

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AB1-088***

Sullivan 345 kV

June 2016

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC) proposes to interconnect a 575 MW (550 MW Capacity) natural gas fired Electric Power Plant to the American Electric Power (AEP) Transmission System at two (2) alternative points. The proposed PJM Project #AB1-088 is located in Sullivan County, Indiana.

The requested in-service date is 06/01/2019.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP Transmission System. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP Transmission System. Stability analysis is not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (Sullivan Station 345 kV Yard)

To accommodate the interconnection at the Sullivan substation 345 kV yard an additional 345 kV circuit breaker and associated protection and control equipment will be installed. Installation of associated 345 kV line risers, SCADA, and metering equipment will be also required.

The following work is required to connect Project AB1-088 to the Proposed Primary Point of Interconnection (Sullivan Station 345 kV Yard):

Station Cost:

- Install a new 345 kV circuit breaker and associated bus work including SCADA and 345 kV revenue metering.
- **Estimated Station Cost: \$2,500,000**
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Protection and Relaying Cost:

- Line protection and controls at the Sullivan 345 kV substation will need to be upgraded.
- **Estimated Protection and Relaying Cost: \$600,000**

Note: The IC's generation facilities were not included in the cost estimate. These are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider utility to determine if a local service agreement is required.

Secondary Point of Interconnection (Sullivan Station 765 kV Yard)

To accommodate the interconnection at the Sullivan substation 765 kV yard an additional 765 kV circuit breaker and associated protection and control equipment will be installed. Installation of associated 765 kV line risers, SCADA, and metering equipment will be also required.

The following work is required to connect Project AB1-088 to the Proposed Secondary Point of Interconnection (Sullivan Station 765 kV Yard):

Station Connection:

- Install a new 765 kV circuit breaker and associated bus work including SCADA and 765 kV revenue metering.
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Protection and Relaying:

- Line protection and controls at the Sullivan 765 kV substation will need to be upgraded.

Local and Network Impacts

The impact of the proposed natural gas fired generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715¹ and Connection Requirements for AEP Transmission System². Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. PJM project AB1-088 was studied as a 575 MW (550 MW capacity) injection to AEP system consistent with the interconnection application. The proposed Project AB1-088 was evaluated for compliance with reliability criteria for summer peak conditions in 2019.

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https://www.aep.com/about/codeofconduct/oasis/transmissionstudies/GuideLines/2015%20AEP%20PJM%20FERC%20715_Final_Part%204.pdf

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https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/Requirements/AEP_Interconnection_Requirements_rev1.pdf

Network Impacts

The Queue Project AB1-088 was evaluated as a 575.0 MW (Capacity 550.0 MW) injection at the Sullivan 345kV substation in the AEP area. Project AB1-088 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-088 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2019

System Reinforcement responsible by Transmission Owner

1. Existing Baseline project

(This project contributes to the following contingency overloads, and there are existing PJM baseline projects to fix the following overloads. If a customer desires to expedite the required date for the existing PJM baseline projects, the customer will be financially responsible)

1. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 128.83% to 135.19% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 89.7 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

2. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 107.3% to 112.24% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of '8808_B2'. This project contributes approximately 69.59 MW to the thermal violation.

CONTINGENCY '8808_B2'

OPEN BRANCH FROM BUS 243229 TO BUS 243878 CKT 1 / 243229 05OLIVE 345
243878 05MEADOW 345 1
END

PJM baseline project (b2449 Rebuild 7-,mile Meadow Lake-Reynolds 345kV line) will eliminate the identified overloads; incremental costs are listed in the Reinforcements Section. The scheduled in service date b2449 is 06/01/2017.

2. Existing Supplemental projects

(This project contributes to the following contingency overloads, and there are existing PJM supplemental projects to fix the following overloads. If a customer desires to expedite the required date for the existing PJM supplemental project, the customer will be financially responsible)

1. (AEP - AEP) The 05SULVN3-05BREED 345 kV line (from bus 247158 to bus 243213 ckt Z3) loads from 104.94% to 135.89% (**DC power flow**) of its normal rating (1754 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 542.76 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

Please refer to Appendix 11 for a table containing the generators having contribution to this flowgate.

PJM supplemental project (S0764-Rebuild Breed 345 kV station adjacent to the existing Sullivan station) will eliminate the identified overloads.. The scheduled in service date s0764 is 06/01/17.

Primary Point of Interconnection (Sullivan Station 345 kV Yard) Potential network impacts were as follows:

Generator Deliverability

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

Table 1 - Primary Point of Interconnection AB1-088 Generator Deliverability														
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	N-1	667_B2_TOR1697	AEP - AEP	05BREED-05DARWIN 345 kV line	243213	243216	1	DC	92.12	101.81	NR	971	94.07	
2	N-1	672_B2_TOR1713	AEP - AEP	05BREED-05DEQUIN 345 kV line	243213	243217	1	DC	95.13	101.22	NR	971	59.11	
3	N-1	363_B2_TOR1682	AEP - MISO AMIL	05BREED-7CASEY 345 kV line	243213	346809	1	DC	94.74	109.29	NR	1332	193.79	
4	N-1	667_B2_TOR1697	AEP - AEP	05DARWIN-05EUGENE 345 kV line	243216	243221	1	DC	92.12	101.81	NR	971	94.07	

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

Table 2 - Primary Point of Interconnection AB1-088 Multiple Facility Contingency														
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	LFFB	6189_C2_05HANG R 765-D1	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	95.73	100.51	ER	2354	97.72	

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.)

