Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-031

"Martinsville-Wilmington 69 kV"

19 MW Capacity / 50 MW Energy

August 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 users, 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), has proposed a solar generating facility located at 776-780 Township Hwy 190, Martinsville, OH 45146. The installed facilities will have a total capability of **50 MW** with **19 MW** of this output being recognized by PJM as capacity. The expected Commercial Operation Date for this project is **Q2-Q3 of 2020**. **This study does not imply a Dayton Power & Light Company (DP&L) commitment to this in-service date.**

Primary Point of Interconnection

The physical interconnection point of **AD2-031 "Martinsville-Wilmington 69 kV**" will be where the attachment hardware interconnects with the tap switch to the Martinsville-Wilmington 69 kV line. This is the primary Point of Interconnection (POI) chosen by the IC. The interconnection scope of work and costs in this report are based off of the Primary Point of Interconnection (Option 1).

See **Attachment 1** for a one line of the physical interconnection point for Option 1.

Secondary Point of Interconnection

The IC requested that a secondary POI be reviewed for network impacts (Option 2). The secondary interconnection chosen was a direct line into Martinsville 69 kV Substation.

This report does not provide costs for the physical interconnection of Option 2. It was just analyzed for network impacts to the system. Results are shown in the "Network Impacts – Option 2" section of this report.

Cost Summary: Martinsville-Wilmington 69 kV Line Tap

The **AD2-031** project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 60,000
Direct Connection Network Upgrades	$ 100,000
Non Direct Connection Network Upgrades	$ 155,000
Total Costs	**$ 315,000**

In addition to the costs for the physical interconnection point above, the **AD2-031** project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 0
Previously Identified Upgrades	$ 115,800,000[1]
Total Costs	**$ 115,800,000**

[1]See "Contribution to Previously Identified System Reinforcements" section below for details on this cost. There is a range of possible costs for these upgrades from $35,266,000 to $155,800,000. Higher value is shown in this table. This project may have cost allocation for the work identified in this section. Cost allocation will be identified in the System Impact Study phase.

Martinsville-Wilmington 69 kV Line Physical Interconnection

Attachment Facilities

This report assumes that the Interconnection Customer will build and own its own generator lead line up to the point of interconnection.

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	Total Cost
Tap the Martinsville-Wilmington 69 kV line and install a three-way phase switch to interconnect the AD2-031 project. (One switch covering the generator lead line is considered an Attachment Facility).	$ 60,000
Total Attachment Facility Costs	**$ 60,000**

The substation Attachment Facility cost estimate for the AD2-031 project is approximately **$60,000**. Dayton Power and Light plans to tap the Martinsville-Wilmington 69kV line and install a three-way phase over phase switch to interconnect the AD2-031 Martinsville-Wilmington 69 kV Solar Project. The three-way switch will be equipped with the necessary communication systems to facilitate remote supervisory control of the switch and status monitoring. One switch of the three-way switch will be considered to be an Attachment Facility (the switch covering the generator lead line). DP&L will install 69kV metering adjacent to the switch.

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.

Description	Total Cost
Tap the Martinsville-Wilmington 69 kV line and install a three-way phase switch to interconnect the AD2-031 project (Two network switches of the three-way switch are considered Direct Connection Facilities).	$ 100,000
Total Direct Connection Facility Costs	**$ 100,000**

The substation direct connection cost estimate for the AD2-031 project is approximately **$100,000**. Dayton Power and Light plans to tap the Martinsville-Wilmington 69kV line and install a three-way phase over phase switch to interconnect the AD2-031 Martinsville-Wilmington Solar Project. The three-way switch will be equipped with the necessary communication systems to facilitate remote supervisory control of the switch and status

monitoring. Two switches of the three-way switch will be considered to be Direct Connection facilities (the two switches that are in network with the main circuit).

Non-Direct Connection Cost Estimate: Martinsville-Wilmington 69 kV Line Tap

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	Total Cost
Protection System changes at Wilmington (Dayton)	$ 65,000
Protection System changes at New Vienna (Dayton)	$ 65,000
Protection System changes at Highland (AEP)	$ 25,000
Total Non-Direct Connection Facility Costs	**$ 155,000**

The substation non-direct connection cost estimate for the AD2-031 project is approximately **$155,000**. Protection system changes will need to be made at Dayton's Wilmington and New Vienna Substations and AEP's Highland Substation to facilitate the interconnection of the new generation.

Interconnection Customer Requirements

Requirement from the PJM Open Access Transmission Tariff:

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.

