Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-075

Segreto 345 kV

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.

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 (IC) is requesting a 145 MW (Capacity 145 MW) uprate to the existing generating station in Van Buren County, MI (see Figure 2). The new MFO and Capacity will be 1200.0 MW. This is an existing Combined Cycle plant connected to AEP's Segreto 345 kV Station (see Figure 1).

The table below documents the series of uprates and queue positions for the total 1200.0 MW

Queue	MFO	MWE	MWC
T94	1035.0	1035.0	1035.0
AC1-072	1055.0	20.0	20.0
AD2-075	1200.0	145.0	145.0
	Total	**1200.0**	**1200.0**

The requested in service date is May 4, 2020.

Attachment Facilities

The existing facilities will accommodate the requested increase in output

Non-Direct Connection Cost Estimate

None

Network Impacts

The Queue Project AD2-075 was evaluated as a 145.0 MW (Capacity 145.0 MW) injection at the IC 345 kV substation in the AEP area. Project AD2-075 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-075 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Generator Deliverability

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

AD2-075 Generator Deliverability															
Contingency				Facility	Bus				Loading		Rating			FG	
#	Type	Name	Affected Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	App.	
1	N-1	AEP_P1-2_#358	AEP - AEP	AA2-116 TAP-05KENZIE 345 kV line	920210	243224	1	DC	99.32	100.65	NR	1409	18.86		

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

AD2-075 Multiple Facility Contingency														
Contingency			Affected	Facility	Bus				Loading		Rating			FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	App.
1	LFFB	ATSI-P2-3-TE-345-030T	MISO METC - FE	18MOROCCO-02ALLEN 345 kV line	256583	238530	1	DC	99.78	100.54	ER	2298	17.51	1

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)

AD2-075 Contribution to Previously Identified Overloads															
	Contingency		Affected		Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	AEP_P4_#7027_05 COOK 345-N	AEP - AEP	05BENTON 345/138 kV transformer	243212	243250	1	DC	251.64	257.43	ER	537	31.13	2
2	DCTL	AEP_P7-1_#7027	AEP - AEP	05BENTON 345/138 kV transformer	243212	243250	1	DC	251.64	257.43	ER	537	31.13	
3	N-1	AEP_P1-2_#1242	AEP - AEP	05BENTON 345/138 kV transformer	243212	243250	1	DC	124.42	127.54	ER	537	16.74	
4	N-1	AEP_P1-2_#7023	AEP - AEP	05BENTON 345/138 kV transformer	243212	243250	1	DC	104.04	106.72	ER	537	14.36	
5	LFFB	AEP_P4_#7443_05 DUMONT 765	AEP - AEP	05COOK-05OLIVE 345 kV line	243215	243229	1	DC	140.88	143.02	ER	1409	30.14	3
6	N-1	AEP_P1-2_#358	AEP - AEP	05COOK-05OLIVE 345 kV line	243215	243229	1	DC	119.86	122.09	NR	1409	31.3	
7	LFFB	AEP_P4_#7027_05 COOK 345-N	AEP - AEP	05BENTON-05CRYSTA 138 kV line	243250	243271	1	DC	131.3	133.83	ER	167	9.38	4
8	DCTL	AEP_P7-1_#7027	AEP - AEP	05BENTON-05CRYSTA 138 kV line	243250	243271	1	DC	131.3	133.83	ER	167	9.38	
9	LFFB	AEP_P4_#7027_05 COOK 345-N	AEP - AEP	05CRYSTA-05HICKOR 138 kV line	243271	243308	1	DC	122.43	124.97	ER	167	9.38	5
10	DCTL	AEP_P7-1_#7027	AEP - AEP	05CRYSTA-05HICKOR 138 kV line	243271	243308	1	DC	122.43	124.97	ER	167	9.38	
11	N-1	AEP_P1-2_#7023	AEP - AEP	05SEGRETO-05BENTON 345 kV line	247803	243212	1	DC	169.86	175.58	NR	1409	80.62	6
12	N-1	AEP_P1-2_#691	AEP - AEP	05SEGRETO-05BENTON 345 kV line	247803	243212	1	DC	140.98	145.41	NR	1409	59.45	
13	Non	Non	AEP - AEP	05SEGRETO-05BENTON 345 kV line	247803	243212	1	DC	126.41	130.44	NR	1409	56.76	
14	N-1	AEP_P1-2_#7021	AEP - AEP	05SEGRETO-05COOK 345 kV line	247803	243215	1	DC	135.66	141.21	NR	1409	67.07	7
15	LFFB	AEP_P4_#7042_05 T094 345-	MISO METC - AEP	18ARGNTA-05TWIN B 345 kV line	256000	243234	1	DC	133.22	135.77	ER	1409	35.96	8
16	DCTL	AEP_P7-1_#7030	MISO METC - AEP	18ARGNTA-05TWIN B 345 kV line	256000	243234	1	DC	133.22	135.77	ER	1409	35.96	
17	LFFB	AEP_P4_#7027_05 COOK 345-N	MISO METC - AEP	18ARGNTA-05TWIN B 345 kV line	256000	243234	1	DC	102.72	104.59	ER	1409	26.37	
18	DCTL	AEP_P7-1_#7027	MISO METC - AEP	18ARGNTA-05TWIN B 345 kV line	256000	243234	1	DC	102.72	104.59	ER	1409	26.37	
19	DCTL	ATSI-P7-1-TE-138-027T	MISO ITCT - FE	19MAJTC-02LEMOYN 345 kV line	264599	238889	1	DC	188.26	189.93	ER	953	15.89	9
20	DCTL	ATSI-P7-1-TE-138-025T	MISO ITCT - FE	19MON12-02LALLENDORF 345 kV line	264612	241901	1	DC	193.95	195.46	ER	1494	22.68	10

AD2-075 Contribution to Previously Identified Overloads															
	Contingency		Affected		Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
21	LFFB	ATSI-P2-3-TE-345-023T	MISO ITCT - FE	19MON12-02LALLENDORF 345 kV line	264612	241901	1	DC	154.51	155.71	ER	1494	17.86	
22	LFFB	ATSI-P2-3-TE-345-022T	MISO ITCT - FE	19MON12-02LALLENDORF 345 kV line	264612	241901	1	DC	154.36	155.56	ER	1494	17.86	
23	N-1	ATSI-P1-2-TE-345-605T	MISO ITCT - FE	19MON12-02LALLENDORF 345 kV line	264612	241901	1	DC	134.01	135.2	ER	1494	17.86	
24	Non	Non	MISO ITCT - FE	19MON12-02LALLENDORF 345 kV line	264612	241901	1	DC	113.88	114.9	NR	1261	12.91	
25	LFFB	AEP_P4_#7443_05 DUMONT 765	AEP - AEP	AA2-116 TAP-05KENZIE 345 kV line	920210	243224	1	DC	109.37	110.65	ER	1409	18.06	11

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)

Not required for existing facility

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during the System Impact Study.

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.

None

Light Load Analysis - 2020

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

(Results of the dynamic studies should be inserted here)

To be determined in the System Impact Study

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)

Generator Deliverability

1. (AEP - AEP) The AA2-116 TAP-05KENZIE 345 kV line (from bus 920210 to bus 243224 ckt 1) loads from 99.32% to 100.65% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#358'. This project contributes approximately 18.86 MW to the thermal violation.

AEP:

1. **A Sag Study will be required on the 2 mile section of line to mitigate the overload. (Limiting Element: ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor section 1) Depending on the sag study results, cost for this upgrade is expected to be between $20,000 (no remediations required just sag study) and $4 million (complete line reconductor/rebuild required).**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

Multiple Facility Contingency

1. (MISO METC - FE) The 18MOROCCO-02ALLEN 345 kV line (from bus 256583 to bus 238530 ckt 1) loads from 99.78% to 100.54% (**DC power flow**) of its emergency rating (2298 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-TE-345-030T'. This project contributes approximately 17.51 MW to the thermal violation.

ATSI:

The correct limiting ratings (FE's end) are S/N: 1517 MVA & S/E: 1793 MVA. The external transmission owner (ITC) owns the transmission line up to the Allen Junction substation. Assuming ITC rebuilds the line; FE can replace the substation line drop and Bitronics M560 meter to increase the new FE summer emergency rating to 2580MVA. The cost of this project will be evaluated once the external / MISO transmission owner (ITC) reviews this overload.

MISO:
The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact 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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

1. (AEP - AEP) The 05BENTON 345/138 kV transformer (from bus 243212 to bus 243250 ckt 1) loads from 251.64% to 257.43% (**DC power flow**) of its emergency rating (537 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 31.13 MW to the thermal violation.

AEP:
1. **Replace 345/138kV transformer (Limiting Element: 345/138kV Benton Transformer). Estimated Cost: $1.5 million.**
2. **Replace Line switch (Limiting Element: Switch (3000A) - 138kV Line Switch). Estimated Cost: $400,000.**
3. **Replace Switch CB F2 (Limiting Element: Switch (3000A) - 138kV Sw.CB F2). Estimated Cost: $400,000.**
4. **An engineering study will need to be conducted to determine if the CT Thermal limits settings can be adjusted to mitigate the overload (Limiting Element: CT Thermal Limit 1596 Amps - Benton CT), Estimated Cost: $25,000. New relay packages will be required if the settings cannot be adjusted, Estimated Cost: $600,000.**

An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

2. (AEP - AEP) The 05BENTON 345/138 kV transformer (from bus 243212 to bus 243250 ckt 1) loads from 251.64% to 257.43% (**DC power flow**) of its emergency rating (537 MVA) for the tower line contingency outage of 'AEP_P7-1_#7027'. This project contributes approximately 31.13 MW to the thermal violation.

Same as Contribution to Previously Identified #1

3. (AEP - AEP) The 05BENTON 345/138 kV transformer (from bus 243212 to bus 243250 ckt 1) loads from 124.42% to 127.54% (**DC power flow**) of its emergency rating (537 MVA) for the single line contingency outage of 'AEP_P1-2_#1242'. This project contributes approximately 16.74 MW to the thermal violation.