Table 3 - Primary Point of Interconnection AB1-088 Contribution to Previously Identified Overloads														
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	LFFB	1760_C2_05JEFRSO 765-A	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	120.48	126.31	ER	2354	137.21	1
2	DCTL	430	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	103.49	108.84	ER	4253	227.82	2
3	DCTL	431	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	103.49	108.84	ER	4253	227.82	
4	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DARWIN 345 kV line	243213	243216	1	DC	141.59	153.89	NR	971	119.4	3

Table 3 - Primary Point of Interconnection
AB1-088 Contribution to Previously Identified Overloads

#	Type	Contingency	Affected Area	Facility	Bus			PF	Loading		Rating		MW Con.	FG App.
		Name		Description	From	To	Cir.		Initial	Final	Type	MVA		
5	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05BREED- 05DARWIN 345 kV line	243213	243216	1	DC	128.46	137.27	ER	1419	125	
6	N-1	363_B2_TOR1682	AEP - AEP	05BREED- 05DEQUIN 345 kV line	243213	243217	1	DC	125.81	134.14	NR	971	80.91	4
7	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05BREED- 05DEQUIN 345 kV line	243213	243217	1	DC	118.56	125.08	ER	1304	85.14	
8	LFFB	8648_C2_05JEFRSO 765-B1	AEP - MISO AMIL	05BREED- 7CASEY 345 kV line	243213	346809	1	DC	138.72	152.56	ER	1466	202.88	5
9	N-1	363_B2_TOR1682	AEP - AEP	05DARWIN- 05EUGENE 345 kV line	243216	243221	1	DC	141.59	153.89	NR	971	119.4	6
10	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05DARWIN- 05EUGENE 345 kV line	243216	243221	1	DC	128.46	137.27	ER	1419	125	
11	LFFB	6485_C2_05DEQUIN 345-C1	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	147.02	152.38	ER	1304	69.94	7
12	N-1	6490_B2_TOR16000	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	135.55	142.36	NR	971	66.17	
13	N-1	363_B2_TOR1682	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	106.34	112.09	NR	971	55.79	
14	LFFB	4704_C2_05DEQUIN 345-B1	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	147.02	152.38	ER	1304	69.94	8
15	N-1	6472_B2_TOR15258	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	135.55	142.36	NR	971	66.17	
16	N-1	363_B2_TOR1682	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	106.34	112.09	NR	971	55.79	
17	N-1	667_B2_TOR1697	AEP - AEP	05EUGENE- 05DEQUIN 345 kV line	243221	243217	1	DC	116.81	121.04	NR	971	41.01	9
18	N-1	363_B2_TOR1682	AEP - AEP	05EUGENE- 05DEQUIN 345 kV line	243221	243217	1	DC	116	119.75	NR	971	36.45	
19	LFFB	8648_C2_05JEFRSO 765-B1	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	149.57	154.55	ER	1918	95.48	10
20	N-1	363_B2_TOR1682	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	128.83	135.19	NR	1409	89.7	
21	N-1	8808_B2	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	107.3	112.24	NR	1409	69.59	
22	N-1	363_B2_TOR1682	AEP - AEP	05SULVN3- 05BREED 345 kV line	247158	243213	Z3	DC	104.94	135.89	NR	1754	542.76	11
23	N-1	345-L8014_T-S	CE - CE	LORETTO ; B- WILTON ; B 345 kV line	270704	270926	1	DC	126.51	128.79	ER	1280	29.09	12
24	N-1	363_B2_TOR1682	CE - CE	LORETTO ; B- WILTON ; B 345 kV line	270704	270926	1	DC	101.49	103.65	ER	1280	27.58	
25	N-1	345-L8014_T-S	CE - CE	PONTIAC ; B- LORETTO ; B 345 kV line	270852	270704	1	DC	126.07	128.42	ER	1241	29.27	13
26	N-1	363_B2_TOR1682	CE - CE	PONTIAC ; B- LORETTO ; B 345 kV line	270852	270704	1	DC	100.32	102.55	ER	1241	27.76	

Short Circuit

(Summary of impacted circuit breakers)

Bus Number	Bus Name	BREAKER	Rating Type	Breaker Capacity (Amps)	Duty Percent With AB1-088_aep_v1	Duty Percent Without AB1-088_aep_v1	Duty Percent Difference	Duty Amps With AB1-088_aep_v1	Duty Amps Without AB1-088_aep_v1	Notes
0	05TWIN B 345.kV	JM	T	48000	100.00%	100.00%	0.00%	48000.9	47998.8	\$280,000, 12 months after IA is signed

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

Note: 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

Table 4 - Primary Point of Interconnection														
AB1-088 Delivery of Energy Portion of Interconnection Request														
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Loading				Rating		MW Con.	FG App.
					From	To	Cir.	PF	Initial	Final	Type	MVA		
1	N-1	8695_B2	AEP - AEP	05ROCKPT-05JEFRS0 765 kV line	243209	243208	1	DC	100.24	104.83	NR	4055	186.15	
2	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DARWIN 345 kV line	243213	243216	1	DC	186.86	199.72	NR	971	124.83	
3	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DEQUIN 345 kV line	243213	243217	1	DC	156.49	165.2	NR	971	84.59	
4	N-1	363_B2_TOR1682	AEP - MISO AMIL	05BREED-7CASEY 345 kV line	243213	346809	1	DC	151.31	166.52	NR	1332	202.6	
5	N-1	363_B2_TOR1682	AEP - AEP	05DARWIN-05EUGENE 345 kV line	243216	243221	1	DC	186.86	199.72	NR	971	124.83	
6	N-1	6490_B2_TOR16000	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	1	DC	191.6	198.72	NR	971	69.17	
7	N-1	6472_B2_TOR15258	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	2	DC	191.6	198.72	NR	971	69.17	
8	N-1	667_B2_TOR1697	AEP - AEP	05EUGENE-05DEQUIN 345 kV line	243221	243217	1	DC	130.38	132.37	NR	971	42.88	
9	N-1	363_B2_TOR1682	AEP - MISO DEM	05EUGENE-08CAYSUB 345 kV line	243221	249504	1	DC	100.83	107.24	NR	1374	88	

