF	*LGEE*	*2.96*
LTF	*MEC*	*10.19*
LTF	*MECS*	*4.14*
LTF	*O-066*	*8.51*
LTF	*RENSSELAER*	*0.35*
LTF	*ROSETON*	*2.53*
LTF	*ROWAN*	*0.27*
904722	*V4-073E*	*0.15*
902531	*W2-040C*	*0.7*
902532	*W2-040E*	*1.15*
LTF	*WEC*	*1.41*

910512	*X3-002 E*	*0.16*
913222	*Y1-054 E*	*1.79*
914372	*Y2-111 E*	*1.13*
915582	*Y3-080 E*	*0.76*
915662	*Y3-099 E*	*0.16*
915672	*Y3-100 E*	*0.16*
916182	*Z1-065 E*	*0.54*
916272	*Z1-080 E*	*0.48*
918802	*AA1-099 E*	*0.32*
930062	*AB1-014 E*	*13.6*
931181	*AB1-169*	*299.22*
925242	*AB2-178 E*	*1.57*
925921	*AC1-068 C*	*7.87*
925922	*AC1-068 E*	*3.68*
925931	*AC1-069 C*	*7.87*
925932	*AC1-069 E*	*3.68*
925981	*AC1-074 C*	*7.11*
925982	*AC1-074 E*	*3.05*
926061	*AC1-085 C*	*34.38*
926062	*AC1-085 E*	*56.1*
926101	*AC1-089 C*	*4.65*
926102	*AC1-089 E*	*7.58*
926631	*AC1-144 C*	*3.6*
926632	*AC1-144 E*	*1.75*
926691	*AC1-152*	*3.37*
926791	*AC1-165 C*	*7.78*
926792	*AC1-165 E*	*3.77*
926801	*AC1-166 C*	*7.78*
926802	*AC1-166 E*	*3.77*
926851	*AC1-172*	*3.37*
926951	*AC1-182*	*2.8*