Same as Contribution to Previously Identified #1

4. (AEP - AEP) The 05BENTON 345/138 kV transformer (from bus 243212 to bus 243250 ckt 1) loads from 104.04% to 106.72% (**DC power flow**) of its emergency rating (537 MVA) for the single line contingency outage of 'AEP_P1-2_#7023'. This project contributes approximately 14.36 MW to the thermal violation.

Same as Contribution to Previously Identified #1

5. (AEP - AEP) The 05COOK-05OLIVE 345 kV line (from bus 243215 to bus 243229 ckt 1) loads from 140.88% to 143.02% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7443_05DUMONT 765'. This project contributes approximately 30.14 MW to the thermal violation.

AEP:

1. **A Sag Study will be required on the 22 mile section of line to mitigate the overload (Limiting Element: ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor Sec1). Depending on the sag study results, cost for this upgrade is expected to be between $88,000 (no remediations required just sag study) and $44 million (complete line reconductor/rebuild required)**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

6. (AEP - AEP) The 05COOK-05OLIVE 345 kV line (from bus 243215 to bus 243229 ckt 1) loads from 119.86% to 122.09% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#358'. This project contributes approximately 31.3 MW to the thermal violation.

Same as Contribution to Previously Identified #5

7. (AEP - AEP) The 05BENTON-05CRYSTA 138 kV line (from bus 243250 to bus 243271 ckt 1) loads from 131.3% to 133.83% (**DC power flow**) of its emergency rating (167 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 9.38 MW to the thermal violation.

AEP:

1. **A Sag Study will be required on the 3.1 mile section of line to mitigate the overload (Limiting Element: ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor Sec 2). Depending on the sag study results, cost for this upgrade is expected to be between $12,400 (no remediations required just sag study) and $4.65 million (complete line reconductor/rebuild required)**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

8. (AEP - AEP) The 05BENTON-05CRYSTA 138 kV line (from bus 243250 to bus 243271 ckt 1) loads from 131.3% to 133.83% (**DC power flow**) of its emergency rating (167 MVA) for the tower line contingency outage of 'AEP_P7-1_#7027'. This project contributes approximately 9.38 MW to the thermal violation.

Same as Contribution to Previously Identified #7

9. (AEP - AEP) The 05CRYSTA-05HICKOR 138 kV line (from bus 243271 to bus 243308 ckt 1) loads from 122.43% to 124.97% (**DC power flow**) of its emergency rating (167 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 9.38 MW to the thermal violation.

AEP:

1. **A Sag Study will be required on the 5.7 mile section of line to mitigate the overload (Limiting Element: ACSR ~ 397.5 ~ 30/7 ~ LARK- Conductor Sec 1). Depending on the sag study results, cost for this upgrade is expected to be between $22,800 (no remediation required just sag study) and $8.55 million (complete line reconductor/rebuild required)**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

10. (AEP - AEP) The 05CRYSTA-05HICKOR 138 kV line (from bus 243271 to bus 243308 ckt 1) loads from 122.43% to 124.97% (**DC power flow**) of its emergency rating (167 MVA) for the tower line contingency outage of 'AEP_P7-1_#7027'. This project contributes approximately 9.38 MW to the thermal violation.

Same as Contribution to Previously Identified #9

11. (AEP - AEP) The 05SEGRETO-05BENTON 345 kV line (from bus 247803 to bus 243212 ckt 1) loads from 169.86% to 175.58% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#7023'. This project contributes approximately 80.62 MW to the thermal violation.

AEP:

1. **Rebuilt / Reconductor 9.2 miles of conductor (Limiting Element: ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor section 1). Estimated Cost: $18.4 million.**
2. **Wavetrap needs to be replaced (Limiting Element: Wavetrap (3000A) - Benton H Wavetrap). Estimated cost: $500,000**
3. **Rebuilt / Reconductor 0.16 miles of conductor (Limiting Element: ACSR/TW ~ 1158.4 ~ Type 13 ~ HUDSON - Conductor section 2). Estimated Cost: $0.32 million.**
4. **Replace Benton H Lien riser (Limiting Element: Sub cond 2-2000 AAC 91 Str.- Benton H Line Riser). Estimated cost : $100,000**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

12. (AEP - AEP) The 05SEGRETO-05BENTON 345 kV line (from bus 247803 to bus 243212 ckt 1) loads from 140.98% to 145.41% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#691'. This project contributes approximately 59.45 MW to the thermal violation.

Same as Contribution to Previously Identified #11

13. (AEP - AEP) The 05SEGRETO-05BENTON 345 kV line (from bus 247803 to bus 243212 ckt 1) loads from 126.41% to 130.44% (**DC power flow**) of its normal rating (1409 MVA) for non-contingency condition. This project contributes approximately 56.76 MW to the thermal violation.

Same as Contribution to Previously Identified #11

14. (AEP - AEP) The 05SEGRETO-05COOK 345 kV line (from bus 247803 to bus 243215 ckt 1) loads from 135.66% to 141.21% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#7021'. This project contributes approximately 67.07 MW to the thermal violation.

Same as Contribution to Previously Identified #11

15. (MISO METC - AEP) The 18ARGNTA-05TWIN B 345 kV line (from bus 256000 to bus 243234 ckt 1) loads from 133.22% to 135.77% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7042_05T094 345-'. This project contributes approximately 35.96 MW to the thermal violation.

AEP:

1. **A Sag Study will be required on the 51.4mile section of line to mitigate the overload (Limiting Element: ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor section 1). Depending on the sag study results, cost for this upgrade is expected to be between $205,600 (no remediation required just sag study) and $102.8 million (complete line reconductor/rebuild required).**
2. **Wavetrap will need to be replaced (Limiting Element: Wavetrap (2500A) - Twin Branch Wave trap). Estimated cost: $500,000.**
3. **An engineering study will need to be conducted to determine if the relay compliance trip limits settings can be adjusted to mitigate the overload (Limiting Element: Relay Compliance Trip Limit 3128 Amps-Twin branch RCTL); Estimated Cost: $25,000. New relay packages will be required if the settings cannot be adjusted, Estimated Cost:$600,000**

(A) Sag Study: 6 to 12 months.
(B) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.

MISO:
The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact study phase.

16. (MISO METC - AEP) The 18ARGNTA-05TWIN B 345 kV line (from bus 256000 to bus 243234 ckt 1) loads from 133.22% to 135.77% (**DC power flow**) of its emergency rating (1409

MVA) for the tower line contingency outage of 'AEP_P7-1_#7030'. This project contributes approximately 35.96 MW to the thermal violation.

Same as Contribution to Previously Identified #15

17. (MISO METC - AEP) The 18ARGNTA-05TWIN B 345 kV line (from bus 256000 to bus 243234 ckt 1) loads from 102.72% to 104.59% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 26.37 MW to the thermal violation.

Same as Contribution to Previously Identified #15

18. (MISO METC - AEP) The 18ARGNTA-05TWIN B 345 kV line (from bus 256000 to bus 243234 ckt 1) loads from 102.72% to 104.59% (**DC power flow**) of its emergency rating (1409 MVA) for the tower line contingency outage of 'AEP_P7-1_#7027'. This project contributes approximately 26.37 MW to the thermal violation.

Same as Contribution to Previously Identified #15

19. (MISO ITCT - FE) The 19MAJTC-02LEMOYN 345 kV line (from bus 264599 to bus 238889 ckt 1) loads from 188.26% to 189.93% (**DC power flow**) of its emergency rating (953 MVA) for the tower line contingency outage of 'ATSI-P7-1-TE-138-027T'. This project contributes approximately 15.89 MW to the thermal violation.

ATSI:

Assuming ITC will rebuild their section of the 345kV line, FE can reconductor the sections of existing 2253.8 ACSR and 1024.5 ACAR with bundled (2) 954 ACSR 48/7 to increase the FE summer emergency rating of the 19MAJTC-02LEMOYN 345 kV line to 1900 MVA. The cost of this project will be evaluated once the external / MISO transmission owner (ITC) reviews this overload.

MISO:

The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact study phase.

20. (MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 193.95% to 195.46% (**DC power flow**) of its emergency rating (1494 MVA) for the tower line contingency outage of 'ATSI-P7-1-TE-138-025T'. This project contributes approximately 22.68 MW to the thermal violation.

ATSI:

The correct limiting ratings (FE's end) are S/N: 1261 MVA & S/E: 1545 MVA. Assuming the external MISO transmission owner (ITC) will rebuild their section of the 345kV line, FE can reconductor the sections of existing 2253.8 ACSR and 1024.5 ACAR with bundled (2) 1033.5 ACSS, replace wavetraps, substation line drops, substation conductor, and Bitronics meter to increase the FE summer emergency ratings to 2965 MVA. The cost of this project will be evaluated once the external / MISO transmission owner (ITC) reviews this overload.

MISO:
The external (i.e. Non-PJM) Transmission Owner, MISO, will not evaluate this violation until the impact study phase.

21. (MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 154.51% to 155.71% (**DC power flow**) of its emergency rating (1494 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-TE-345-023T'. This project contributes approximately 17.86 MW to the thermal violation.

Same as Contribution to Previously Identified #20

22. (MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 154.36% to 155.56% (**DC power flow**) of its emergency rating (1494 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-TE-345-022T'. This project contributes approximately 17.86 MW to the thermal violation.

Same as Contribution to Previously Identified #20

23. (MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 134.01% to 135.2% (**DC power flow**) of its emergency rating (1494 MVA) for the single line contingency outage of 'ATSI-P1-2-TE-345-605T'. This project contributes approximately 17.86 MW to the thermal violation.

Same as Contribution to Previously Identified #20

24. (MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 113.88% to 114.9% (**DC power flow**) of its normal rating (1261 MVA) for non-contingency condition. This project contributes approximately 12.91 MW to the thermal violation.