Table 4 - Primary Point of Interconnection
AB1-088 Delivery of Energy Portion of Interconnection Request

#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
10	N-1	8695_B2	AEP - AEP	05MEADOW-05OLIVE 345 kV line	243878	243229	1	DC	127.26	129.02	NR	971	38.05	
11	N-1	363_B2_TOR1682	AEP - MISO NIPS	05MEADOW-17REYNOLDS 345 kV line	243878	255205	1	DC	196.93	203.58	NR	1409	93.78	
12	N-1	363_B2_TOR1682	AEP - AEP	05SULVN3-05BREED 345 kV line	247158	243213	Z3	DC	106.35	138.7	NR	1754	567.43	

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 (Table 1)

1. (AEP - AEP) The 05BREED-05DARWIN 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 92.12% to 101.81% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '667_B2_TOR1697'. This project contributes approximately 94.07 MW to the thermal violation.

Reinforcement: Reconductor/Rebuild the entire 12.65 mile section of line.

Cost: \$25,360,000.

Time: 24-36 months

2. (AEP - AEP) The 05BREED-05DEQUIN 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 95.13% to 101.22% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '672_B2_TOR1713'. This project contributes approximately 59.11 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild the entire 97.19 mile ACSR/PE ~ 1414 ~ 62/19 ~ Conductor Section 1.

Cost: \$194, 380,000

Time: 24-36 months

3. (AEP - MISO AMIL) The 05BREED-7CASEY 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 94.74% to 109.29% (**DC power flow**) of its normal rating (1332 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 193.79 MW to the thermal violation.

Reinforcement: (1) Reconduct/Rebuild 0.61miles of conductor section. Estimated cost is \$2,000,000. (2) Upgrade Sullivan Wavetrap. Estimated cost is \$400,000, (3) Upgrad Sub Cond 2-2000 AAC 91

Str. Sullivan Line Risers \$250,000, and (4) Reconduct/Rebuild 0.82miles of conductor section 3. Estimated Cost is: \$2,000,000 This is an AEP-AMIL tie line therefore, PJM is going to have to coordinate this upgrade with AMIL as well to make sure that their equipment will not set a limit lower than what is specified here. AMIL's portion of the conductor needs to be reconducted/rebuilt as well as the West Casey Wavetrap (3000A) to mitigate this overload.

Cost: \$4,650,000

Time: 24-36 months

4. (AEP - AEP) The 05DARWIN-05EUGENE 345 kV line (from bus 243216 to bus 243221 ckt 1) loads from 92.12% to 101.81% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '667_B2_TOR1697'. This project contributes approximately 94.07 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild the entire the entire 39.32 mile section of line.

Cost: \$ 78,640,000

Time: 24-36 months

Multiple Facility Contingency (Table 2)

1. (AEP - OVEC) The 05JEFRSO-06CLIFTY 345 kV line (from bus 242865 to bus 248000 ckt Z1) loads from 95.73% to 100.51% (**DC power flow**) of its emergency rating (2354 MVA) for the line fault with failed breaker contingency outage of '6189_C2_05HANG R 765-D1'. This project contributes approximately 97.72 MW to the thermal violation.

Reinforcement: A Sag Study will be required on the 0.75 mile section of line to mitigate the overload on the Jefferson - Clifty Creek 345 kV line. Depending on the sag study results, cost for this upgrade is expected to be between \$4,000 (no remediations required just sag study) and \$2.0 million (complete line rebuild required).

This is an AEP-OVEC tie line therefore, PJM is going to have to coordinate this upgrade with OVEC as well to make sure that their equipment will not set a limit lower than what is specified here.

Cost: \$ 2,004,000

Time: 24-36 months

Contribution to Previously Identified Overloads (Table 3)

1. (AEP - OVEC) The 05JEFRSO-06CLIFTY 345 kV line (from bus 242865 to bus 248000 ckt Z1) loads from 120.48% to 126.31% (**DC power flow**) of its emergency rating (2354 MVA) for the line fault with failed breaker contingency outage of '1760_C2_05JEFRSO 765-A'. This project contributes approximately 137.21 MW to the thermal violation.

Same as Multiple Facility #1

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. (AEP - AEP) The 05ROCKPT-05JEFRSO 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 103.49% to 108.84% (**DC power flow**) of its emergency rating (4253 MVA) for the tower line contingency outage of '430'. This project contributes approximately 227.82 MW to the thermal violation.

Reinforcement: Replace Rockport Wavetrap. Estimated Cost: \$500,000. Replace Jefferson Wavetrap. Estimated Cost: \$500,000.

Cost: \$1M

Time: 12 months

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. (AEP - AEP) The 05ROCKPT-05JEFRSO 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 103.49% to 108.84% (**DC power flow**) of its emergency rating (4253 MVA) for the tower line contingency outage of '431'. This project contributes approximately 227.82 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #2

4. (AEP - AEP) The 05BREED-05DARWIN 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 141.59% to 153.89% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

Same as Generator Deliverability #1

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

5. (AEP - AEP) The 05BREED-05DARWIN 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 128.46% to 137.27% (**DC power flow**) of its emergency rating (1419 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 125.0 MW to the thermal violation.

