Generation Interconnection Impact Study Report

For

PJM Generation Interconnection Request Queue Position AD1-137

Dequine 345 kV

December 2019

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: 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 an Interconnection Customer 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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer 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.

General

Jordan Creek Wind, LLC (Jordan Creek) proposes to install PJM Project #AD1-137, a 500.0 MW (65.0 MW Capacity) wind generating facility in Benton, IN (see Figure 2). The point of interconnection will be a direct connection to AEP's Dequine 345 kV substation (see Figure 1).

The requested in service date is December 18, 2020.

Point of Interconnection

Point of Interconnection (Dequine 345 kV Substation)

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

Cost Summary

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 350,000
Direct Connection Network Upgrades	$ 2,500,000
Non Direct Connection Network Upgrades	$ 600,000
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 54,508,000
Total Costs	**$ 57,958,000**

Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Estimated Cost
345 kV Revenue Metering	$350,000

Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Dequine Station Work:

- Install one (1) new 345 kV circuit breaker and associated bus work. Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.
    - **Estimated Station Cost: $2,500,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Estimated Cost
Upgrade line protection and controls at the expanded Dequine 345 kV substation.	**$600,000**
Total	**$600,000**

Interconnection Customer Requirements

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

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 AD1-137 was evaluated as a 500.0 MW (Capacity 65.0 MW) injection into the Dequine 345 kV substation in the AEP area. Project AD1-137 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-137 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

Contingency Descriptions

Contingency Name	Description
AEP_P1-2_#6472	CONTINGENCY 'AEP_P1-2_#6472' OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217 05DEQUIN 345 243878 05MEADOW 345 1 END
AEP_P1-2_#6490	CONTINGENCY 'AEP_P1-2_#6490' OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217 05DEQUIN 345 243878 05MEADOW 345 2 END
AEP_P1-2_#709	CONTINGENCY 'AEP_P1-2_#709' OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1 END
AEP_P1-2_#8695	CONTINGENCY 'AEP_P1-2_#8695' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878 05MEADOW 345 255205 17REYNOLDS 345 1 END

AEP_P4_#1760_05JEFRSO 765	CONTINGENCY 'AEP_P4_#1760_05JEFRSO 765' OPEN BRANCH FROM BUS 243207 TO BUS 243208 CKT 1 OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 END	/ 243207 05GRNTWN 765 243208 05JEFRSO 765 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1
AEP_P4_#4704_05DEQUIN 345	CONTINGENCY 'AEP_P4_#4704_05DEQUIN 345' OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 END	/ 243217 05DEQUIN 345 243878 05MEADOW 345 1 / 243217 05DEQUIN 345 249525 08WESTWD 345 1
AEP_P4_#6189_05HANG R 765	CONTINGENCY 'AEP_P4_#6189_05HANG R 765' OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 END	/ 242921 05CORNU 765 242924 05HANG R 765 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1
AEP_P4_#6485_05DEQUIN 345	CONTINGENCY 'AEP_P4_#6485_05DEQUIN 345' OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 END	/ 243217 05DEQUIN 345 243878 05MEADOW 345 2 / 243217 05DEQUIN 345 249525 08WESTWD 345 1
AEP_P7-1_#6484	CONTINGENCY 'AEP_P7-1_#6484' OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 END	/ 243217 05DEQUIN 345 243878 05MEADOW 345 1 / 243217 05DEQUIN 345 243878 05MEADOW 345 2

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

Overload		Contingency			Bus				Loading %		Rating		MW	Flowgate
Number	Type	Name	Affected Area	Facility Description	From	To	Circuit	Power Flow	Initial	Final	Type	MVA	Contribution	Appendix
1	DCTL	AEP_P7-1_#6484	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	99.78	101.66	ER	4571	83.91	1

Short Circuit

(Summary of impacted circuit breakers)

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)

Overload		Contingency			Bus				Loading %		Rating		MW	Flowgate
Number	Type	Name	Affected Area	Facility Description	From	To	Circuit	Power Flow	Initial	Final	Type	MVA	Contribution	Appendix
2	LFFB	AEP_P4_#1760_05JEFRSO 765	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	138.17	139.64	ER	2045	32.89	3
3	LFFB	AEP_P4_#6189_05HANG R 765	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	AC	102.44	103.16	ER	2045	59.65	
4	LFFB	AEP_P4_#6485_05DEQUIN 345	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	1	AC	132.36	146.42	ER	1959	274.59	4
5	LFFB	AEP_P4_#4704_05DEQUIN 345	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	2	AC	131.46	145.42	ER	1959	272.65	5

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

None.