Same as Contribution to Previously Identified #20

25. (AEP - AEP) The AA2-116 TAP-05KENZIE 345 kV line (from bus 920210 to bus 243224 ckt 1) loads from 109.37% to 110.65% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7443_05DUMONT 765'. This project contributes approximately 18.06 MW to the thermal violation.

Same as Generator Deliverability #1

Cost Summary Table for Reinforcement work for Generator Deliverability, Multiple Facility Contingency, and Contributions to Previously Identified System Reinforcements

		Estimated Costs	
		Low	**High**
	Generator Deliverability		
1	AA2-116 TAP-KENZIE 345 kV line	$20,000	$4,000,000
	Multiple Facility Contingency		
1	to be determined in System Impact Study (MISO)		
	Contributions to Previously Identified System Reinforcements		
1	Benton Transformer		$2,900,000
2	Same as #1		
3	Same as #1		
4	Same as #1		
5	COOK-OLIVE 345 kV line	$88,000	$44,000,000
6	Same as #5		
7	BENTON-CRYSTA 138 kV line	$12,400	$4,650,000
8	Same as #7		
9	CRYSTA-HICKOR 138 kV line	$22,800	$8,550,000
10	Same as #9		
11	SEGRETO-BENTON 345 kV		$19,320,000
12	Same as #11		
13	Same as #11		
14	Same as #11		
15	ARGNTA-TWIN B 345 kV line	$230,000	$103,900,000
16	Same as #15		
17	Same as #15		
18	Same as #15		
19	MAJTC-LEMOYN 345 kV line (MISO)		
20	MON12-LALLENDORF 345 kV line (MISO)		
21	MON12-LALLENDORF 345 kV line (MISO)		
22	Same as #20		
23	Same as #20		
24	Same as #20		
25	Same as #1		
	Total	**$353,200**	**$183,320,000**

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)

Light Load studies are performed in the System Impact Study phase of the project.

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)

Light Load studies are performed in the System Impact Study phase of the project.

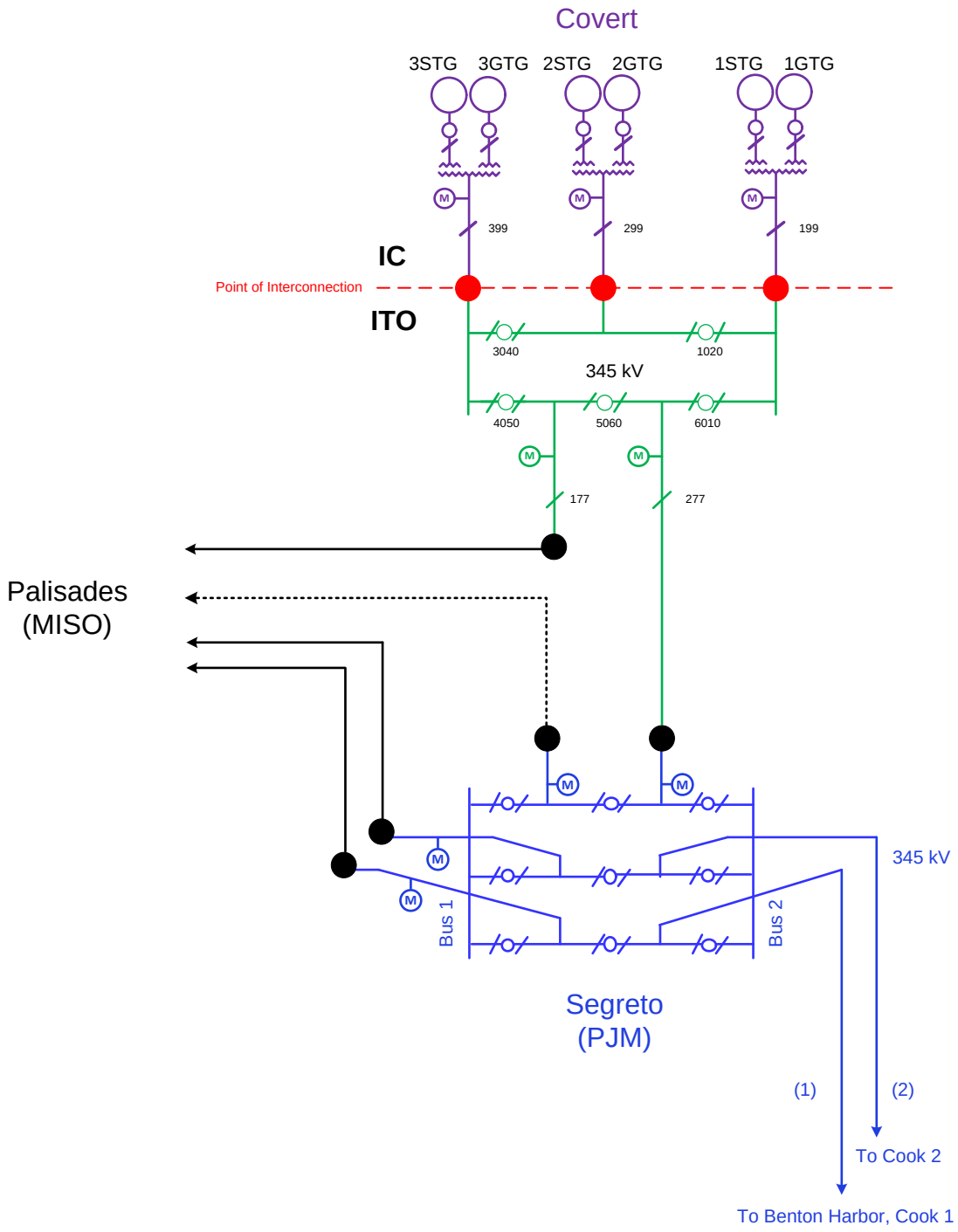

Figure 1 – Single Line Diagram

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

(MISO METC - FE) The 18MOROCCO-02ALLEN 345 kV line (from bus 256583 to bus 238530 ckt 1) loads from 99.78% to 100.54% (**DC power flow**) of its emergency rating (2298 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-TE-345-030T'. This project contributes approximately 17.51 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-TE-345-030T' /* Y1-069 345 BREAKER B2
DISCONNECT BRANCH FROM BUS 241901 TO BUS 264612 CKT 1 /* 02_Y1-069 345 19MON12 345
DISCONNECT BRANCH FROM BUS 241901 TO BUS 238563 CKT 1 /* 02_Y1-069 345 02BAY SH 345
END

Bus Number	*Bus Name*	*Full Contribution*
240968	*02BG2 GEN*	*-1.22*
240969	*02BG4 G1*	*-0.3*
240970	*02BG4 G2&3*	*-0.6*
240971	*02BG4 G4&5*	*-0.6*
240973	*02BG6 AMPO*	*-5.37*
246431	*05BUCHANAN*	*0.34*
247528	*05COVRT1*	*3.02*
247529	*05COVRT2*	*3.02*
247530	*05COVRT3*	*3.02*
247531	*05COVRT4*	*2.91*
247532	*05COVRT5*	*2.91*
247533	*05COVRT6*	*2.91*
246536	*05MOTTVILL*	*0.13*
LTF	*AD1-092*	*5.54*
LTF	*AD1-093*	*9.53*
LTF	*AD1-094*	*1.82*
936141	*AD2-020 C O1*	*5.5*
936142	*AD2-020 E O1*	*3.39*
936601	*AD2-075*	*17.51*
LTF	*CARR*	*0.79*
LTF	*CBM-S1*	*6.69*
LTF	*CBM-S2*	*2.1*
LTF	*CBM-W1*	*135.52*
LTF	*CBM-W2*	*55.83*
LTF	*CIN*	*8.46*
LTF	*CPLE*	*0.32*
LTF	*G-007*	*1.42*
940311	*G934 C*	*3.71*
940312	*G934 E*	*14.83*

960018	*G997 E*	*8.03*
LTF	*IPL*	*5.35*
960031	*J201 C*	*0.7*
960032	*J201 E*	*2.81*
938541	*J203 C*	*8.53*
938542	*J203 E*	*34.12*
940031	*J301 C*	*4.05*
940032	*J301 E*	*16.21*
940041	*J308 C*	*12.3*
940042	*J308 E*	*49.22*
983041	*J325 C*	*0.16*
983042	*J325 E*	*0.48*
983051	*J327 C*	*6.02*
983052	*J327 E*	*18.07*
983111	*J340 C*	*4.01*
983112	*J340 E*	*12.04*
983151	*J354 C*	*2.09*
983152	*J354 E*	*6.26*
940121	*J392*	*46.27*
940241	*J419*	*31.06*
981121	*J444*	*61.47*
940351	*J466*	*5.84*
940361	*J469*	*0.27*
970341	*J533 C*	*5.38*
970342	*J533 E*	*21.5*
970381	*J538 C*	*7.92*
970382	*J538 E*	*31.7*
970391	*J540*	*5.47*
951551	*J571*	*0.54*
951071	*J572*	*14.21*
951591	*J589 C*	*4.31*
951592	*J589 E*	*17.25*
951341	*J602 C*	*6.7*
951342	*J602 E*	*26.8*
981022	*J646 E*	*0.35*
981041	*J647*	*12.34*
938301	*J701 C*	*1.84*
938302	*J701 E*	*7.37*
981321	*J717 C*	*6.33*
981322	*J717 E*	*25.31*
981471	*J728 C*	*6.33*
981472	*J728 E*	*25.31*
981601	*J749*	*3.03*
981111	*J752 C*	*3.81*
981112	*J752 E*	*15.25*