Same as Generator Deliverability #1

6. (AEP - AEP) The 05BREED-05DEQUIN 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 125.81% to 134.14% (**DC power flow**) of its normal rating (971 MVA) for the single

line contingency outage of '363_B2_TOR1682'. This project contributes approximately 80.91 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild the entire 97.19 mile ACSR/PE ~ 1414 ~ 62/19 ~ Conductor Section 1. Estimated Cost: \$194, 380,000; (2) Replace the Dequine Riser. Estimated Cost: \$100,000; (3) Rebuild the entire 0.09 mile ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 2. Estimated Cost: \$180,000. (4) An engineering study will need to be conducted to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: \$600,000

Cost: \$195,260,000

Time: 24-36 months

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

7. (AEP - AEP) The 05BREED-05DEQUIN 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 118.56% to 125.08% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 85.14 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #6

8. (AEP - MISO AMIL) The 05BREED-7CASEY 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 138.72% to 152.56% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 202.88 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild 0.61miles of conductor section. Estimated cost is \$2,000,000. (2) Upgrade Sullivan Wavetrap. Estimated cost is \$400,000, (3) Upgrad Sub Cond 2-2000 AAC 91 Str. Sullivan Line Risers \$250,000, and (4) Reconduct/Rebuild 0.82miles of conductor section 3. Estimated Cost is: \$2,000,000 . This is an AEP-AMIL tie line therefore, PJM is going to have to coordinate this upgrade with AMIL as well to make sure that their equipment will not set a limit lower than what is specified here. AMIL's portion of the conductor needs to be reconducted/rebuilt as well as the West Casey Wavetrap (3000A) to mitigate this overload.

Cost: \$4,650,000

Time: 24-36 months

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

9. (AEP - AEP) The 05DARWIN-05EUGENE 345 kV line (from bus 243216 to bus 243221 ckt 1) loads from 141.59% to 153.89% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild the entire the entire 39.32 mile section of line. Estimated Cost: \$ 78,640,000; (2) Reconductor/Rebuild the entire the entire 0.09 mile section of line. Estimated Cost: \$ 180,000.

Cost: \$78,820,000
Time: 24-36 months

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

10. (AEP - AEP) The 05DARWIN-05EUGENE 345 kV line (from bus 243216 to bus 243221 ckt 1) loads from 128.46% to 137.27% (**DC power flow**) of its emergency rating (1419 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 125.0 MW to the thermal violation.

Reinforcement: (1) Reconductor/Rebuild the entire 39.32 mile ACSR/PE ~ 1414 ~ 62/19 ~ Conductor Section 1, Estimated Cost: \$ 78,640,000 (2) Rebuild the entire 0.09 mile ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 2, Estimated Cost: \$ 180,000 (3) Replace Eugene Wavetrap. Estimated Cost: \$400,000, (4) Replace Darwin Wavetrap. Estimated Cost: \$400,000, and (5) An engineering study will need to be conducted to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: \$600,000 (6) Upgrade Eugene Risers Estimated Cost is \$100,000 of line. Estimated Cost: \$ 180,000.

Cost: \$80,500,000
Time: 24-36 months

11. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 147.02% to 152.38% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '6485_C2_05DEQUIN 345-C1'. This project contributes approximately 69.94 MW to the thermal violation.

Reinforcement: (1) Replace the Dequine line riser, Estimated cost: \$ 100,000, (2) Rebuild the entire 22.17 mile of ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 1, Estimate cost: \$44,340,000, (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. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: \$600,000 , (4) Replace Dequine Wavetrap (2500A), \$400,000.

Cost: \$45,440,000
Time: 24-36 months

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

12. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 135.55% to 142.36% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '6490_B2_TOR16000'. This project contributes approximately 66.17 MW to the thermal violation.

Reinforcement: (1) Replace the Dequine line riser, Estimated cost: \$ 100,000, (2) Rebuild the entire 22.17 mile of ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 1, Estimate cost: \$44,340,000.

Cost: \$44,440,000

Time: 24-36 months

13. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 106.34% to 112.09% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 55.79 MW to the thermal violation.

Reinforcement: Replace the Dequine Line riser.

Cost: \$ 100,000

Time: 12 months

14. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 147.02% to 152.38% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '4704_C2_05DEQUIN 345-B1'. This project contributes approximately 69.94 MW to the thermal violation.

Reinforcement: (1) Replace the Dequine line riser, Estimated cost: \$ 100,000, (2) Rebuild the entire 22.17 mile of ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 1, Estimate cost: \$44,340,000, (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. New relay packages will be required if the settings cannot be adjusted. Estimated Cost: \$600,000 , (4) Replace Dequine Wavetrapp (2500A), \$400,000.

Cost: \$45,440,000

Time: 24-36 months

Please refer to Appendix 8 for a table containing the generators having contribution to this flowgate.

15. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 135.55% to 142.36% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '6472_B2_TOR15258'. This project contributes approximately 66.17 MW to the thermal violation.

Reinforcement: (1) Replace the Dequine line riser, Estimated cost: \$ 100,000, (2) Rebuild the entire 22.17 mile of ACAR ~ 2303.5 ~ 54/37 ~ Conductor Section 1, Estimate cost: \$44,340,000.

Cost: \$44,440,000

Time: 24-36 months

16. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 106.34% to 112.09% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 55.79 MW to the thermal violation.

Reinforcement: Replace the Dequine Line riser

Cost: \$ 100,000

Time: 12 months

17. (AEP - AEP) The 05EUGENE-05DEQUIN 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 116.81% to 121.04% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '667_B2_TOR1697'. This project contributes approximately 41.01 MW to the thermal violation.