Dayton Interconnection Requirements

The Dayton Power and Light Company (DP&L) has prepared this Facilities Connection Requirements document to ensure compliance with North American Electric Reliability Council (NERC) Reliability Standards and applicable Regional Reliability Organization, sub regional, Power Pool, and individual Transmission Owner planning criteria and facility connection requirements in compliance to NERC Standard FAC-001-2. These connection requirements apply to all generation facilities, transmission facilities, and end-users connecting to the DP&L transmission system. Detailed information outlining DP&L interconnection requirements can be reviewed utilizing the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx

Schedule

Based on the extent of the Dayton primary Non-Direct Connection and Attachment upgrades required to support the AD2-031 generation project, it is expected to take a minimum of **12 months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation subject to market conditions and vendor lead times. This includes the requirement for the Interconnection Customer to make a preliminary payment to Dayton which funds the first three months of engineering design that is related to the construction of the Non-Direct Connection facilities. It assumes that there will be no environmental or permitting issues to implement the Non-Direct Connection upgrades for this project and that all system outages will be allowed when requested.

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.

Dayton Metering Requirements

The Interconnection Customer will be required to comply with all Dayton Revenue Metering Requirements for Generation Interconnection Customers as outlined in the link below. The Revenue Metering Requirements may be found within the Dayton Power & Light Co. "Requirements for the Connection of Facilities to the Dayton Power & Light Co. Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-dayton/dayton-facilities-connection-requirements.ashx

http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts

Option 1

The Queue Project AD2-031 was evaluated as a 50.0 MW (Capacity 19.0 MW) injection tapping the Martinsville to Wilmington 69kV line in the Dayton area. Project AD2-031 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-031 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
AEP_P1-2_#5891	CONTINGENCY 'AEP_P1-2_#5891' OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
AEP_P4_#8108_05HILLSB 138	CONTINGENCY 'AEP_P4_#8108_05HILLSB 138' OPEN BRANCH FROM BUS 243019 TO BUS 932430 CKT 1 / 243019 05HILLSB 138 932430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
AEP_P4_#8109_05HILLSB 138	CONTINGENCY 'AEP_P4_#8109_05HILLSB 138' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1 END
AEP_P7-1_#7981_A	CONTINGENCY 'AEP_P7-1_#7981_A' OPEN BRANCH FROM BUS 243019 TO BUS 932430 CKT 1 / 243019 05HILLSB 138 932430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
AEP_P7-1_#7981_B	CONTINGENCY 'AEP_P7-1_#7981_B' OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
DAY_P1_160_B3	CONTINGENCY 'DAY_P1_160_B3' OPEN BRANCH FROM BUS 253110 TO BUS 253100 CKT 1 / 253110 09ADKINS 345 253100 09ATLNTA 345 1 OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100 09ATLNTA 345 253099 09ATLNTA 69.0 1

	END
DAY_P1_5891_B2_TOR607	CONTINGENCY 'DAY_P1_5891_B2_TOR607' OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
DAY_P1_762_B2_TOR8072	CONTINGENCY 'DAY_P1_762_B2_TOR8072' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 END
DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381	CONTINGENCY 'DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381' OPEN BUS 249995 END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

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.)

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 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
1	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	122.21	123.31	ER	185	4.52	1
2	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	100.07	101.17	ER	185	4.52	
3	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	100.07	101.17	ER	185	4.52	
4	LFFB	AEP_P4_#8109_05HILLSB 138	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	135.33	136.36	ER	184	4.23	2
5	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	128.43	129.61	ER	173	4.52	3

6	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	104.76	105.94	ER	173	4.52	
7	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	104.76	105.94	ER	173	4.52	
8	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	127.44	128.22	ER	185	3.22	4
9	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	109.74	110.52	ER	185	3.22	
10	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	109.74	110.52	ER	185	3.22	
11	DCTL	AEP_P7-1_#7981_B	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	126.14	126.92	ER	185	3.22	5
12	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	108.44	109.23	ER	185	3.22	
13	DCTL	AEP_P7-1_#7981_A	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	108.44	109.23	ER	185	3.22	
14	LFFB	AEP_P4_#8109_05HILLSB 138	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	137.48	138.44	ER	198	4.23	6
15	LFFB	AEP_P4_#8109_05HILLSB 138	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	161.72	162.75	ER	184	4.23	7
16	DCTL	AEP_P7-1_#7981_B	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	173.59	174.76	ER	173	4.52	8
17	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	149.91	151.09	ER	173	4.52	
18	DCTL	AEP_P7-1_#7981_A	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	149.91	151.09	ER	173	4.52	

Note: Please see Attachment 2 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper Appendix in the Attachment. For each overloaded facility, there will be only one Flowgate Appendix for the contingency that results in the highest facility loading.

Steady-State Voltage Requirements

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

To be determined in the Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

None

Affected System Analysis & Mitigation

(Summary of impacts on systems external to PJM)

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.