981591	*J758*	*23.87*
938021	*J793*	*286.87*
938111	*J794 C*	*0.38*
938112	*J794 E*	*1.52*
938321	*J796*	*39.23*
938351	*J799*	*58.7*
938761	*J806*	*22.29*
938401	*J809*	*8.06*
938871	*J832*	*13.37*
938881	*J833*	*31.06*
938901	*J839*	*21.47*
938441	*J841*	*115.77*
938951	*J846*	*19.78*
939031	*J857*	*17.3*
939101	*J865*	*17.38*
939201	*J875*	*44.38*
939321	*J890 C*	*2.67*
939322	*J890 E*	*10.7*
939791	*J906 C*	*1.74*
939792	*J906 E*	*6.96*
939501	*J914*	*2.84*
938001	*J921 C*	*2.43*
938002	*J921 E*	*9.71*
939621	*J931 C*	*2.53*
939622	*J931 E*	*10.12*
939661	*J936*	*61.07*
939671	*J937*	*61.07*
LTF	*LGEE*	*1.21*
LTF	*MEC*	*21.23*
LTF	*MECS*	*98.17*
LTF	*O-066*	*9.16*
LTF	*RENSSELAER*	*0.62*
LTF	*ROSETON*	*4.48*
LTF	*WEC*	*3.67*
247604	*X1-042*	*0.06*
LTF	*Y3-032*	*88.74*
LTF	*Z1-043*	*13.93*
247966	*Z2-113 E*	*0.23*
920211	*AA2-116*	*81.58*
LTF	*AB2-013*	*7.94*
925961	*AC1-072*	*2.42*
926581	*AC1-141*	*7.47*

Appendix 2

(AEP - AEP) The 05BENTON 345/138 kV transformer (from bus 243212 to bus 243250 ckt 1) loads from 251.64% to 257.43% (**DC power flow**) of its emergency rating (537 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 31.13 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7027_05COOK 345-N'
OPEN BRANCH FROM BUS 243212 TO BUS 243215 CKT 1 / 243212 05BENTON 345 243215 05COOK 345 1
OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
246431	*05BUCHANAN*	*-0.62*
247528	*05COVRT1*	*5.37*
247529	*05COVRT2*	*5.37*
247530	*05COVRT3*	*5.37*
247531	*05COVRT4*	*5.16*
247532	*05COVRT5*	*5.16*
247533	*05COVRT6*	*5.16*
246536	*05MOTTVILL*	*-0.14*
936601	*AD2-075*	*31.13*
LTF	*AMIL*	*0.48*
LTF	*BAYOU*	*1.09*
LTF	*BIG_CAJUN1*	*1.61*
LTF	*BIG_CAJUN2*	*3.25*
LTF	*BLUEG*	*1.56*
LTF	*CALDERWOOD*	*0.34*
LTF	*CANNELTON*	*0.32*
LTF	*CATAWBA*	*0.13*
LTF	*CBM-N*	*0.14*
LTF	*CBM-W1*	*18.21*
LTF	*CELEVELAND*	*0.38*
LTF	*CHEOAH*	*0.31*
LTF	*CHILHOWEE*	*0.11*
LTF	*CHOCTAW*	*0.99*
LTF	*CLIFTY*	*3.95*
LTF	*COTTONWOOD*	*4.42*
LTF	*EDWARDS*	*1.17*
LTF	*ELMERSMITH*	*0.92*
LTF	*FARMERCITY*	*0.62*
LTF	*G-007A*	*0.89*

940311	*G934 C*	*3.5*
940312	*G934 E*	*13.98*
960018	*G997 E*	*3.3*
LTF	*GIBSON*	*0.71*
LTF	*HAMLET*	*0.35*
960031	*J201 C*	*0.37*
960032	*J201 E*	*1.49*
938541	*J203 C*	*3.09*
938542	*J203 E*	*12.37*
940031	*J301 C*	*1.67*
940032	*J301 E*	*6.68*
940041	*J308 C*	*4.88*
940042	*J308 E*	*19.52*
983041	*J325 C*	*0.07*
983042	*J325 E*	*0.2*
983051	*J327 C*	*2.48*
983052	*J327 E*	*7.43*
983111	*J340 C*	*1.65*
983112	*J340 E*	*4.96*
983151	*J354 C*	*0.86*
983152	*J354 E*	*2.58*
940121	*J392*	*44.03*
940241	*J419*	*6.12*
981121	*J444*	*14.95*
940351	*J466*	*2.55*
940361	*J469*	*0.19*
970341	*J533 C*	*4.47*
970342	*J533 E*	*17.86*
970381	*J538 C*	*2.03*
970382	*J538 E*	*8.12*
970391	*J540*	*5.74*
951551	*J571*	*0.64*
951071	*J572*	*18.78*
938031	*J579 C*	*4.4*
938032	*J579 E*	*17.58*
951591	*J589 C*	*3.13*
951592	*J589 E*	*12.53*
951341	*J602 C*	*3.85*
951342	*J602 E*	*15.39*
938611	*J632 C*	*6.36*
938612	*J632 E*	*25.43*
981022	*J646 E*	*0.12*
981041	*J647*	*19.11*
938301	*J701 C*	*0.86*
938302	*J701 E*	*3.45*

981321	*J717 C*	*4.02*
981322	*J717 E*	*16.07*
981471	*J728 C*	*4.02*
981472	*J728 E*	*16.07*
981601	*J749*	*2.07*
981111	*J752 C*	*1.74*
981112	*J752 E*	*6.95*
981591	*J758*	*18.66*
938021	*J793*	*100.51*
938111	*J794 C*	*0.26*
938112	*J794 E*	*1.03*
938321	*J796*	*23.46*
938351	*J799*	*11.57*
938761	*J806*	*13.11*
938401	*J809*	*13.*
938871	*J832*	*10.98*
938881	*J833*	*6.12*
938901	*J839*	*7.7*
938441	*J841*	*68.64*
938951	*J846*	*10.06*
939031	*J857*	*11.29*
939101	*J865*	*6.07*
939201	*J875*	*10.25*
939321	*J890 C*	*2.2*
939322	*J890 E*	*8.79*
939791	*J906 C*	*2.57*
939792	*J906 E*	*10.29*
939501	*J914*	*3.76*
938001	*J921 C*	*3.94*
938002	*J921 E*	*15.75*
939621	*J931 C*	*3.9*
939622	*J931 E*	*15.58*
939661	*J936*	*48.34*
939671	*J937*	*48.34*
LTF	*MECS*	*34.69*
LTF	*MORGAN*	*1.52*
LTF	*NEWTON*	*1.97*
LTF	*NYISO*	*2.1*
LTF	*PRAIRIE*	*3.82*
LTF	*ROWAN*	*0.23*
LTF	*SANTEETLA*	*0.09*
LTF	*SMITHLAND*	*0.24*
LTF	*TATANKA*	*1.25*
LTF	*TILTON*	*1.05*
LTF	*TRIMBLE*	*0.29*

LTF	*TVA*	*0.68*
LTF	*UNIONPOWER*	*0.51*
LTF	*VFT*	*2.42*
LTF	*Y3-032*	*17.4*
925961	*AC1-072*	*4.29*

Appendix 3

(AEP - AEP) The 05COOK-05OLIVE 345 kV line (from bus 243215 to bus 243229 ckt 1) loads from 140.88% to 143.02% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7443_05DUMONT 765'. This project contributes approximately 30.14 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7443_05DUMONT 765'
OPEN BRANCH FROM BUS 243205 TO BUS 243206 CKT 1 / 243205 05COOK 765 243206 05DUMONT 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 246999 CKT 1 / 243206 05DUMONT 765 246999 05SORENS 765 1
END

Bus Number	*Bus Name*	*Full Contribution*
243440	*05CKG1*	*54.29*
243441	*05CKG2*	*56.85*
247528	*05COVRT1*	*5.2*
247529	*05COVRT2*	*5.2*
247530	*05COVRT3*	*5.2*
247531	*05COVRT4*	*5.*
247532	*05COVRT5*	*5.*
247533	*05COVRT6*	*5.*
246536	*05MOTTVILL*	*0.14*
933281	*AC2-140 C*	*10.91*
936141	*AD2-020 C O1*	*6.99*
936142	*AD2-020 E O1*	*4.3*
936601	*AD2-075*	*30.14*
LTF	*AMIL*	*1.28*
LTF	*BAYOU*	*2.74*
LTF	*BIG_CAJUN1*	*4.01*
LTF	*BIG_CAJUN2*	*8.09*
LTF	*BLUEG*	*3.14*
LTF	*CALDERWOOD*	*0.75*
LTF	*CANNELTON*	*0.73*
LTF	*CATAWBA*	*0.25*
LTF	*CBM-N*	*0.26*
LTF	*CELEVELAND*	*0.74*
LTF	*CHEOAH*	*0.68*
LTF	*CHILHOWEE*	*0.25*
LTF	*CHOCTAW*	*2.42*
LTF	*CLIFTY*	*6.48*
LTF	*COTTONWOOD*	*11.13*
LTF	*EDWARDS*	*3.32*

LTF	*ELMERSMITH*	*2.11*
LTF	*FARMERCITY*	*1.71*
LTF	*G-007A*	*1.91*
940311	*G934 C*	*4.46*
940312	*G934 E*	*17.83*
960018	*G997 E*	*4.68*
LTF	*GIBSON*	*1.62*
LTF	*HAMLET*	*0.64*
960031	*J201 C*	*0.51*
960032	*J201 E*	*2.03*
938541	*J203 C*	*4.48*
938542	*J203 E*	*17.91*
940031	*J301 C*	*2.36*
940032	*J301 E*	*9.45*
940041	*J308 C*	*6.95*
940042	*J308 E*	*27.8*
983041	*J325 C*	*0.09*
983042	*J325 E*	*0.28*
983051	*J327 C*	*3.51*
983052	*J327 E*	*10.52*
983111	*J340 C*	*2.34*
983112	*J340 E*	*7.02*
983151	*J354 C*	*1.22*
983152	*J354 E*	*3.65*
940121	*J392*	*56.59*
940241	*J419*	*9.68*
981121	*J444*	*23.2*
940351	*J466*	*3.58*
940361	*J469*	*0.25*
970341	*J533 C*	*5.76*
970342	*J533 E*	*23.05*
970381	*J538 C*	*3.24*
970382	*J538 E*	*12.98*
970391	*J540*	*7.33*
951551	*J571*	*0.9*
951071	*J572*	*23.63*
938031	*J579 C*	*5.98*
938032	*J579 E*	*23.9*
951591	*J589 C*	*4.11*
951592	*J589 E*	*16.44*
951341	*J602 C*	*5.19*
951342	*J602 E*	*20.78*
938611	*J632 C*	*7.46*
938612	*J632 E*	*29.83*
981022	*J646 E*	*0.18*