Reinforcement: (1) Rebuild the entire 22.17 mile of ACSR/PE ~ 1414 ~ 62/19 ~ Conductor Section 1, Estimate cost: \$44,340,000, and (2) Replace the Dequine riser, Estimated cost: \$100,000.

Cost: \$44,440,000

Time: 24-36 months

Please refer to Appendix 9 for a table containing the generators having contribution to this flowgate.

18. (AEP - AEP) The 05EUGENE-05DEQUIN 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 116.0% to 119.75% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 36.45 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #17

19. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 149.57% to 154.55% (**DC power flow**) of its emergency rating (1918 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 95.48 MW to the thermal violation.

Reinforcement: [B2449-Rebuild 7 miles of the Meadow Lake-Reynolds 345kV line. ISD 6/1/17] AEP is in the process of rebuilding this line and we cannot use a larger conductor to mitigate this overload for various constraints. Therefore, building a third line between Meadow Lake and Reynolds is proposed as an alternate which will also involve work at Meadow Lake and Reynolds Stations.

Cost: \$32,000,000.

Time: 24-36 months

Please refer to Appendix 10 for a table containing the generators having contribution to this flowgate.

20. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 128.83% to 135.19% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 89.7 MW to the thermal violation.

B2449-Rebuild 7 miles of the Meadow Lake-Reynolds 345kV line. ISD 6/1/17

21. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 107.3% to 112.24% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of '8808_B2'. This project contributes approximately 69.59 MW to the thermal violation.

B2449-Rebuild 7 miles of the Meadow Lake-Reynolds 345kV line. ISD 6/1/17

22. (AEP - AEP) The 05SULVN3-05BREED 345 kV line (from bus 247158 to bus 243213 ckt Z3) loads from 104.94% to 135.89% (**DC power flow**) of its normal rating (1754 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 542.76 MW to the thermal violation.

S0764-Rebuild Breed 345 kV station adjacent to the existing Sullivan station

Please refer to Appendix 11 for a table containing the generators having contribution to this flowgate.

23. (CE - CE) The LORETTO ; B-WILTON ; B 345 kV line (from bus 270704 to bus 270926 ckt 1) loads from 126.51% to 128.79% (**DC power flow**) of its emergency rating (1280 MVA) for the single line contingency outage of '345-L8014_T_-S'. This project contributes approximately 29.09 MW to the thermal violation.

Reinforcement: The 345kV L11212 SLD rating of 1280MVA is due to a sag limitation. Upgrade to be for sag mitigation by re-conductoring 345kV of L11212, The next SLTE limit would be 1479 MVA.

Cost: \$45M

Time: 24-30 months

Please refer to Appendix 12 for a table containing the generators having contribution to this flowgate.

24. (CE - CE) The LORETTO ; B-WILTON ; B 345 kV line (from bus 270704 to bus 270926 ckt 1) loads from 101.49% to 103.65% (**DC power flow**) of its emergency rating (1280 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 27.58 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #23

25. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 126.07% to 128.42% (**DC power flow**) of its emergency rating (1241 MVA) for the single line contingency outage of '345-L8014_T_-S'. This project contributes approximately 29.27 MW to the thermal violation.

Reinforcement: ComEd facility is 345kV L8012. The SLD rating of 1329 MVA is limited by the sag of the line. Sag mitigation of the line is required. Upon full mitigation of sag limit, the ALDR for L8012 will be 2199 MVA.

Cost: \$14.5M

Time: 18-24 months

Please refer to Appendix 13 for a table containing the generators having contribution to this flowgate.

26. (CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 100.32% to 102.55% (**DC power flow**) of its emergency rating (1241 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 27.76 MW to the thermal violation.

Same as Contribution to Previously Identified Overload #25

Local/Network Upgrades

Mitigation plan for the Rockport – Jefferson 765 kV Line:

- Replace the Rockport Wavetrap (3000A). Estimated Cost: \$500,000.
- Replace the Jefferson Wavetrap (3000A). Estimated Cost: \$500,000.

Mitigation plan for the Jefferson – Clifty Creek (OVEC) 345 kV Line:

- A sag study analysis has been completed and determined that grading is needed for Span 1-2. Estimated Cost: \$243,000
- This is an AEP-OVEC tie line therefore; PJM is going to have to coordinate this upgrade with OVEC as well to make sure that their equipment will not set a limit lower than what is specified here.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 575 MW (550 MW Capacity) natural gas generating facility for PJM Project #AB1-088 will require the following additional interconnection charges. This plan of service will interconnect the proposed natural gas generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC's natural gas generating facility.

A summary table of the cost estimates below is for the Primary Point of Interconnection (Sullivan Station 345 kV Yard) only:

Upgrade	Cost
Direct Connection Cost	\$3,100,000
Sullivan – Reynolds 345 kV Line Reconductoring	\$104,040,000
Sullivan – Reynolds 345 kV Line Rebuild	\$404,360,000
Rockport 765 kV Wavetrap (3000A)	\$500,000
Jefferson 765 kV Wavetrap (3000A)	\$500,000
Jefferson – Clifty Creek 345 kV Line Grading (Span 1-2)	\$243,000
Eugene Wavetrap (2500A)	\$400,000
Darwin Wavetrap (2500A)	\$400,000
Dequine Wavetrap (2500A)	\$400,000
Sullivan Wavetrap (2500A)	\$400,000
Sullivan Line Risers	\$250,000
Dequine line riser	\$100,000
Eugene Risers	\$100,000
Dequine riser	\$100,000
An engineering study will need to be conducted to determine if the Darwin – Eugene Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted.	\$600,000
An engineering study will need to be conducted to determine if the Dequine Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted.	\$600,000
An engineering study will need to be conducted to determine if the Darwin Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted.	\$600,000
An engineering study will need to be conducted to determine if the Meadow Lake Relay Compliance Trip limits settings can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted.	\$600,000
Total Cost for Project AB1-088	\$112,933,000
	This cost estimate assumes reconductoring will mitigate the line sections that are identified as constraints for this project using existing tower structures.
Total Cost for Project AB1-088	\$413,253,000
	This cost estimate assumes a complete rebuild will be required to mitigate the line sections that are identified as constraints for this project.