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
19	N-1	AEP_P1-2_#5891	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	126.81	127.54	ER	184	3
20	Non	Non	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	119.25	120	NR	159	2.62
21	N-1	DAY_P1_160_B3	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	119.58	120.98	ER	90	2.81
22	N-1	DAY_P1_762_B2_TOR8072	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	174.83	177.14	ER	50	2.56
23	N-1	DAY_P1_5891_B2_TOR607	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	124.11	124.79	ER	198	3
24	Non	Non	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	99.62	100.22	NR	198	2.62
25	N-1	AEP_P1-2_#5891	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	147.96	148.7	ER	184	3
26	Non	Non	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	140.95	141.69	NR	159	2.62
27	N-1	DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	132.87	133.87	ER	173	3.86
28	Non	Non	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	101.53	102.35	NR	173	3.15

Light Load Analysis - 2021

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

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 in the Impact Study phase.

Summer Peak Load Flow Analysis Reinforcements

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

None

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)

(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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1, 2, 3	05HILLSB-05SINKG8 138 kV line	(AEP) A Sag Study will be required on the 4.355 mile section of line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $6.5 million (complete line reconductor/rebuild required). The Sag Study is expected to take 6-12 months to complete. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.	Pending	**$138,000 to $6,500,000**
4	05HILLSB-AC2-061 TAP 138 kV line	(AEP) A Sag Study will be required on the 5 mile section of line to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $7.5 million (complete line reconductor/rebuild required) The Sag Study is expected to take 6-12 months to complete. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.	Pending	**$138,000 to $7,500,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
5, 6, 7	05SINKG8-AC2-064 TAP 138 kV line	(AEP) An engineering study will need to be conducted to determine if the CT Thermal limits settings can be adjusted to mitigate the overload. Cost Estimate: $50k - $800k A Sag Study will be required on the 5 mile section of line to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $7.5 million (complete line reconductor/rebuild required) Sag study: 6 to 12 months. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.	Pending	**$188,000 to $8,300,000**
8, 9 10	05WLDCAT-05EMERSS 138 kV line	(AEP) A Sag Study will be required on the 1.3 mile section of line to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $1.5 million (complete line reconductor/rebuild required) The Sag Study is expected to take 6-12 months to complete. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.	Pending	**$138,000 to $1,500,000**
11, 12, 13	05EMERSS-4KENTON 138 kV line	(AEP) A Sag Study will be required on the 23.52 mile section of line to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $34.5 million (complete line reconductor/rebuild required) Sag study: 6 to 12 months. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement. LGEE: The external (i.e. Non-PJM) Transmission Owner, LGEE, will not evaluate this violation until the impact study phase.	Pending	**$138,000 to $34,500,000**
14	08CLINCO-08WARRN1 138 kV line	(DEOK) DEOK will rebuild the 17 mile long line between Clinton County and Warren substations with 954ACSR and light duty steel poles. Cost estimate is $34 million. The project can be completed two years from the signing of the ISA.	Pending	**$34,000,000**
15	AC2-061 TAP-08CLINCO 138 kV line	(AEP) A Sag Study will be required on the 5 mile section of line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $7.5 million (complete line reconductor/rebuild required) Sag study: 6 to 12 months. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement. (DEOK) AC2-061 does not connect in DEOK territory. DEOK owns the first 2.8 miles of the line outside Clinton County substation with the remainder being owned by AEP. DEOK section of the line is rated at A/B/C = 301/301/301MVA. The limit is on the AEP side.	Pending	**$138,000 to $7,500,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
16, 17 , 18	AC2-064 TAP-05MILLBR 138 kV line	(AEP) An engineering study will need to be conducted to determine if the CT Thermal limits settings can be adjusted to mitigate the overload. Cost Estimate: $50k - $800k A Sag Study will be required on the 9.5 mile section of line to mitigate the overload. Depending on the sag study results, cost for this upgrade is expected to be between $138,000 (no remediations required just sag study) and $15 million (complete line reconductor/rebuild required) Replace Risers (Limiting Element: Sub Conductor 795 AAC, 37 Str); Estimated Cost: $200,000 Sag study: 6 to 12 months. Rebuild. The standard time required for construction differs from state to state. An Approximate construction would be 36 to 48 months after signing an interconnection agreement.	Pending	**$388,000 to $16,000,000**
Total				**$35,266,000 to $115,800,000**

Light Load Load Flow Analysis Reinforcements

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

None

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

Network Impacts

Option 2

The Queue Project AD2-031 was evaluated as a 50.0 MW (Capacity 19.0 MW) injection at the Martinsville 69kV substation in the Dayton area. Project AD2-031 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-031 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