981041	*J647*	*23.84*
938301	*J701 C*	*1.2*
938302	*J701 E*	*4.78*
981321	*J717 C*	*5.35*
981322	*J717 E*	*21.41*
981471	*J728 C*	*5.35*
981472	*J728 E*	*21.41*
981601	*J749*	*2.73*
981111	*J752 C*	*2.42*
981112	*J752 E*	*9.68*
981591	*J758*	*26.59*
938021	*J793*	*146.35*
938111	*J794 C*	*0.34*
938112	*J794 E*	*1.36*
938321	*J796*	*31.45*
938351	*J799*	*18.29*
938761	*J806*	*18.88*
938401	*J809*	*16.16*
938871	*J832*	*14.28*
938881	*J833*	*9.68*
938901	*J839*	*11.16*
938441	*J841*	*92.13*
938951	*J846*	*16.58*
939031	*J857*	*16.2*
939101	*J865*	*8.85*
939201	*J875*	*15.77*
939321	*J890 C*	*2.86*
939322	*J890 E*	*11.43*
939791	*J906 C*	*3.21*
939792	*J906 E*	*12.86*
939501	*J914*	*4.73*
938001	*J921 C*	*4.85*
938002	*J921 E*	*19.41*
939621	*J931 C*	*4.86*
939622	*J931 E*	*19.42*
939661	*J936*	*67.74*
939671	*J937*	*67.74*
LTF	*MECS*	*38.55*
LTF	*MORGAN*	*3.63*
LTF	*NEWTON*	*5.18*
LTF	*NYISO*	*3.84*
LTF	*PRAIRIE*	*10.08*
LTF	*ROWAN*	*0.42*
LTF	*SANTEETLA*	*0.2*
LTF	*SMITHLAND*	*0.59*

LTF	*TATANKA*	*3.47*
LTF	*TILTON*	*2.87*
LTF	*TRIMBLE*	*0.59*
LTF	*TVA*	*1.61*
LTF	*UNIONPOWER*	*1.19*
LTF	*VFT*	*5.15*
247604	*X1-042*	*0.08*
LTF	*Y3-032*	*20.61*
247633	*Z1-051*	*4.43*
916512	*Z1-107 E*	*1.44*
247640	*Z2-113 C*	*0.06*
247966	*Z2-113 E*	*0.3*
918972	*AA1-116 E*	*1.46*
918982	*AA1-117 E*	*1.46*
920211	*AA2-116*	*170.89*
925961	*AC1-072*	*4.16*
926581	*AC1-141*	*15.64*

Appendix 4

(AEP - AEP) The 05BENTON-05CRYSTA 138 kV line (from bus 243250 to bus 243271 ckt 1) loads from 131.3% to 133.83% (**DC power flow**) of its emergency rating (167 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 9.38 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7027_05COOK 345-N'
OPEN BRANCH FROM BUS 243212 TO BUS 243215 CKT 1 / 243212 05BENTON 345 243215 05COOK 345 1
OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
936601	*AD2-075*	*9.38*
LTF	*AMIL*	*0.16*
LTF	*BAYOU*	*0.35*
LTF	*BIG_CAJUN1*	*0.52*
LTF	*BIG_CAJUN2*	*1.04*
LTF	*BLUEG*	*0.47*
LTF	*CALDERWOOD*	*0.11*
LTF	*CANNELTON*	*0.1*
LTF	*CATAWBA*	*0.04*
LTF	*CBM-N*	*0.05*
LTF	*CBM-W1*	*5.09*
LTF	*CELEVELAND*	*0.11*
LTF	*CHEOAH*	*0.1*
LTF	*CHILHOWEE*	*0.04*
LTF	*CHOCTAW*	*0.32*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*1.42*
LTF	*EDWARDS*	*0.39*
LTF	*ELMERSMITH*	*0.29*
LTF	*FARMERCITY*	*0.21*
LTF	*G-007A*	*0.3*
LTF	*GIBSON*	*0.22*
LTF	*HAMLET*	*0.1*
940121	*J392*	*13.54*
938611	*J632 C*	*1.94*
938612	*J632 E*	*7.76*
938021	*J793*	*31.27*
938441	*J841*	*21.19*
939661	*J936*	*14.98*

939671	*J937*	*14.98*
LTF	*MECS*	*10.58*
LTF	*MORGAN*	*0.48*
LTF	*NEWTON*	*0.64*
LTF	*NYISO*	*0.68*
LTF	*PRAIRIE*	*1.24*
LTF	*ROWAN*	*0.07*
LTF	*SANTEETLA*	*0.03*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.42*
LTF	*TILTON*	*0.34*
LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*0.22*
LTF	*UNIONPOWER*	*0.16*
LTF	*VFT*	*0.81*
247604	*X1-042*	*0.08*
LTF	*Y3-032*	*5.34*
247640	*Z2-113 C*	*0.05*
247966	*Z2-113 E*	*0.25*
925961	*AC1-072*	*1.29*

Appendix 5

(AEP - AEP) The 05CRYSTA-05HICKOR 138 kV line (from bus 243271 to bus 243308 ckt 1) loads from 122.43% to 124.97% (**DC power flow**) of its emergency rating (167 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7027_05COOK 345-N'. This project contributes approximately 9.38 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7027_05COOK 345-N'
OPEN BRANCH FROM BUS 243212 TO BUS 243215 CKT 1 / 243212 05BENTON 345 243215 05COOK 345 1
OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
936601	*AD2-075*	*9.38*
LTF	*AMIL*	*0.16*
LTF	*BAYOU*	*0.35*
LTF	*BIG_CAJUN1*	*0.52*
LTF	*BIG_CAJUN2*	*1.04*
LTF	*BLUEG*	*0.47*
LTF	*CALDERWOOD*	*0.11*
LTF	*CANNELTON*	*0.1*
LTF	*CATAWBA*	*0.04*
LTF	*CBM-N*	*0.05*
LTF	*CBM-W1*	*5.09*
LTF	*CELEVELAND*	*0.11*
LTF	*CHEOAH*	*0.1*
LTF	*CHILHOWEE*	*0.04*
LTF	*CHOCTAW*	*0.32*
LTF	*CLIFTY*	*1.16*
LTF	*COTTONWOOD*	*1.42*
LTF	*EDWARDS*	*0.39*
LTF	*ELMERSMITH*	*0.29*
LTF	*FARMERCITY*	*0.21*
LTF	*G-007A*	*0.3*
LTF	*GIBSON*	*0.22*
LTF	*HAMLET*	*0.1*
940121	*J392*	*13.54*
938611	*J632 C*	*1.94*
938612	*J632 E*	*7.76*
938021	*J793*	*31.27*
938441	*J841*	*21.19*
939661	*J936*	*14.98*

939671	*J937*	*14.98*
LTF	*MECS*	*10.58*
LTF	*MORGAN*	*0.48*
LTF	*NEWTON*	*0.64*
LTF	*NYISO*	*0.68*
LTF	*PRAIRIE*	*1.24*
LTF	*ROWAN*	*0.07*
LTF	*SANTEETLA*	*0.03*
LTF	*SMITHLAND*	*0.08*
LTF	*TATANKA*	*0.42*
LTF	*TILTON*	*0.34*
LTF	*TRIMBLE*	*0.09*
LTF	*TVA*	*0.22*
LTF	*UNIONPOWER*	*0.16*
LTF	*VFT*	*0.81*
247604	*X1-042*	*0.08*
LTF	*Y3-032*	*5.34*
247640	*Z2-113 C*	*0.05*
247966	*Z2-113 E*	*0.25*
925961	*AC1-072*	*1.29*

Appendix 6

(AEP - AEP) The 05SEGRETO-05BENTON 345 kV line (from bus 247803 to bus 243212 ckt 1) loads from 169.86% to 175.58% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#7023'. This project contributes approximately 80.62 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#7023'
OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*17.*
239293	*02BS-PKR*	*0.3*
247528	*05COVRT1*	*13.91*
247529	*05COVRT2*	*13.91*
247530	*05COVRT3*	*13.91*
247531	*05COVRT4*	*13.37*
247532	*05COVRT5*	*13.37*
247533	*05COVRT6*	*13.37*
936601	*AD2-075*	*80.62*
LTF	*AMIL*	*1.19*
LTF	*BAYOU*	*2.76*
LTF	*BIG_CAJUN1*	*4.07*
LTF	*BIG_CAJUN2*	*8.21*
LTF	*BLUEG*	*4.05*
LTF	*CALDERWOOD*	*0.88*
LTF	*CANNELTON*	*0.83*
LTF	*CATAWBA*	*0.33*
LTF	*CBM-N*	*0.36*
LTF	*CBM-W1*	*50.12*
LTF	*CELEVELAND*	*0.99*
LTF	*CHEOAH*	*0.8*
LTF	*CHILHOWEE*	*0.29*
LTF	*CHOCTAW*	*2.51*
LTF	*CLIFTY*	*10.42*
LTF	*COTTONWOOD*	*11.15*
LTF	*EDWARDS*	*2.89*
LTF	*ELMERSMITH*	*2.37*
LTF	*FARMERCITY*	*1.55*
LTF	*G-007A*	*2.31*
940311	*G934 C*	*9.05*
LTF	*GIBSON*	*1.81*