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. The cost estimates for the secondary point of interconnection are not included in this estimate. Final estimates will require an on-site review and coordination to determine final construction requirements.

Secondary Point of Interconnection (Sullivan Station 765 kV Yard) Potential network impacts were as follows:

Generator Deliverability

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

Secondary Point of Interconnection AB1-088 Generator Deliverability														
#	Type	Contingency Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	N-1	363_B2_TOR1682	AEP - MISO IPL	05BREED-16WHEAT 345 kV line	243213	254539	1	DC	89.89	100.59	NR	1386	148.2	1
2	N-1	363_B2_TOR1682	AEP - MISO AMIL	05BREED-7CASEY 345 kV line	243213	346809	1	DC	94.68	109.23	NR	1332	193.79	
3	N-1	363_B2_TOR1682	AEP - AEP	05SULVN1-05BREED 345 kV line	247065	243213	Z1	DC	89.46	104.92	NR	1754	271.15	2
4	N-1	363_B2_TOR1682	AEP - AEP	05SULVN3-05BREED 345 kV line	247158	243213	Z3	DC	89.46	104.92	NR	1754	271.15	3

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

Secondary Point of Interconnection AB1-088 Multiple Facility Contingency														
#	Type	Contingency Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	LFFB	6189_C2_05HANG R 765-D1	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	96.77	102.69	ER	2354	124.17	

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.)

Secondary Point of Interconnection AB1-088 Contribution to Previously Identified Overloads														
#	Type	Contingency Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	LFFB	1760_C2_05JEFRSO 765-A	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	121.37	129.07	ER	2354	181.14	4
2	DCTL	431	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	104.64	111.14	ER	4253	276.52	5
3	DCTL	430	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	104.64	111.14	ER	4253	276.52	
4	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DARWIN 345 kV line	243213	243216	1	DC	141.63	153.93	NR	971	119.4	6

Secondary Point of Interconnection
AB1-088 Contribution to Previously Identified Overloads

#	Type	Contingency	Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
		Name			From	To			Initial	Final	Type	MVA		
5	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05BREED- 05DARWIN 345 kV line	243213	243216	1	DC	128.49	137.3	ER	1419	125	
6	N-1	363_B2_TOR1682	AEP - AEP	05BREED- 05DEQUIN 345 kV line	243213	243217	1	DC	125.86	134.19	NR	971	80.91	7
7	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05BREED- 05DEQUIN 345 kV line	243213	243217	1	DC	118.6	125.13	ER	1304	85.14	
8	LFFB	8648_C2_05JEFRSO 765-B1	AEP - MISO AMIL	05BREED- 7CASEY 345 kV line	243213	346809	1	DC	138.67	152.51	ER	1466	202.88	8
9	N-1	363_B2_TOR1682	AEP - AEP	05DARWIN- 05EUGENE 345 kV line	243216	243221	1	DC	141.63	153.93	NR	971	119.4	9
10	LFFB	8648_C2_05JEFRSO 765-B1	AEP - AEP	05DARWIN- 05EUGENE 345 kV line	243216	243221	1	DC	128.49	137.3	ER	1419	125	
11	LFFB	6485_C2_05DEQUIN 345-C1	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	146.28	150.8	ER	1304	58.97	10
12	N-1	6490_B2_TOR16000	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	134.62	140.36	NR	971	55.79	
13	N-1	363_B2_TOR1682	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	1	DC	106.42	112.16	NR	971	55.79	
14	LFFB	4704_C2_05DEQUIN 345-B1	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	146.28	150.8	ER	1304	58.97	11
15	N-1	6472_B2_TOR15258	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	134.62	140.36	NR	971	55.79	
16	N-1	363_B2_TOR1682	AEP - AEP	05DEQUIN- 05MEADOW 345 kV line	243217	243878	2	DC	106.42	112.16	NR	971	55.79	
17	N-1	363_B2_TOR1682	AEP - AEP	05EUGENE- 05DEQUIN 345 kV line	243221	243217	1	DC	116.09	119.84	NR	971	36.45	12
18	N-1	667_B2_TOR1697	AEP - AEP	05EUGENE- 05DEQUIN 345 kV line	243221	243217	1	DC	116.24	119.79	NR	971	34.44	
19	LFFB	8648_C2_05JEFRSO 765-B1	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	149.61	154.59	ER	1918	95.49	13
20	N-1	363_B2_TOR1682	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	128.88	135.25	NR	1409	89.7	
21	N-1	8808_B2	AEP - MISO NIPS	05MEADOW- 17REYNOLDS 345 kV line	243878	255205	1	DC	106.58	110.72	NR	1409	58.3	
22	N-1	363_B2_TOR1682	CE - CE	LORETTO ; B- WILTON ; B 345 kV line	270704	270926	1	DC	101.56	103.71	ER	1280	27.58	14
23	N-1	363_B2_TOR1682	CE - CE	PONTIAC ; B- LORETTO ; B 345 kV line	270852	270704	1	DC	100.38	102.62	ER	1241	27.75	15