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AEP_P4_#8108_05HILLSB 138	CONTINGENCY 'AEP_P4_#8108_05HILLSB 138' OPEN BRANCH FROM BUS 243019 TO BUS 932430 CKT 1 / 243019 05HILLSB 138 932430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
AEP_P4_#8109_05HILLSB 138	CONTINGENCY 'AEP_P4_#8109_05HILLSB 138' OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1 END
AEP_P7-1_#7981_A	CONTINGENCY 'AEP_P7-1_#7981_A' OPEN BRANCH FROM BUS 243019 TO BUS 932430 CKT 1 / 243019 05HILLSB 138 932430 AC2-061 TAP 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
AEP_P7-1_#7981_B	CONTINGENCY 'AEP_P7-1_#7981_B' OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
DAY_P1_160_B3	CONTINGENCY 'DAY_P1_160_B3' OPEN BRANCH FROM BUS 253110 TO BUS 253100 CKT 1 / 253110 09ADKINS 345 253100 09ATLNTA 345 1 OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100 09ATLNTA 345 253099 09ATLNTA 69.0 1

	END
DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381	CONTINGENCY 'DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381' OPEN BUS 249995 END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

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.)

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 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
1	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	122.21	124.92	ER	185	5.02	1
2	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	100.07	102.79	ER	185	5.02	
3	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	100.07	102.79	ER	185	5.02	
4	LFFB	AEP_P4_#8109_05HILLSB 138	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	135.33	136.5	ER	184	4.77	2
5	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	128.43	131.33	ER	173	5.02	3
6	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	104.76	107.66	ER	173	5.02	
7	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05SINKG8-AC2-064 TAP 138 kV line	243102	932450	1	DC	104.76	107.66	ER	173	5.02	
8	DCTL	AEP_P7-1_#7981_B	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	127.44	128.32	ER	185	3.65	4
9	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	109.74	110.63	ER	185	3.65	
10	DCTL	AEP_P7-1_#7981_A	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	109.74	110.63	ER	185	3.65	
11	DCTL	AEP_P7-1_#7981_B	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	126.14	127.03	ER	185	3.65	5

12	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	108.44	109.33	ER	185	3.65	
13	DCTL	AEP_P7-1_#7981_A	AEP - LGEE	05EMERSS-4KENTON 138 kV line	247034	324267	1	DC	108.44	109.33	ER	185	3.65	
14	LFFB	AEP_P4_#8109_05HILLSB 138	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	137.48	138.57	ER	198	4.77	6
15	LFFB	AEP_P4_#8109_05HILLSB 138	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	161.72	162.89	ER	184	4.77	7
16	DCTL	AEP_P7-1_#7981_B	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	173.59	176.49	ER	173	5.02	8
17	LFFB	AEP_P4_#8108_05HILLSB 138	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	149.91	152.82	ER	173	5.02	
18	DCTL	AEP_P7-1_#7981_A	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	149.91	152.82	ER	173	5.02	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper Appendix in the Attachment. For each overloaded facility, there will be only one Flowgate Appendix for the contingency that results in the highest facility loading.

Steady-State Voltage Requirements

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

To be determined in the Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

None

Affected System Analysis & Mitigation

(Summary of impacts on systems external to PJM)

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.

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
19	N-1	AEP_P1-2_#5891	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	126.81	127.64	ER	184	3.42
20	Non	Non	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	932430	1	DC	119.25	120.09	NR	159	2.96
21	N-1	DAY_P1_160_B3	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	119.58	121.09	ER	90	3.03
22	N-1	AEP_P1-2_#5891	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	124.11	124.89	ER	198	3.42
23	Non	Non	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	99.62	100.29	NR	198	2.96
24	N-1	AEP_P1-2_#5891	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	147.96	148.8	ER	184	3.42
25	Non	Non	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	140.95	141.79	NR	159	2.96
26	N-1	DEO&K P1-* P2-1 WARREN-CLINTONCO-HILLSBORO 2381	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	132.87	133.97	ER	173	4.26
27	Non	Non	AEP - AEP	AC2-064 TAP-05MILLBR 138 kV line	932450	243042	1	DC	101.53	102.42	NR	173	3.45

Light Load Analysis - 2021

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Attachment 1. AD2-031 ‘Martinsville-Wilmington 69 kV’
One Line Diagram

Attachment 2.

Flowgate Appendices – Option 1

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 05HILLSB-05SINKG8 138 kV line (from bus 243019 to bus 243102 ckt 1) loads from 122.21% to 123.31% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 4.52 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O1*	*1.72*
936252	*AD2-031 E O1*	*2.8*
LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*

LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*

Appendix 2

(AEP - DEO&K) The 05HILLSB-AC2-061 TAP 138 kV line (from bus 243019 to bus 932430 ckt 1) loads from 135.33% to 136.36% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.23 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O1*	*1.61*
936252	*AD2-031 E O1*	*2.63*
LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*

LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*
LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*

LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*2.17*
918802	*AA1-099 E*	*1.45*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 3

(AEP - AEP) The 05SINKG8-AC2-064 TAP 138 kV line (from bus 243102 to bus 932450 ckt 1) loads from 128.43% to 129.61% (**DC power flow**) of its emergency rating (173 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 4.52 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O1*	*1.72*
936252	*AD2-031 E O1*	*2.8*
LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*

LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*

Appendix 4

(AEP - AEP) The 05WLDCAT-05EMERSS 138 kV line (from bus 246946 to bus 247034 ckt 1) loads from 127.44% to 128.22% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 3.22 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.47*
932132	*AC2-020 E*	*0.76*
932381	*AC2-055 C*	*1.16*
932382	*AC2-055 E*	*1.9*
932421	*AC2-060 C*	*4.12*
932422	*AC2-060 E*	*2.32*
932431	*AC2-061 C*	*16.26*
932432	*AC2-061 E*	*16.48*
932451	*AC2-064 C*	*9.53*
932452	*AC2-064 E*	*6.35*
932651	*AC2-087 C*	*3.05*
932652	*AC2-087 E*	*2.42*
934491	*AD1-073 C*	*0.85*
934492	*AD1-073 E*	*0.44*
936091	*AD2-012 C*	*58.59*
936092	*AD2-012 E*	*39.06*
936251	*AD2-031 C O1*	*1.23*
936252	*AD2-031 E O1*	*2.*

LTF	*AMIL*	*0.1*
LTF	*BAYOU*	*0.32*
LTF	*BIG_CAJUN1*	*0.49*
LTF	*BIG_CAJUN2*	*0.98*
LTF	*BLUEG*	*1.25*
LTF	*CALDERWOOD*	*0.15*
LTF	*CANNELTON*	*0.17*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-N*	*0.02*
LTF	*CELEVELAND*	*0.07*
LTF	*CHEOAH*	*0.13*
LTF	*CHILHOWEE*	*0.05*
LTF	*CHOCTAW*	*0.33*
LTF	*CLIFTY*	*1.3*
LTF	*COTTONWOOD*	*1.29*
LTF	*DEARBORN*	*0.06*
LTF	*EDWARDS*	*0.15*
LTF	*ELMERSMITH*	*0.49*
LTF	*FARMERCITY*	*0.11*
LTF	*G-007A*	*0.27*
LTF	*GIBSON*	*0.29*
LTF	*HAMLET*	*0.05*
LTF	*MORGAN*	*0.55*
LTF	*NEWTON*	*0.51*
LTF	*NYISO*	*0.37*
LTF	*O-066A*	*0.13*

LTF	*PRAIRIE*	*0.91*
LTF	*ROWAN*	*0.03*
LTF	*SANTEETLA*	*0.04*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.19*
LTF	*TILTON*	*0.23*
LTF	*TRIMBLE*	*0.24*
LTF	*TVA*	*0.26*
LTF	*UNIONPOWER*	*0.13*
LTF	*VFT*	*0.72*
924371	*AB2-085 C O1*	*6.94*
924372	*AB2-085 E O1*	*3.27*
926101	*AC1-089 C*	*24.2*
926102	*AC1-089 E*	*39.48*
926631	*AC1-144 C*	*16.01*
926632	*AC1-144 E*	*7.78*

Appendix 5

(AEP - LGEE) The 05EMERSS-4KENTON 138 kV line (from bus 247034 to bus 324267 ckt 1) loads from 126.14% to 126.92% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 3.22 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.47*
932132	*AC2-020 E*	*0.76*
932381	*AC2-055 C*	*1.16*
932382	*AC2-055 E*	*1.9*
932421	*AC2-060 C*	*4.12*
932422	*AC2-060 E*	*2.32*
932431	*AC2-061 C*	*16.26*
932432	*AC2-061 E*	*16.48*
932451	*AC2-064 C*	*9.53*
932452	*AC2-064 E*	*6.35*
932651	*AC2-087 C*	*3.05*
932652	*AC2-087 E*	*2.42*
934491	*AD1-073 C*	*0.85*
934492	*AD1-073 E*	*0.44*
936091	*AD2-012 C*	*58.59*
936092	*AD2-012 E*	*39.06*
936251	*AD2-031 C O1*	*1.23*
936252	*AD2-031 E O1*	*2.*

LTF	*AMIL*	*0.1*
LTF	*BAYOU*	*0.32*
LTF	*BIG_CAJUN1*	*0.49*
LTF	*BIG_CAJUN2*	*0.98*
LTF	*BLUEG*	*1.25*
LTF	*CALDERWOOD*	*0.15*
LTF	*CANNELTON*	*0.17*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-N*	*0.02*
LTF	*CELEVELAND*	*0.07*
LTF	*CHEOAH*	*0.13*
LTF	*CHILHOWEE*	*0.05*
LTF	*CHOCTAW*	*0.33*
LTF	*CLIFTY*	*1.3*
LTF	*COTTONWOOD*	*1.29*
LTF	*DEARBORN*	*0.06*
LTF	*EDWARDS*	*0.15*
LTF	*ELMERSMITH*	*0.49*
LTF	*FARMERCITY*	*0.11*
LTF	*G-007A*	*0.27*
LTF	*GIBSON*	*0.29*
LTF	*HAMLET*	*0.05*
LTF	*MORGAN*	*0.55*
LTF	*NEWTON*	*0.51*
LTF	*NYISO*	*0.37*
LTF	*O-066A*	*0.13*