LTF	HAMLET	0.89
960031	J201 C	0.96
938541	J203 C	8.01
940031	J301 C	4.32
940041	J308 C	12.63
983041	J325 C	0.17
983051	J327 C	6.41
983111	J340 C	4.28
983151	J354 C	2.23
940121	J392	114.01
940241	J419	15.86
981121	J444	38.7
940351	J466	6.61
940361	J469	0.48
970341	J533 C	11.56
970381	J538 C	5.33
970391	J540	14.87
951551	J571	1.66
951071	J572	48.62
938031	J579 C	11.42
951591	J589 C	8.11
951341	J602 C	9.96
938611	J632 C	16.44
981041	J647	49.47
938301	J701 C	2.23
981321	J717 C	10.4
981471	J728 C	10.4
981601	J749	5.35
981111	J752 C	4.5
981591	J758	48.61
938021	J793	260.2
938111	J794 C	0.67
938321	J796	60.74
938351	J799	29.97
938761	J806	34.11
938401	J809	33.66
938871	J832	28.44
938881	J833	15.86
938901	J839	19.93
938441	J841	177.7
938951	J846	26.84
939031	J857	29.4
939101	J865	15.72
939201	J875	26.62
939321	J890 C	5.69

939791	*J906 C*	*6.66*
939501	*J914*	*9.72*
938001	*J921 C*	*10.19*
939621	*J931 C*	*10.09*
939661	*J936*	*125.53*
939671	*J937*	*125.53*
LTF	*MECS*	*90.52*
LTF	*MORGAN*	*3.85*
LTF	*NEWTON*	*4.98*
LTF	*NYISO*	*5.45*
LTF	*PRAIRIE*	*9.57*
LTF	*ROWAN*	*0.59*
LTF	*SANTEETLA*	*0.23*
LTF	*SMITHLAND*	*0.6*
LTF	*TATANKA*	*3.09*
LTF	*TILTON*	*2.64*
LTF	*TRIMBLE*	*0.77*
LTF	*TVA*	*1.72*
LTF	*UNIONPOWER*	*1.3*
LTF	*VFT*	*6.25*
LTF	*Y3-032*	*45.55*
918401	*AA1-056*	*0.98*
931951	*AB1-107 1*	*29.87*
931961	*AB1-107 2*	*67.82*
925961	*AC1-072*	*11.12*

Appendix 7

(AEP - AEP) The 05SEGRETO-05COOK 345 kV line (from bus 247803 to bus 243215 ckt 1) loads from 135.66% to 141.21% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'AEP_P1-2_#7021'. This project contributes approximately 67.07 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#7021'
OPEN BRANCH FROM BUS 243212 TO BUS 247803 CKT 1 / 243212 05BENTON 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*14.18*
238564	*02BAYSG1*	*12.59*
239293	*02BS-PKR*	*0.25*
247528	*05COVRT1*	*11.57*
247529	*05COVRT2*	*11.57*
247530	*05COVRT3*	*11.57*
247531	*05COVRT4*	*11.13*
247532	*05COVRT5*	*11.13*
247533	*05COVRT6*	*11.13*
936601	*AD2-075*	*67.07*
LTF	*AMIL*	*0.99*
LTF	*BAYOU*	*2.28*
LTF	*BIG_CAJUN1*	*3.37*
LTF	*BIG_CAJUN2*	*6.8*
LTF	*BLUEG*	*3.38*
LTF	*CALDERWOOD*	*0.73*
LTF	*CANNELTON*	*0.69*
LTF	*CATAWBA*	*0.27*
LTF	*CBM-N*	*0.3*
LTF	*CBM-W1*	*42.12*
LTF	*CELEVELAND*	*0.82*
LTF	*CHEOAH*	*0.66*
LTF	*CHILHOWEE*	*0.24*
LTF	*CHOCTAW*	*2.08*
LTF	*CLIFTY*	*8.7*
LTF	*COTTONWOOD*	*9.23*
LTF	*EDWARDS*	*2.39*
LTF	*ELMERSMITH*	*1.97*
LTF	*FARMERCITY*	*1.28*
LTF	*G-007A*	*1.92*
940311	*G934 C*	*7.53*

LTF	*GIBSON*	*1.5*
LTF	*HAMLET*	*0.74*
960031	*J201 C*	*0.8*
938541	*J203 C*	*6.66*
940031	*J301 C*	*3.6*
940041	*J308 C*	*10.51*
983041	*J325 C*	*0.14*
983051	*J327 C*	*5.34*
983111	*J340 C*	*3.56*
983151	*J354 C*	*1.85*
940121	*J392*	*94.84*
940241	*J419*	*13.19*
981121	*J444*	*32.19*
940351	*J466*	*5.5*
940361	*J469*	*0.4*
970341	*J533 C*	*9.62*
970381	*J538 C*	*4.44*
970391	*J540*	*12.37*
951551	*J571*	*1.39*
951071	*J572*	*40.45*
938031	*J579 C*	*9.51*
951591	*J589 C*	*6.75*
951341	*J602 C*	*8.29*
938611	*J632 C*	*13.67*
981041	*J647*	*41.16*
938301	*J701 C*	*1.86*
981321	*J717 C*	*8.65*
981471	*J728 C*	*8.65*
981601	*J749*	*4.45*
981111	*J752 C*	*3.74*
981591	*J758*	*40.48*
938021	*J793*	*216.45*
938111	*J794 C*	*0.56*
938321	*J796*	*50.53*
938351	*J799*	*24.93*
938761	*J806*	*28.4*
938401	*J809*	*28.*
938871	*J832*	*23.66*
938881	*J833*	*13.19*
938901	*J839*	*16.58*
938441	*J841*	*147.83*
938951	*J846*	*22.44*
939031	*J857*	*24.48*
939101	*J865*	*13.08*
939201	*J875*	*22.16*

939321	*J890 C*	*4.73*
939791	*J906 C*	*5.54*
939501	*J914*	*8.09*
938001	*J921 C*	*8.48*
939621	*J931 C*	*8.39*
939661	*J936*	*104.48*
939671	*J937*	*104.48*
LTF	*MECS*	*75.4*
LTF	*MORGAN*	*3.19*
LTF	*NEWTON*	*4.13*
LTF	*NYISO*	*4.54*
LTF	*PRAIRIE*	*7.92*
LTF	*ROWAN*	*0.49*
LTF	*SANTEETLA*	*0.19*
LTF	*SMITHLAND*	*0.5*
LTF	*TATANKA*	*2.55*
LTF	*TILTON*	*2.18*
LTF	*TRIMBLE*	*0.64*
LTF	*TVA*	*1.43*
LTF	*UNIONPOWER*	*1.08*
LTF	*VFT*	*5.19*
LTF	*Y3-032*	*37.97*
918401	*AA1-056*	*0.82*
931951	*AB1-107 1*	*24.91*
931961	*AB1-107 2*	*56.56*
925961	*AC1-072*	*9.25*

Appendix 8

(MISO METC - AEP) The 18ARGNTA-05TWIN B 345 kV line (from bus 256000 to bus 243234 ckt 1) loads from 133.22% to 135.77% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7042_05T094 345-'. This project contributes approximately 35.96 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7042_05T094 345-'
OPEN BRANCH FROM BUS 243212 TO BUS 247803 CKT 1 / 243212 05BENTON 345 247803 05SEGRETO 345 1
OPEN BRANCH FROM BUS 243215 TO BUS 247803 CKT 1 / 243215 05COOK 345 247803 05SEGRETO 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*11.45*
240968	*02BG2 GEN*	*0.58*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.29*
240971	*02BG4 G4&5*	*0.29*
240950	*02BG5*	*1.79*
240973	*02BG6 AMPO*	*2.6*
238979	*02NAPMUN*	*2.85*
240975	*02PGE GEN*	*4.03*
247528	*05COVRT1*	*6.2*
247529	*05COVRT2*	*6.2*
247530	*05COVRT3*	*6.2*
247531	*05COVRT4*	*5.96*
247532	*05COVRT5*	*5.96*
247533	*05COVRT6*	*5.96*
934891	*AD1-118*	*5.81*
936601	*AD2-075*	*35.96*
LTF	*AMIL*	*0.86*
LTF	*BAYOU*	*1.97*
LTF	*BIG_CAJUN1*	*2.91*
LTF	*BIG_CAJUN2*	*5.87*
LTF	*BLUEG*	*2.92*
LTF	*CALDERWOOD*	*0.62*
LTF	*CANNELTON*	*0.59*
LTF	*CATAWBA*	*0.23*
LTF	*CBM-N*	*0.28*
LTF	*CBM-W1*	*32.36*
LTF	*CELEVELAND*	*0.68*
LTF	*CHEOAH*	*0.56*

LTF	*CHILHOWEE*	*0.2*
LTF	*CHOCTAW*	*1.79*
LTF	*CLIFTY*	*7.43*
LTF	*COTTONWOOD*	*7.98*
LTF	*EDWARDS*	*2.09*
LTF	*ELMERSMITH*	*1.7*
LTF	*FARMERCITY*	*1.12*
LTF	*G-007A*	*1.84*
940311	*G934 C*	*5.99*
940312	*G934 E*	*23.95*
960018	*G997 E*	*6.17*
LTF	*GIBSON*	*1.3*
LTF	*HAMLET*	*0.6*
960031	*J201 C*	*0.68*
960032	*J201 E*	*2.71*
938541	*J203 C*	*5.87*
938542	*J203 E*	*23.48*
940031	*J301 C*	*3.12*
940032	*J301 E*	*12.47*
940041	*J308 C*	*9.15*
940042	*J308 E*	*36.62*
983041	*J325 C*	*0.12*
983042	*J325 E*	*0.37*
983051	*J327 C*	*4.63*
983052	*J327 E*	*13.88*
983111	*J340 C*	*3.09*
983112	*J340 E*	*9.26*
983151	*J354 C*	*1.61*
983152	*J354 E*	*4.82*
940121	*J392*	*77.55*
940241	*J419*	*12.35*
981121	*J444*	*29.48*
940351	*J466*	*4.73*
940361	*J469*	*0.33*
970341	*J533 C*	*7.73*
970342	*J533 E*	*30.93*
970381	*J538 C*	*4.36*
970382	*J538 E*	*17.42*
970391	*J540*	*10.08*
951551	*J571*	*1.39*
951071	*J572*	*32.73*
938031	*J579 C*	*10.02*
938032	*J579 E*	*40.07*
951591	*J589 C*	*5.53*
951592	*J589 E*	*22.12*