Short Circuit

(Summary of impacted circuit breakers)

Bus Number	Bus Name	BREAKER	Rating Type	Breaker Capacity (Amps)	Duty Percent With AB1-088_aep_v1	Duty Percent Without AB1-088_aep_v1	Duty Percent Difference	Duty Amps With AB1-088_aep_v1	Duty Amps Without AB1-088_aep_v1	Notes
0	05TWIN B 345.kV	JM	T	48000	100.00%	100.00%	0.00%	48000.9	47998.8	\$280,000, 12 months after IA is signed

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

Note: 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

Secondary Point of Interconnection														
AB1-088 Delivery of Energy Portion of Interconnection Request														
#	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Initial	Final	Rating Type	MVA	MW Con.	FG App.
1	N-1	709_B2_TOR546	AEP - OVEC	05JEFRSO-06CLIFTY 345 kV line	242865	248000	Z1	DC	95.48	101.41	NR	2354	124.28	
2	N-1	8695_B2	AEP - AEP	05ROCKPT-05JEFRSO 765 kV line	243209	243208	1	DC	101.58	107.52	NR	4055	240.88	
3	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DARWIN 345 kV line	243213	243216	1	DC	186.91	199.76	NR	971	124.83	
4	N-1	363_B2_TOR1682	AEP - AEP	05BREED-05DEQUIN 345 kV line	243213	243217	1	DC	156.54	165.25	NR	971	84.59	
5	N-1	363_B2_TOR1682	AEP - MISO IPL	05BREED-16WHEAT 345 kV line	243213	254539	1	DC	134.66	145.84	NR	1386	154.93	
6	N-1	363_B2_TOR1682	AEP - MISO AMIL	05BREED-7CASEY 345 kV line	243213	346809	1	DC	151.25	166.46	NR	1332	202.6	
7	N-1	363_B2_TOR1682	AEP - AEP	05DARWIN-05EUGENE 345 kV line	243216	243221	1	DC	186.91	199.76	NR	971	124.83	
8	N-1	6490_B2_TOR16000	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	1	DC	190.62	196.63	NR	971	58.33	
9	N-1	6472_B2_TOR15258	AEP - AEP	05DEQUIN-05MEADOW 345 kV line	243217	243878	2	DC	190.62	196.63	NR	971	58.33	

Secondary Point of Interconnection

AB1-088 Delivery of Energy Portion of Interconnection Request

#	Type	Contingency	Affected Area	Facility	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
		Name		Description	From	To			Initial	Final	Type	MVA		
10	N-1	667_B2_TOR1697	AEP - AEP	05EUGENE-05DEQUIN 345 kV line	243221	243217	1	DC	130.17	131.84	NR	971	36	
11	N-1	363_B2_TOR1682	AEP - MISO DEM	05EUGENE-08CAYSUB 345 kV line	243221	249504	1	DC	100.85	107.25	NR	1374	87.98	
12	N-1	363_B2_TOR1682	AEP - MISO NIPS	05MEADOW-17REYNOLDS 345 kV line	243878	255205	1	DC	196.98	203.64	NR	1409	93.78	
13	N-1	363_B2_TOR1682	AEP - AEP	05SULVN1-05BREED 345 kV line	247065	243213	Z1	DC	90.16	106.32	NR	1754	283.48	
14	N-1	363_B2_TOR1682	AEP - AEP	05SULVN3-05BREED 345 kV line	247158	243213	Z3	DC	90.16	106.32	NR	1754	283.48	

Appendices for Primary Point of Interconnection(345 kV)

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. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AEP - OVEC) The 05JEFRSO-06CLIFTY 345 kV line (from bus 242865 to bus 248000 ckt Z1) loads from 120.48% to 126.31% (**DC power flow**) of its emergency rating (2354 MVA) for the line fault with failed breaker contingency outage of '1760_C2_05JEFRSO 765-A'. This project contributes approximately 137.21 MW to the thermal violation.

CONTINGENCY '1760_C2_05JEFRSO 765-A'

OPEN BRANCH FROM BUS 243207 TO BUS 243208 CKT 1 / 243207 05GRNTWN
765 243208 05JEFRSO 765 1

OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R
765 243208 05JEFRSO 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
247900	05FR-11G E	6.1
247901	05FR-12G E	6.
247902	05FR-21G E	6.41
247903	05FR-22G E	6.14
247904	05FR-3G E	12.43
247905	05FR-4G E	9.35
247906	05MDL-1G E	10.38
247907	05MDL-2G E	5.15
247912	05MDL-3G E	5.38
247913	05MDL-4G E	5.13
243442	05RKG1	54.24
243443	05RKG2	53.42
251940	08BKJGT1	-3.25
251941	08BKJGT2	-3.25
251942	08BKJGT3	-3.25
251943	08BKJGT4	-3.25
251949	08M.FRT6	-10.21
294401	BSHIL;1U E	4.83
294410	BSHIL;2U E	4.83
274890	CAYUG;1U E	7.61
274891	CAYUG;2U E	7.61
274849	CRESCENT ;1U	3.27
927331	J196 C	0.63
927332	J196 E	2.5
990901	L-005 E	7.46
293771	O-035 E	3.55
296309	R-030 E1	8.98
296272	R-030 E2	8.98