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during the Facilities Study Phase.

New System Reinforcements

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

To be determined during the Facilities Study Phase.

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)

1. To resolve the overloads on the Rockport – Jefferson 765 kV line, Jefferson – Clifty 345 kV line, Dequine – Meadowlake 345 kV line #1, and Dequine – Meadowlake 345 kV line #2:

   Build a new 765 kV line from Reynolds to Sullivan (N5034).

   Sullivan – Reynolds 765 kV line: $442 million

   Work at Sullivan Station: $6 million

   Work at Reynolds Station: $16 million

   Total Cost: $464 million

   (3) three to (4) four years to build once CSA is signed.

   The cost allocation is as follows:

Queue	MW contribution	Percentage of Cost	$ cost ($464 M)
X3-028 MTX	1230.5	0.526	244.255
AB1-087	215.2	0.092	42.717
AB1-088	215.2	0.092	42.717
AC1-040	100.0	0.043	19.850
J708	23.3	0.010	4.625
J754	39.0	0.017	7.742
AC2-157	78.24	0.033	15.531
J827	37.14	0.016	7.372
J714	18.0	0.008	3.572
J829	22.3	0.010	4.423
J824	21.5	0.009	4.276
J949	17.1	0.007	3.384
J843	16.0	0.007	3.174
J842	14.8	0.006	2.942
J805	14.7	0.006	2.912
AD1-137	274.6	0.117	54.508

Potential Congestion due to Local Energy Deliverability

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

Overload Number	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
6	N-1	AEP_P1-2_#709	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	AC	105.66	106.54	NR	2045	59.77	
7	N-1	AEP_P1-2_#6490	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	1	AC	130.01	143.76	NR	1959	268.53	
8	N-1	AEP_P1-2_#6472	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	2	AC	129.08	142.72	NR	1959	266.56	
9	N-1	AEP_P1-2_#8695	EP - MISO NIP	5MEADOW-17REYNOLDS 345 kV lin	243878	255205	2	AC	106.01	117.18	NR	2938	283.06	
10	N-1	AEP_P1-2_#709	AEP - AEP	X1-020 TAP-05DUMONT 765 kV line	907040	243206	1	AC	105.16	106.46	NR	4061	78.18	

Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

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:

None

Figure 1: Point of Interconnection (Dequine 345 kV Substation)