951341	*J602 C*	*6.96*
951342	*J602 E*	*27.85*
938611	*J632 C*	*9.76*
938612	*J632 E*	*39.04*
981022	*J646 E*	*0.23*
981041	*J647*	*33.08*
938301	*J701 C*	*1.59*
938302	*J701 E*	*6.34*
981321	*J717 C*	*7.19*
981322	*J717 E*	*28.76*
981471	*J728 C*	*7.19*
981472	*J728 E*	*28.76*
981601	*J749*	*3.67*
981111	*J752 C*	*3.21*
981112	*J752 E*	*12.82*
981591	*J758*	*40.74*
938021	*J793*	*191.48*
938111	*J794 C*	*0.46*
938112	*J794 E*	*1.83*
938321	*J796*	*42.06*
938351	*J799*	*23.35*
938761	*J806*	*28.25*
938401	*J809*	*22.29*
938871	*J832*	*19.46*
938881	*J833*	*12.35*
938901	*J839*	*14.62*
938441	*J841*	*123.23*
938951	*J846*	*22.51*
939031	*J857*	*24.53*
939101	*J865*	*11.57*
939201	*J875*	*21.37*
939321	*J890 C*	*3.89*
939322	*J890 E*	*15.57*
939791	*J906 C*	*4.45*
939792	*J906 E*	*17.79*
939501	*J914*	*6.55*
938001	*J921 C*	*6.56*
938002	*J921 E*	*26.23*
939621	*J931 C*	*6.73*
939622	*J931 E*	*26.93*
939661	*J936*	*106.98*
939671	*J937*	*106.98*
LTF	*MECS*	*61.57*
LTF	*MORGAN*	*2.75*
LTF	*NEWTON*	*3.56*

LTF	*NYISO*	*4.24*
LTF	*PRAIRIE*	*6.87*
LTF	*ROWAN*	*0.4*
LTF	*SANTEETLA*	*0.16*
LTF	*SMITHLAND*	*0.43*
LTF	*TATANKA*	*2.24*
LTF	*TILTON*	*1.87*
LTF	*TRIMBLE*	*0.55*
LTF	*TVA*	*1.23*
LTF	*UNIONPOWER*	*0.92*
LTF	*VFT*	*4.97*
LTF	*Y3-032*	*33.97*
931951	*AB1-107 1*	*22.67*
931961	*AB1-107 2*	*51.27*
925961	*AC1-072*	*4.96*

Appendix 9

(MISO ITCT - FE) The 19MAJTC-02LEMOYN 345 kV line (from bus 264599 to bus 238889 ckt 1) loads from 188.26% to 189.93% (**DC power flow**) of its emergency rating (953 MVA) for the tower line contingency outage of 'ATSI-P7-1-TE-138-027T'. This project contributes approximately 15.89 MW to the thermal violation.

CONTINGENCY 'ATSI-P7-1-TE-138-027T' /* ALLEN-MIL-MONRO & BAYSH-MONRO 345KV
DISCONNECT BRANCH FROM BUS 238530 TO BUS 256583 CKT 1 /* 02ALLEN 345 18LENAWEE 345
DISCONNECT BRANCH FROM BUS 264594 TO BUS 264839 CKT 1 /* 19LULU 345 19MILAN 345
DISCONNECT BRANCH FROM BUS 264594 TO BUS 264613 CKT 1 /* 19LULU 345 19MON34 345
DISCONNECT BUS 256583 /* 18LENAWEE 345
DISCONNECT BRANCH FROM BUS 241901 TO BUS 264612 CKT 1 /* 02_Y1-069 345 19MON12 345
END

Bus Number	*Bus Name*	*Full Contribution*
240968	*02BG2 GEN*	*-0.85*
240969	*02BG4 G1*	*-0.21*
240970	*02BG4 G2&3*	*-0.42*
240971	*02BG4 G4&5*	*-0.42*
240973	*02BG6 AMPO*	*-3.77*
246431	*05BUCHANAN*	*0.3*
247528	*05COVRT1*	*2.74*
247529	*05COVRT2*	*2.74*
247530	*05COVRT3*	*2.74*
247531	*05COVRT4*	*2.64*
247532	*05COVRT5*	*2.64*
247533	*05COVRT6*	*2.64*
246536	*05MOTTVILL*	*0.12*
LTF	*AD1-092*	*5.06*
LTF	*AD1-093*	*8.7*
LTF	*AD1-094*	*1.66*
936141	*AD2-020 C O1*	*5.*
936142	*AD2-020 E O1*	*3.08*
936601	*AD2-075*	*15.89*
LTF	*CARR*	*0.73*
LTF	*CBM-S1*	*6.1*
LTF	*CBM-S2*	*1.9*

LTF	*CBM-W1*	*116.48*
LTF	*CBM-W2*	*50.97*
LTF	*CIN*	*7.74*
LTF	*CPLE*	*0.29*
LTF	*G-007*	*1.31*
940311	*G934 C*	*3.38*
940312	*G934 E*	*13.53*
960018	*G997 E*	*7.16*
LTF	*IPL*	*4.89*
960031	*J201 C*	*0.63*
960032	*J201 E*	*2.52*
938541	*J203 C*	*7.6*
938542	*J203 E*	*30.4*
940031	*J301 C*	*3.62*
940032	*J301 E*	*14.46*
940041	*J308 C*	*10.98*
940042	*J308 E*	*43.91*
983041	*J325 C*	*0.14*
983042	*J325 E*	*0.43*
983051	*J327 C*	*5.37*
983052	*J327 E*	*16.12*
983111	*J340 C*	*3.58*
983112	*J340 E*	*10.75*
983151	*J354 C*	*1.86*
983152	*J354 E*	*5.59*
940121	*J392*	*42.28*
940241	*J419*	*22.17*
981121	*J444*	*48.3*
940351	*J466*	*5.22*
940361	*J469*	*0.24*
970341	*J533 C*	*4.88*
970342	*J533 E*	*19.53*
970381	*J538 C*	*4.14*
970382	*J538 E*	*16.55*
970391	*J540*	*5.02*
951551	*J571*	*0.49*
951071	*J572*	*13.18*
951591	*J589 C*	*3.9*
951592	*J589 E*	*15.62*
951341	*J602 C*	*6.05*
951342	*J602 E*	*24.19*
981022	*J646 E*	*0.31*
981041	*J647*	*11.55*
938301	*J701 C*	*1.65*
938302	*J701 E*	*6.59*

981321	*J717 C*	*5.71*
981322	*J717 E*	*22.82*
981471	*J728 C*	*5.71*
981472	*J728 E*	*22.82*
981601	*J749*	*2.74*
981111	*J752 C*	*3.41*
981112	*J752 E*	*13.63*
981591	*J758*	*21.12*
938021	*J793*	*253.73*
938111	*J794 C*	*0.34*
938112	*J794 E*	*1.37*
938321	*J796*	*35.33*
938351	*J799*	*41.9*
938761	*J806*	*19.1*
938401	*J809*	*7.56*
938871	*J832*	*12.15*
938881	*J833*	*22.17*
938901	*J839*	*19.*
938441	*J841*	*104.16*
938951	*J846*	*13.15*
939031	*J857*	*14.37*
939101	*J865*	*15.36*
939201	*J875*	*25.58*
939321	*J890 C*	*2.43*
939322	*J890 E*	*9.72*
939791	*J906 C*	*1.62*
939792	*J906 E*	*6.5*
939501	*J914*	*2.64*
938001	*J921 C*	*2.27*
938002	*J921 E*	*9.09*
939621	*J931 C*	*2.37*
939622	*J931 E*	*9.47*
939661	*J936*	*59.56*
939671	*J937*	*59.56*
LTF	*LGEE*	*1.11*
LTF	*MEC*	*19.38*
LTF	*MECS*	*82.32*
LTF	*O-066*	*8.43*
LTF	*RENSSELAER*	*0.57*
LTF	*ROSETON*	*4.12*
LTF	*WEC*	*3.35*
LTF	*Y3-032*	*71.63*
LTF	*Z1-043*	*12.72*
247966	*Z2-113 E*	*0.2*
920211	*AA2-116*	*74.32*

LTF	*AB2-013*	*7.25*
925961	*AC1-072*	*2.19*
926581	*AC1-141*	*6.8*

Appendix 10

(MISO ITCT - FE) The 19MON12-02LALLENDORF 345 kV line (from bus 264612 to bus 241901 ckt 1) loads from 193.95% to 195.46% (**DC power flow**) of its emergency rating (1494 MVA) for the tower line contingency outage of 'ATSI-P7-1-TE-138-025T'. This project contributes approximately 22.68 MW to the thermal violation.