LTF	*PRAIRIE*	*0.91*
LTF	*ROWAN*	*0.03*
LTF	*SANTEETLA*	*0.04*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.19*
LTF	*TILTON*	*0.23*
LTF	*TRIMBLE*	*0.24*
LTF	*TVA*	*0.26*
LTF	*UNIONPOWER*	*0.13*
LTF	*VFT*	*0.72*
924371	*AB2-085 C O1*	*6.94*
924372	*AB2-085 E O1*	*3.27*
926101	*AC1-089 C*	*24.2*
926102	*AC1-089 E*	*39.48*
926631	*AC1-144 C*	*16.01*
926632	*AC1-144 E*	*7.78*

Appendix 6

(DEO&K - DEO&K) The 08CLINCO-08WARRN1 138 kV line (from bus 249995 to bus 250122 ckt 1) loads from 137.48% to 138.44% (**DC power flow**) of its emergency rating (198 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.23 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932431	*AC2-061 C*	*24.16*
932432	*AC2-061 E*	*24.49*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O1*	*1.61*
936252	*AD2-031 E O1*	*2.63*

LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*
LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*

LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*
LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*3.83*
918802	*AA1-099 E*	*2.55*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 7

(DEO&K - DEO&K) The AC2-061 TAP-08CLINCO 138 kV line (from bus 932430 to bus 249995 ckt 1) loads from 161.72% to 162.75% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.23 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932431	*AC2-061 C*	*24.16*
932432	*AC2-061 E*	*24.49*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O1*	*1.61*
936252	*AD2-031 E O1*	*2.63*

LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*
LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*

LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*
LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*2.17*
918802	*AA1-099 E*	*1.45*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 8

(AEP - AEP) The AC2-064 TAP-05MILLBR 138 kV line (from bus 932450 to bus 243042 ckt 1) loads from 173.59% to 174.76% (**DC power flow**) of its emergency rating (173 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 4.52 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932451	*AC2-064 C*	*47.29*
932452	*AC2-064 E*	*31.53*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O1*	*1.72*
936252	*AD2-031 E O1*	*2.8*

LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*

Attachment 3.

Flowgate Appendices – Option 2

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 05HILLSB-05SINKG8 138 kV line (from bus 243019 to bus 243102 ckt 1) loads from 122.21% to 124.92% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 5.02 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O2*	*1.91*
936252	*AD2-031 E O2*	*3.11*
LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*

LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*

Appendix 2

(AEP - DEO&K) The 05HILLSB-AC2-061 TAP 138 kV line (from bus 243019 to bus 932430 ckt 1) loads from 135.33% to 136.5% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.77 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O2*	*1.81*
936252	*AD2-031 E O2*	*2.96*
LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*

LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*
LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*

LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*2.17*
918802	*AA1-099 E*	*1.45*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 3

(AEP - AEP) The 05SINKG8-AC2-064 TAP 138 kV line (from bus 243102 to bus 932450 ckt 1) loads from 128.43% to 131.33% (**DC power flow**) of its emergency rating (173 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 5.02 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O2*	*1.91*
936252	*AD2-031 E O2*	*3.11*
LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*

LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*

Appendix 4

(AEP - AEP) The 05WLDCAT-05EMERSS 138 kV line (from bus 246946 to bus 247034 ckt 1) loads from 127.44% to 128.32% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 3.65 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.47*
932132	*AC2-020 E*	*0.76*
932381	*AC2-055 C*	*1.16*
932382	*AC2-055 E*	*1.9*
932421	*AC2-060 C*	*4.12*
932422	*AC2-060 E*	*2.32*
932431	*AC2-061 C*	*16.26*
932432	*AC2-061 E*	*16.48*
932451	*AC2-064 C*	*9.53*
932452	*AC2-064 E*	*6.35*
932651	*AC2-087 C*	*3.05*
932652	*AC2-087 E*	*2.42*
934491	*AD1-073 C*	*0.85*
934492	*AD1-073 E*	*0.44*
936091	*AD2-012 C*	*58.59*
936092	*AD2-012 E*	*39.06*
936251	*AD2-031 C O2*	*1.39*
936252	*AD2-031 E O2*	*2.26*