Single-Line Diagram

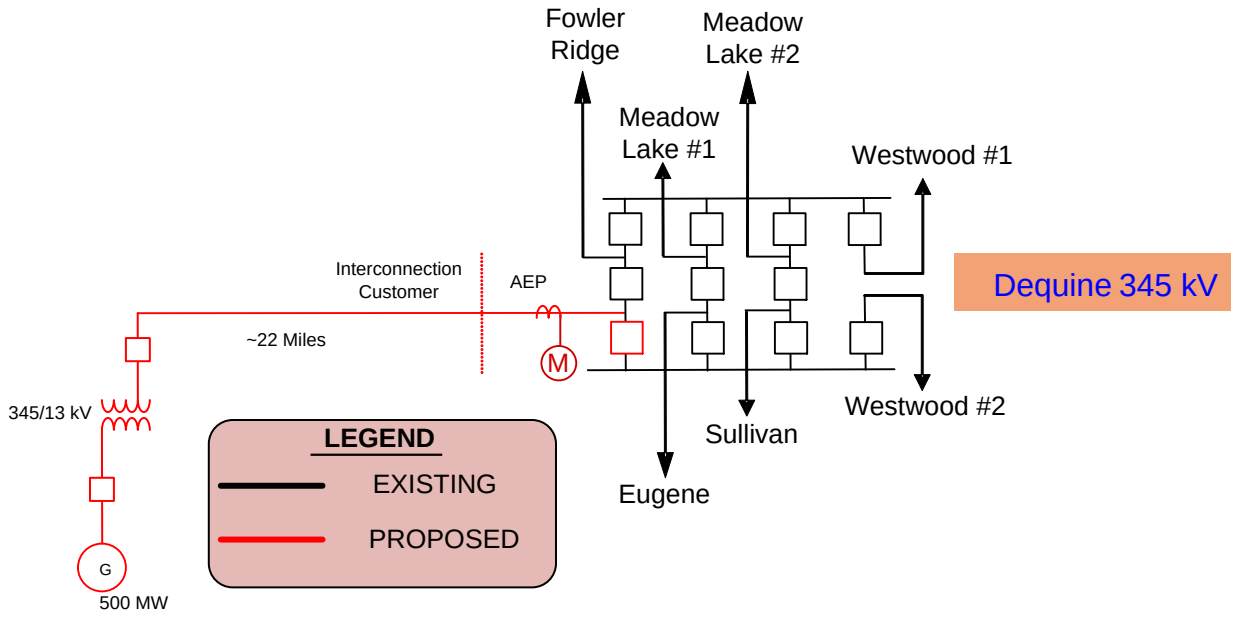
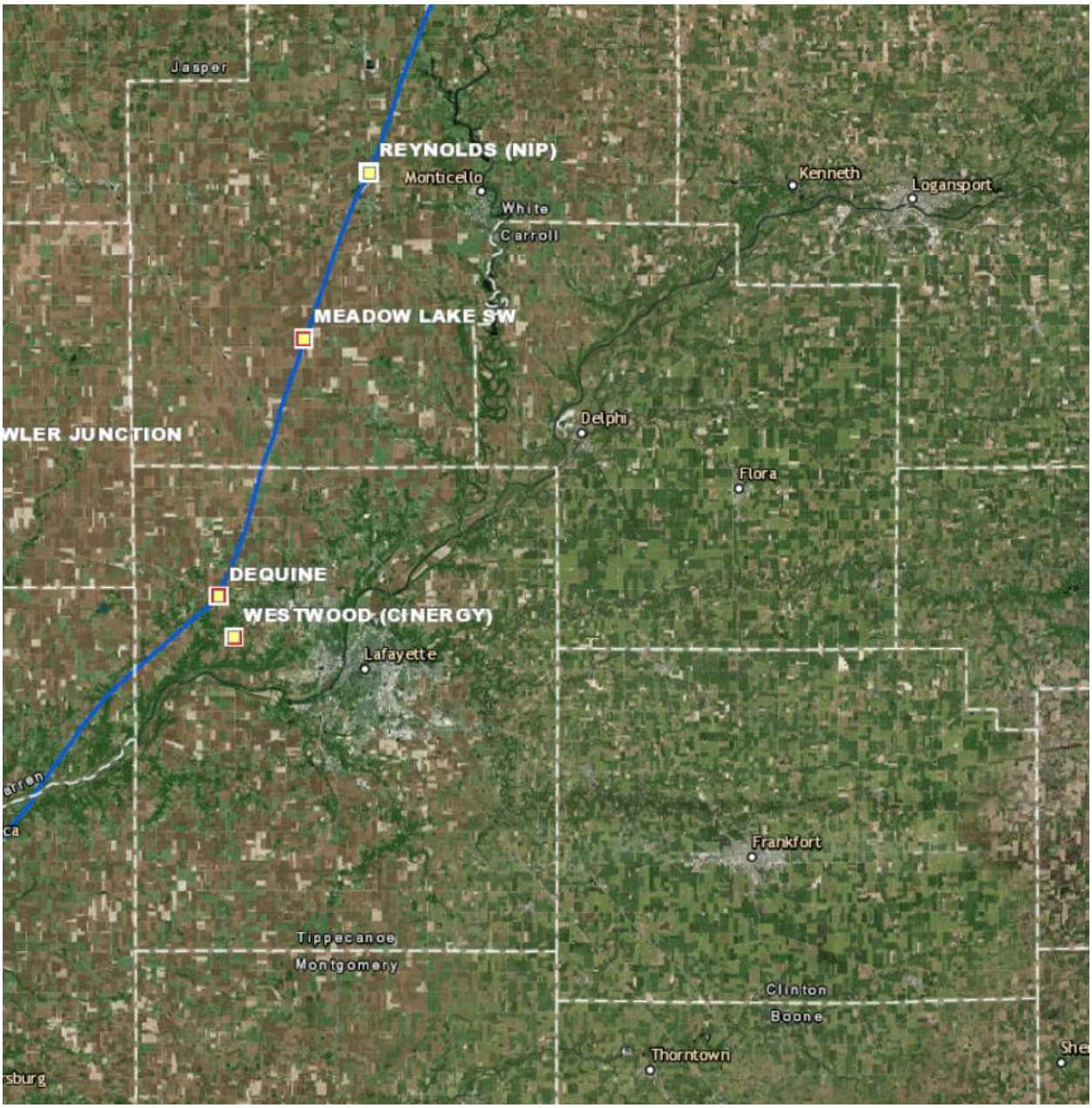