CONTINGENCY 'ATSI-P7-1-TE-138-025T' /* ALLEN-MAJ-MONROE & LEMO-MAJESTIC 345KV
DISCONNECT BRANCH FROM BUS 238530 TO BUS 256583 CKT 1 /* 02ALLEN 345 18LENAWEE 345
DISCONNECT BRANCH FROM BUS 264594 TO BUS 256583 CKT 1 /* 19LULU 345 18LENAWEE 345
DISCONNECT BRANCH FROM BUS 264594 TO BUS 264839 CKT 1 /* 19LULU 345 19MILAN 345
DISCONNECT BRANCH FROM BUS 264594 TO BUS 264613 CKT 1 /* 19LULU 345 19MON34 345
DISCONNECT BUS 256583 /* 18LENAWEE 345
DISCONNECT BRANCH FROM BUS 238889 TO BUS 264599 CKT 1 /* 02LEMOYN 345 19MAJTC 345
END

Bus Number	*Bus Name*	*Full Contribution*
240968	*02BG2 GEN*	*-1.02*
240969	*02BG4 G1*	*-0.26*
240970	*02BG4 G2&3*	*-0.52*
240971	*02BG4 G4&5*	*-0.52*
240973	*02BG6 AMPO*	*-4.59*
246427	*05BERRIENS*	*0.1*
246431	*05BUCHANAN*	*0.44*
243440	*05CKG1*	*21.32*
247528	*05COVRT1*	*3.91*
247529	*05COVRT2*	*3.91*
247530	*05COVRT3*	*3.91*
247531	*05COVRT4*	*3.76*
247532	*05COVRT5*	*3.76*
247533	*05COVRT6*	*3.76*
246422	*05MAYFLWER*	*0.13*
246536	*05MOTTVILL*	*0.17*
LTF	*AD1-092*	*7.28*
LTF	*AD1-093*	*12.52*
LTF	*AD1-094*	*2.39*
936141	*AD2-020 C O1*	*7.16*

936142	*AD2-020 E O1*	*4.4*
936601	*AD2-075*	*22.68*
LTF	*CARR*	*1.05*
LTF	*CBM-S1*	*8.92*
LTF	*CBM-S2*	*2.85*
LTF	*CBM-W1*	*180.02*
LTF	*CBM-W2*	*73.98*
LTF	*CIN*	*11.25*
LTF	*CPLE*	*0.45*
LTF	*G-007*	*1.88*
940311	*G934 C*	*4.92*
940312	*G934 E*	*19.67*
960018	*G997 E*	*10.99*
LTF	*IPL*	*7.12*
960031	*J201 C*	*0.95*
960032	*J201 E*	*3.8*
938541	*J203 C*	*11.73*
938542	*J203 E*	*46.91*
940031	*J301 C*	*5.55*
940032	*J301 E*	*22.19*
940041	*J308 C*	*16.87*
940042	*J308 E*	*67.47*
983041	*J325 C*	*0.22*
983042	*J325 E*	*0.66*
983051	*J327 C*	*8.25*
983052	*J327 E*	*24.74*
983111	*J340 C*	*5.5*
983112	*J340 E*	*16.49*
983151	*J354 C*	*2.86*
983152	*J354 E*	*8.57*
940121	*J392*	*61.2*
940241	*J419*	*30.92*
981121	*J444*	*83.39*
940351	*J466*	*7.98*
940361	*J469*	*0.36*
970341	*J533 C*	*7.16*
970342	*J533 E*	*28.66*
970381	*J538 C*	*5.75*
970382	*J538 E*	*22.99*
970391	*J540*	*7.19*
951071	*J572*	*18.39*
951591	*J589 C*	*5.77*
951592	*J589 E*	*23.07*
951341	*J602 C*	*9.*
951342	*J602 E*	*36.*

981022	*J646 E*	*0.48*
981041	*J647*	*15.73*
938301	*J701 C*	*2.51*
938302	*J701 E*	*10.05*
981321	*J717 C*	*8.52*
981322	*J717 E*	*34.07*
981471	*J728 C*	*8.52*
981472	*J728 E*	*34.07*
981601	*J749*	*4.07*
981111	*J752 C*	*5.2*
981112	*J752 E*	*20.81*
981591	*J758*	*27.03*
938021	*J793*	*394.68*
938111	*J794 C*	*0.51*
938112	*J794 E*	*2.04*
938321	*J796*	*52.84*
938351	*J799*	*58.44*
938761	*J806*	*24.65*
938871	*J832*	*17.81*
938881	*J833*	*30.92*
938901	*J839*	*29.5*
938441	*J841*	*156.29*
938951	*J846*	*17.34*
939031	*J857*	*18.64*
939101	*J865*	*23.91*
939201	*J875*	*36.14*
939321	*J890 C*	*3.56*
939322	*J890 E*	*14.25*
939791	*J906 C*	*2.23*
939792	*J906 E*	*8.92*
939501	*J914*	*3.68*
938001	*J921 C*	*3.09*
938002	*J921 E*	*12.34*
939621	*J931 C*	*3.24*
939622	*J931 E*	*12.95*
939661	*J936*	*74.64*
939671	*J937*	*74.64*
LTF	*LGEE*	*1.63*
LTF	*MEC*	*27.94*
LTF	*MECS*	*130.93*
LTF	*O-066*	*12.11*
LTF	*RENSSELAER*	*0.83*
LTF	*ROSETON*	*5.98*
LTF	*WEC*	*4.82*
247604	*X1-042*	*0.07*

LTF	*Y3-032*	*119.71*
LTF	*Z1-043*	*18.3*
247640	*Z2-113 C*	*0.05*
247966	*Z2-113 E*	*0.29*
920211	*AA2-116*	*106.35*
LTF	*AB2-013*	*10.43*
925961	*AC1-072*	*3.13*
926581	*AC1-141*	*9.74*

Appendix 11

(AEP - AEP) The AA2-116 TAP-05KENZIE 345 kV line (from bus 920210 to bus 243224 ckt 1) loads from 109.37% to 110.65% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'AEP_P4_#7443_05DUMONT 765'. This project contributes approximately 18.06 MW to the thermal violation.

CONTINGENCY 'AEP_P4_#7443_05DUMONT 765'
OPEN BRANCH FROM BUS 243205 TO BUS 243206 CKT 1 / 243205 05COOK 765 243206 05DUMONT 765 1
OPEN BRANCH FROM BUS 243206 TO BUS 246999 CKT 1 / 243206 05DUMONT 765 246999 05SORENS 765 1
END

Bus Number	*Bus Name*	*Full Contribution*
246431	*05BUCHANAN*	*-0.37*
243440	*05CKG1*	*39.12*
243441	*05CKG2*	*40.99*
247528	*05COVRT1*	*3.12*
247529	*05COVRT2*	*3.12*
247530	*05COVRT3*	*3.12*
247531	*05COVRT4*	*3.*
247532	*05COVRT5*	*3.*
247533	*05COVRT6*	*3.*
933281	*AC2-140 C*	*7.87*
936601	*AD2-075*	*18.06*
LTF	*AMIL*	*0.43*
LTF	*BAYOU*	*1.08*
LTF	*BIG_CAJUN1*	*1.61*
LTF	*BIG_CAJUN2*	*3.24*
LTF	*BLUEG*	*1.59*
LTF	*CALDERWOOD*	*0.37*
LTF	*CANNELTON*	*0.3*
LTF	*CATAWBA*	*0.16*
LTF	*CBM-N*	*0.05*
LTF	*CBM-W1*	*3.51*
LTF	*CELEVELAND*	*0.48*
LTF	*CHEOAH*	*0.34*
LTF	*CHILHOWEE*	*0.12*
LTF	*CHOCTAW*	*1.*
LTF	*CLIFTY*	*4.56*
LTF	*COTTONWOOD*	*4.37*
LTF	*EDWARDS*	*1.14*
LTF	*ELMERSMITH*	*0.88*

LTF	*FARMERCITY*	*0.61*
LTF	*G-007A*	*0.2*
940311	*G934 C*	*2.1*
940312	*G934 E*	*8.4*
960018	*G997 E*	*2.05*
LTF	*GIBSON*	*0.61*
LTF	*HAMLET*	*0.48*
960031	*J201 C*	*0.23*
960032	*J201 E*	*0.91*
940031	*J301 C*	*1.03*
940032	*J301 E*	*4.13*
940041	*J308 C*	*3.03*
940042	*J308 E*	*12.11*
983041	*J325 C*	*0.04*
983042	*J325 E*	*0.12*
983051	*J327 C*	*1.53*
983052	*J327 E*	*4.6*
983111	*J340 C*	*1.02*
983112	*J340 E*	*3.07*
983151	*J354 C*	*0.53*
983152	*J354 E*	*1.6*
940121	*J392*	*26.37*
940351	*J466*	*1.58*
940361	*J469*	*0.11*
970341	*J533 C*	*2.69*
970342	*J533 E*	*10.77*
970391	*J540*	*3.43*
951551	*J571*	*0.39*
951071	*J572*	*11.16*
938031	*J579 C*	*2.49*
938032	*J579 E*	*9.94*
951591	*J589 C*	*1.9*
951592	*J589 E*	*7.58*
951341	*J602 C*	*2.34*
951342	*J602 E*	*9.38*
938611	*J632 C*	*3.77*
938612	*J632 E*	*15.07*
981041	*J647*	*11.34*
938301	*J701 C*	*0.53*
938302	*J701 E*	*2.12*
981321	*J717 C*	*2.44*
981322	*J717 E*	*9.76*
981471	*J728 C*	*2.44*
981472	*J728 E*	*9.76*
981601	*J749*	*1.25*

981111	*J752 C*	*1.07*
981112	*J752 E*	*4.28*
981591	*J758*	*11.24*
938111	*J794 C*	*0.16*
938112	*J794 E*	*0.63*
938321	*J796*	*14.29*
938761	*J806*	*7.94*
938401	*J809*	*7.72*
938871	*J832*	*6.61*
938441	*J841*	*41.8*
939031	*J857*	*6.82*
939321	*J890 C*	*1.32*
939322	*J890 E*	*5.28*
939791	*J906 C*	*1.53*
939792	*J906 E*	*6.11*
939501	*J914*	*2.23*
938001	*J921 C*	*2.35*
938002	*J921 E*	*9.4*
939621	*J931 C*	*2.31*
939622	*J931 E*	*9.24*
939661	*J936*	*28.17*
939671	*J937*	*28.17*
LTF	*MECS*	*19.25*
LTF	*MORGAN*	*1.53*
LTF	*NEWTON*	*1.69*
LTF	*NYISO*	*0.83*
LTF	*PRAIRIE*	*3.52*
LTF	*ROWAN*	*0.3*
LTF	*SANTEETLA*	*0.1*
LTF	*SMITHLAND*	*0.22*
LTF	*TATANKA*	*1.23*
LTF	*TILTON*	*0.79*
LTF	*TRIMBLE*	*0.3*
LTF	*TVA*	*0.68*
LTF	*UNIONPOWER*	*0.55*
LTF	*VFT*	*0.54*
LTF	*Y3-032*	*9.63*
247633	*Z1-051*	*3.19*
920211	*AA2-116*	*408.41*
925961	*AC1-072*	*2.49*
926581	*AC1-141*	*37.39*