LTF	*AMIL*	*0.1*
LTF	*BAYOU*	*0.32*
LTF	*BIG_CAJUN1*	*0.49*
LTF	*BIG_CAJUN2*	*0.98*
LTF	*BLUEG*	*1.25*
LTF	*CALDERWOOD*	*0.15*
LTF	*CANNELTON*	*0.17*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-N*	*0.02*
LTF	*CELEVELAND*	*0.07*
LTF	*CHEOAH*	*0.13*
LTF	*CHILHOWEE*	*0.05*
LTF	*CHOCTAW*	*0.33*
LTF	*CLIFTY*	*1.3*
LTF	*COTTONWOOD*	*1.29*
LTF	*DEARBORN*	*0.06*
LTF	*EDWARDS*	*0.15*
LTF	*ELMERSMITH*	*0.49*
LTF	*FARMERCITY*	*0.11*
LTF	*G-007A*	*0.27*
LTF	*GIBSON*	*0.29*
LTF	*HAMLET*	*0.05*
LTF	*MORGAN*	*0.55*
LTF	*NEWTON*	*0.51*
LTF	*NYISO*	*0.37*
LTF	*O-066A*	*0.13*

LTF	*PRAIRIE*	*0.91*
LTF	*ROWAN*	*0.03*
LTF	*SANTEETLA*	*0.04*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.19*
LTF	*TILTON*	*0.23*
LTF	*TRIMBLE*	*0.24*
LTF	*TVA*	*0.26*
LTF	*UNIONPOWER*	*0.13*
LTF	*VFT*	*0.72*
924371	*AB2-085 C O1*	*6.94*
924372	*AB2-085 E O1*	*3.27*
926101	*AC1-089 C*	*24.2*
926102	*AC1-089 E*	*39.48*
926631	*AC1-144 C*	*16.01*
926632	*AC1-144 E*	*7.78*

Appendix 5

(AEP - LGEE) The 05EMERSS-4KENTON 138 kV line (from bus 247034 to bus 324267 ckt 1) loads from 126.14% to 127.03% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 3.65 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.47*
932132	*AC2-020 E*	*0.76*
932381	*AC2-055 C*	*1.16*
932382	*AC2-055 E*	*1.9*
932421	*AC2-060 C*	*4.12*
932422	*AC2-060 E*	*2.32*
932431	*AC2-061 C*	*16.26*
932432	*AC2-061 E*	*16.48*
932451	*AC2-064 C*	*9.53*
932452	*AC2-064 E*	*6.35*
932651	*AC2-087 C*	*3.05*
932652	*AC2-087 E*	*2.42*
934491	*AD1-073 C*	*0.85*
934492	*AD1-073 E*	*0.44*
936091	*AD2-012 C*	*58.59*
936092	*AD2-012 E*	*39.06*
936251	*AD2-031 C O2*	*1.39*
936252	*AD2-031 E O2*	*2.26*

LTF	*AMIL*	*0.1*
LTF	*BAYOU*	*0.32*
LTF	*BIG_CAJUN1*	*0.49*
LTF	*BIG_CAJUN2*	*0.98*
LTF	*BLUEG*	*1.25*
LTF	*CALDERWOOD*	*0.15*
LTF	*CANNELTON*	*0.17*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-N*	*0.02*
LTF	*CELEVELAND*	*0.07*
LTF	*CHEOAH*	*0.13*
LTF	*CHILHOWEE*	*0.05*
LTF	*CHOCTAW*	*0.33*
LTF	*CLIFTY*	*1.3*
LTF	*COTTONWOOD*	*1.29*
LTF	*DEARBORN*	*0.06*
LTF	*EDWARDS*	*0.15*
LTF	*ELMERSMITH*	*0.49*
LTF	*FARMERCITY*	*0.11*
LTF	*G-007A*	*0.27*
LTF	*GIBSON*	*0.29*
LTF	*HAMLET*	*0.05*
LTF	*MORGAN*	*0.55*
LTF	*NEWTON*	*0.51*
LTF	*NYISO*	*0.37*
LTF	*O-066A*	*0.13*

LTF	*PRAIRIE*	*0.91*
LTF	*ROWAN*	*0.03*
LTF	*SANTEETLA*	*0.04*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.19*
LTF	*TILTON*	*0.23*
LTF	*TRIMBLE*	*0.24*
LTF	*TVA*	*0.26*
LTF	*UNIONPOWER*	*0.13*
LTF	*VFT*	*0.72*
924371	*AB2-085 C O1*	*6.94*
924372	*AB2-085 E O1*	*3.27*
926101	*AC1-089 C*	*24.2*
926102	*AC1-089 E*	*39.48*
926631	*AC1-144 C*	*16.01*
926632	*AC1-144 E*	*7.78*

Appendix 6

(DEO&K - DEO&K) The 08CLINCO-08WARRN1 138 kV line (from bus 249995 to bus 250122 ckt 1) loads from 137.48% to 138.57% (**DC power flow**) of its emergency rating (198 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.77 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932431	*AC2-061 C*	*24.16*
932432	*AC2-061 E*	*24.49*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O2*	*1.81*
936252	*AD2-031 E O2*	*2.96*

LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*
LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*

LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*
LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*3.83*
918802	*AA1-099 E*	*2.55*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 7

(DEO&K - DEO&K) The AC2-061 TAP-08CLINCO 138 kV line (from bus 932430 to bus 249995 ckt 1) loads from 161.72% to 162.89% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#8109_05HILLSB 138'. This project contributes approximately 4.77 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#8109_05HILLSB 138'
OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 932450 TO BUS 243102 CKT 1 / 932450 AC2-064 TAP 138 243102 05SINKG8 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.49*
932382	*AC2-055 E*	*2.43*
932421	*AC2-060 C*	*5.28*
932422	*AC2-060 E*	*2.97*
932431	*AC2-061 C*	*24.16*
932432	*AC2-061 E*	*24.49*
932651	*AC2-087 C*	*3.91*
932652	*AC2-087 E*	*3.1*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*75.07*
936092	*AD2-012 E*	*50.05*
936251	*AD2-031 C O2*	*1.81*
936252	*AD2-031 E O2*	*2.96*

LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.04*
LTF	*BIG_CAJUN1*	*0.05*
LTF	*BIG_CAJUN2*	*0.09*
LTF	*BLUEG*	*0.43*
LTF	*CANNELTON*	*0.05*
LTF	*CBM-N*	*0.01*
LTF	*CBM-S2*	*0.19*
LTF	*CHOCTAW*	*0.02*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*0.17*
LTF	*CPLE*	*0.05*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.13*
LTF	*FARMERCITY*	*0.05*
LTF	*G-007A*	*0.18*
LTF	*GIBSON*	*0.15*
LTF	*MORGAN*	*< 0.01*
LTF	*NEWTON*	*0.26*
LTF	*NYISO*	*0.21*
LTF	*O-066A*	*0.08*
LTF	*PRAIRIE*	*0.37*
LTF	*SMITHLAND*	*0.02*
LTF	*TATANKA*	*0.1*
LTF	*TILTON*	*0.14*

LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*< 0.01*
LTF	*VFT*	*0.48*
916272	*Z1-080 E*	*2.17*
918802	*AA1-099 E*	*1.45*
924371	*AB2-085 C O1*	*8.76*
924372	*AB2-085 E O1*	*4.12*
926101	*AC1-089 C*	*16.27*
926102	*AC1-089 E*	*26.55*
926631	*AC1-144 C*	*20.51*
926632	*AC1-144 E*	*9.97*

Appendix 8

(AEP - AEP) The AC2-064 TAP-05MILLBR 138 kV line (from bus 932450 to bus 243042 ckt 1) loads from 173.59% to 176.49% (**DC power flow**) of its emergency rating (173 MVA) for the tower line contingency outage of 'AEP_P7-1_#7981_B'. This project contributes approximately 5.02 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7981_B'
OPEN BRANCH FROM BUS 932430 TO BUS 249995 CKT 1 / 932430 AC2-061 TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
932131	*AC2-020 C*	*0.6*
932132	*AC2-020 E*	*0.98*
932381	*AC2-055 C*	*1.48*
932382	*AC2-055 E*	*2.42*
932421	*AC2-060 C*	*5.26*
932422	*AC2-060 E*	*2.96*
932431	*AC2-061 C*	*20.34*
932432	*AC2-061 E*	*20.62*
932451	*AC2-064 C*	*47.29*
932452	*AC2-064 E*	*31.53*
932651	*AC2-087 C*	*3.9*
932652	*AC2-087 E*	*3.09*
934491	*AD1-073 C*	*1.09*
934492	*AD1-073 E*	*0.56*
936091	*AD2-012 C*	*73.29*
936092	*AD2-012 E*	*48.86*
936251	*AD2-031 C O2*	*1.91*
936252	*AD2-031 E O2*	*3.11*

LTF	*CARR*	*0.03*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-S1*	*0.87*
LTF	*CBM-W1*	*2.8*
LTF	*CBM-W2*	*4.74*
LTF	*CELEVELAND*	*0.05*
LTF	*CIN*	*1.07*
LTF	*G-007*	*0.1*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.69*
LTF	*LGEE*	*0.36*
LTF	*MEC*	*1.23*
LTF	*MECS*	*0.74*
LTF	*O-066*	*0.34*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.16*
LTF	*ROWAN*	*0.06*
LTF	*WEC*	*0.18*
924371	*AB2-085 C O1*	*8.26*
924372	*AB2-085 E O1*	*3.89*
926101	*AC1-089 C*	*15.99*
926102	*AC1-089 E*	*26.08*
926631	*AC1-144 C*	*20.02*
926632	*AC1-144 E*	*9.73*