Figure 2: Point of Interconnection (Dequine 345 kV Substation)



Appendices

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 - AEP) The 05ROCKPT-05JEFRSO 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 99.78% to 101.66% (DC power flow) of its emergency rating (4571 MVA) for the tower line contingency outage of 'AEP_P7-1_#6484'. This project contributes approximately 83.91 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#6484'
OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217 05DEQUIN 345 243878 05MEADOW 345 1
OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217 05DEQUIN 345 243878 05MEADOW 345 2
END

Bus Number	Bus Name	Full Contribution
243859	05FR-11G C	0.68
247900	05FR-11G E	13.14
243862	05FR-12G C	0.67
247901	05FR-12G E	12.92
243864	05FR-21G C	0.71
247902	05FR-21G E	13.81
243866	05FR-22G C	0.68
247903	05FR-22G E	13.22
243870	05FR-3G C	1.38
247904	05FR-3G E	26.78
243873	05FR-4G C	1.07
247905	05FR-4G E	20.14
243442	05RKG1	131.55
243443	05RKG2	129.56
933441	AC2-157 C	21.49
933442	AC2-157 E	35.06
LTF	AD1-092	6.31
LTF	AD1-093	10.59
LTF	AD1-094	1.91
935035	AD1-137 C	10.91
935036	AD1-137 E	73
LTF	CARR	0.6
LTF	CBM-S1	19.59
LTF	CBM-S2	3.62
LTF	CBM-W1	39.38
LTF	CBM-W2	186.56
LTF	CIN	35.45
LTF	CLIFTY	28.42
LTF	CPLE	0.39

Bus Number	Bus Name	Full Contribution
LTF	DEARBORN	0.73
LTF	G-007	1.61
LTF	IPL	23.16
981181	J708	120.76
981521	J759	12.03
981531	J762	30.01
981571	J783	11.91
938921	J842 C	5
938922	J842 E	20
938931	J843 C	5.09
938932	J843 E	20.36
939021	J856	11.29
274650	KINCAID ;1U	12.57
274651	KINCAID ;2U	12.52
LTF	LGEE	2.03
LTF	MEC	33.3
LTF	O-066	5.43
LTF	RENSSELAER	0.47
LTF	ROSETON	3.41
LTF	WEC	2.81
900404	X3-028 C	424.08
900405	X3-028 E	565.44
LTF	Z1-043	14.61
930461	AB1-087	155.5
930471	AB1-088	155.5
LTF	AB2-013	8.83
927331	AC1-040 C	23.32
927332	AC1-040 E	38.05

Appendix 3

(AEP - OVEC) The 05JEFRSO-06CLIFTY 345 kV line (from bus 242865 to bus 248000 ckt Z1) loads from 138.17% to 139.64% (DC power flow) of its emergency rating (2045 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#1760_05JEFRSO 765'. This project contributes approximately 32.89 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#1760_05JEFRSO 765'
OPEN BRANCH FROM BUS 243207 TO BUS 243208 CKT 1 / 243207 05GRNTWN 765 243208 05JEFRSO 765 1
OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANGR 765 243208 05JEFRSO 765 1
END

Bus Number	Bus Name	Full Contribution
247900	05FR-11G E	5.15
247901	05FR-12G E	5.07
247902	05FR-21G E	5.41
247903	05FR-22G E	5.18
247904	05FR-3G E	10.5
247905	05FR-4G E	7.89
247906	05MDL-1G E	9.07
247907	05MDL-2G E	4.5
247912	05MDL-3G E	4.7
247913	05MDL-4G E	4.49
243442	05RKG1	87.98
243443	05RKG2	86.64
933441	AC2-157 C	13.33
933442	AC2-157 E	21.74
934051	AD1-031 C O1	1.44
934052	AD1-031 E O1	2.35
934421	AD1-066	0.53
LTF	AD1-092	5.74
LTF	AD1-093	9.75
LTF	AD1-094	1.81
935001	AD1-133 C O1	9.34
935002	AD1-133 E O1	6.23
935035	AD1-137 C	4.28
935036	AD1-137 E	28.62
935141	AD1-148	3.43
274832	ANNAWAN ; 1U	5.39
LTF	BLUEG	16.87
294401	BSHIL;1U E	4.33
294410	BSHIL;2U E	4.33
LTF	CARR	0.43

Bus Number	Bus Name	Full Contribution
293717	O-029 E	2.27
293771	O-035 E	3.19
LTF	O-066	4.06
296308	R-030 C1	1.9
296271	R-030 C2	1.9
296125	R-030 C3	1.92
296309	R-030 E1	7.58
296272	R-030 E2	7.58
296128	R-030 E3	7.68
LTF	RENSSELAER	0.34
LTF	ROSETON	2.45
247943	T-127 E	4.6
LTF	TRIMBLE	3.9
274853	TWINGROVE;U1	9.93
274854	TWINGROVE;U2	9.93
276150	W2-048 E	0.94
905082	W4-005 E	20.44
LTF	WEC	3.17
909052	X2-022 E	13.12
900404	X3-028 C	263.03
900405	X3-028 E	350.7
913222	Y1-054 E	-1.33
915662	Y3-099 E	0.14
915672	Y3-100 E	0.14
LTF	Z1-043	13.86
916182	Z1-065 E	0.37
916272	Z1-080 E	0.3
917501	Z2-087 C	1.49
917502	Z2-087 E	9.95
918802	AA1-099 E	0.2

274890	CAYUG;1U E	6.41
274891	CAYUG;2U E	6.41
LTF	CBM-S1	4.17
LTF	CBM-S2	0.74
LTF	CBM-W1	38.43
LTF	CBM-W2	102.72
LTF	CIN	16.7
LTF	CLIFTY	86.71
274849	CRESCENT ;1U	2.41
LTF	G-007	1.21
LTF	IPL	10.98
981181	J708	52.67
981521	J759	5.62
981531	J762	12.47
981571	J783	5.57
938921	J842 C	2.04
938922	J842 E	8.16
938931	J843 C	2.03
938932	J843 E	8.1
939021	J856	4.82
990901	L-005 E	6.63
LTF	MEC	25.54
LTF	MECS	4.19
293516	O-009 E1	4.22
293517	O-009 E2	2.14
293518	O-009 E3	2.36
293715	O-029 E	4.51
293716	O-029 E	2.47

919221	AA1-146	7.91
919581	AA2-030	7.91
919621	AA2-039 C	1.06
919622	AA2-039 E	7.06
930041	AB1-006 C	1.48
930042	AB1-006 E	9.88
930461	AB1-087	96.44
930471	AB1-088	96.44
LTF	AB2-013	8.13
924041	AB2-047 C O1	1.88
924042	AB2-047 E O1	12.55
924261	AB2-070 C O1	1.79
924262	AB2-070 E O1	12.01
925161	AB2-173	1.41
925242	AB2-178 E	1.43
925581	AC1-033 C	0.71
925582	AC1-033 E	4.75
927331	AC1-040 C	15.01
927332	AC1-040 E	24.49
925771	AC1-053 C	1.8
925772	AC1-053 E	12.07
926821	AC1-168 C	0.54
926822	AC1-168 E	3.62
926841	AC1-171 C	0.61
926842	AC1-171 E	4.1
927201	AC1-214 C	1.03
927202	AC1-214 E	2.72

Appendix 4

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 132.36% to 146.42% (AC power flow) of its emergency rating (1959 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#6485_05DEQUIN 345'. This project contributes approximately 274.59 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#6485_05DEQUIN 345'
OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217 05DEQUIN 345 243878 05MEADOW 345 2
OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN 345 249525 08WESTWD 345 1
END

Bus Number	Bus Name	Full Contribution
243859	05FR-11G C	2.22
247900	05FR-11G E	43
243862	05FR-12G C	2.19
247901	05FR-12G E	42.29
243864	05FR-21G C	2.33
247902	05FR-21G E	45.2
243866	05FR-22G C	2.23
247903	05FR-22G E	43.28
243870	05FR-3G C	4.52
247904	05FR-3G E	87.65
243873	05FR-4G C	3.5
247905	05FR-4G E	65.9
933441	AC2-157 C	10.2
933442	AC2-157 E	16.64
935035	AD1-137 C	35.7
935036	AD1-137 E	238.9
LTF	CARR	0.05
LTF	CBM-S1	9.97
LTF	CBM-S2	4.08
LTF	CBM-W2	91.71
LTF	CIN	23.65
LTF	CPLE	0.82
LTF	DEARBORN	2.46
LTF	G-007A	0.2
LTF	IPL	12.69

Bus Number	Bus Name	Full Contribution
960026	J196 E	4.6
983081	J333	17.46
983091	J334	19.58
940541	J468 C	4.29
940542	J468 E	17.17
940552	J515 E	66.7
938681	J714 C	4.06
938682	J714 E	16.22
981511	J754 C	8.23
981512	J754 E	32.91
938831	J824	24.82
938851	J827	37.62
938861	J829	25.26
939741	J949	19.09
LTF	LGEE	1.68
LTF	MEC	8.44
LTF	O-066A	0.09
LTF	RENSSELAER	0.04
LTF	ROSETON	0.27
LTF	VFT	0.52
900404	X3-028 C	201.24
900405	X3-028 E	268.32
930461	AB1-087	73.79
930471	AB1-088	73.79

Appendix 5

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 131.46% to 145.42% (AC power flow) of its emergency rating (1959 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#4704_05DEQUIN 345'. This project contributes approximately 272.65 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#4704_05DEQUIN 345'
OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217 05DEQUIN 345 243878 05MEADOW 345 1
OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN 345 249525 08WESTWD 345 1
END

Bus Number	Bus Name	Full Contribution
243859	05FR-11G C	2.2
247900	05FR-11G E	42.7
243862	05FR-12G C	2.17
247901	05FR-12G E	41.99
243864	05FR-21G C	2.32
247902	05FR-21G E	44.88
243866	05FR-22G C	2.21
247903	05FR-22G E	42.97
243870	05FR-3G C	4.49
247904	05FR-3G E	87.03
243873	05FR-4G C	3.47
247905	05FR-4G E	65.44
933441	AC2-157 C	10.12
933442	AC2-157 E	16.52
935035	AD1-137 C	35.44
935036	AD1-137 E	237.21
LTF	CARR	0.05
LTF	CBM-S1	9.9
LTF	CBM-S2	4.05
LTF	CBM-W2	91.07
LTF	CIN	23.48
LTF	CPLE	0.82
LTF	DEARBORN	2.44
LTF	G-007A	0.2
LTF	IPL	12.6

Bus Number	Bus Name	Full Contribution
960026	J196 E	4.57
983081	J333	17.34
983091	J334	19.44
940541	J468 C	4.26
940542	J468 E	17.05
940552	J515 E	66.22
938681	J714 C	4.03
938682	J714 E	16.11
981511	J754 C	8.17
981512	J754 E	32.67
938831	J824	24.64
938851	J827	37.35
938861	J829	25.09
939741	J949	18.96
LTF	LGEE	1.67
LTF	MEC	8.38
LTF	O-066A	0.09
LTF	RENSSELAER	0.04
LTF	ROSETON	0.27
LTF	VFT	0.52
900404	X3-028 C	199.82
900405	X3-028 E	266.42
930461	AB1-087	73.27
930471	AB1-088	73.27