296128	R-030 E3	9.09
274853	TWINGROVE;U1	11.82
274854	TWINGROVE;U2	11.82
276150	W2-048 E	5.21
905081	W4-005 C	3.64
905082	W4-005 E	24.38
909052	X2-022 E	15.77
900404	X3-028 C	356.52
900405	X3-028 E	475.36
913222	Y1-054 E	-1.29
915151	Y3-038	17.42
915662	Y3-099 E	0.14
915672	Y3-100 E	0.14
LTF	Z1-043	15.53
916182	Z1-065 E	0.37
LTF	Z1-070	90.81
916211	Z1-072	0.6
LTF	Z1-112	5.89
917501	Z2-087 C	1.76
917502	Z2-087 E	11.78
LTF	AA1-001	5.83
LTF	AA1-071	3.93
918711	AA1-086 C	2.08
918712	AA1-086 E	13.89
LTF	AA2-038	16.52
919621	AA2-039 C	1.18
919622	AA2-039 E	7.87
930041	AB1-006 C	1.69
930042	AB1-006 E	11.31
930451	AB1-086 C	37.2
930452	AB1-086 E	1.69
930461	AB1-087 C OP	131.25
930462	AB1-087 E OP	5.97
930471	AB1-088 C OP	131.25
930472	AB1-088 E OP	5.97

Appendix 2

(AEP - AEP) The 05ROCKPT-05JEFRSO 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 103.49% to 108.84% (**DC power flow**) of its emergency rating (4253 MVA) for the tower line contingency outage of '430'. This project contributes approximately 227.82 MW to the thermal violation.

CONTINGENCY '430'

OPEN BRANCH FROM BUS 243213 TO BUS 243216 CKT 1 / 243213 05BREED 345
243216 05DARWIN 345 1

OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1 / 243213 05BREED 345
243217 05DEQUIN 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	74.9
243443	05RKG2	73.76
274650	KINCAID ;1U	5.5
274651	KINCAID ;2U	5.5
900404	X3-028 C	592.71
900405	X3-028 E	790.28
915151	Y3-038	24.05
LTF	Z1-070	105.01
LTF	AA1-001	8.92
930461	AB1-087 C OP	217.91
930462	AB1-087 E OP	9.91
930471	AB1-088 C OP	217.91
930472	AB1-088 E OP	9.91

Appendix 3

(AEP - AEP) The 05BREED-05DARWIN 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 141.59% to 153.89% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	24.33
243443	05RKG2	23.97
900404	X3-028 C	325.64
915151	Y3-038	7.81
930461	AB1-087 C OP	119.4
930471	AB1-088 C OP	119.4

Appendix 4

(AEP - AEP) The 05BREED-05DEQUIN 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 125.81% to 134.14% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 80.91 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	16.49
243443	05RKG2	16.24
900404	X3-028 C	220.67
915151	Y3-038	5.3
930461	AB1-087 C OP	80.91
930471	AB1-088 C OP	80.91

Appendix 5

(AEP - MISO AMIL) The 05BREED-7CASEY 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 138.72% to 152.56% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 202.88 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1 / 243208 05JEFRSO
765 242865 05JEFRSO 345 1

OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO
345 248000 06CLIFTY 345 Z1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
247900	05FR-11G E	4.67
247901	05FR-12G E	4.59
247902	05FR-21G E	4.9
247903	05FR-22G E	4.69
247904	05FR-3G E	9.51
247905	05FR-4G E	7.15
243442	05RKG1	39.57
243443	05RKG2	38.97
927421	J201 C	0.24
927422	J201 E	0.95
927501	J246 C	0.08
927502	J246 E	0.33
927581	J325 C	0.05
927582	J325 E	0.14
927591	J327 C	1.78
927592	J327 E	5.34
927611	J332	8.93
927621	J333	19.55
927631	J334	20.98
927651	J340 C	1.19
927652	J340 E	3.56
927691	J354 C	0.62
927692	J354 E	1.85
900404	X3-028 C	529.25
900405	X3-028 E	705.66
915151	Y3-038	12.71
LTF	AA1-051	5.01

<i>LTF</i>	<i>AA1-053</i>	<i>55.76</i>
<i>LTF</i>	<i>AA1-055</i>	<i>182.56</i>
<i>930461</i>	<i>AB1-087 C OP</i>	<i>194.06</i>
<i>930462</i>	<i>AB1-087 E OP</i>	<i>8.82</i>
<i>930471</i>	<i>AB1-088 C OP</i>	<i>194.06</i>
<i>930472</i>	<i>AB1-088 E OP</i>	<i>8.82</i>
<i>930972</i>	<i>AB1-146 E</i>	<i>0.1</i>

Appendix 6

(AEP - AEP) The 05DARWIN-05EUGENE 345 kV line (from bus 243216 to bus 243221 ckt 1) loads from 141.59% to 153.89% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	24.33
243443	05RKG2	23.97
900404	X3-028 C	325.64
915151	Y3-038	7.81
930461	AB1-087 C OP	119.4
930471	AB1-088 C OP	119.4

Appendix 7

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 147.02% to 152.38% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '6485_C2_05DEQUIN 345-C1'. This project contributes approximately 69.94 MW to the thermal violation.

CONTINGENCY '6485_C2_05DEQUIN 345-C1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217 05DEQUIN
345 243878 05MEADOW 345 2

OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN
345 249525 08WESTWD 345 1

OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525 08WESTWD
345 249874 08WESTWD 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.89
247900	05FR-11G E	42.01
243862	05FR-12G C	0.88
247901	05FR-12G E	41.31
243864	05FR-21G C	0.94
247902	05FR-21G E	44.16
243866	05FR-22G C	0.9
247903	05FR-22G E	42.28
243870	05FR-3G C	1.82
247904	05FR-3G E	85.63
243873	05FR-4G C	1.41
247905	05FR-4G E	64.39
927331	J196 C	1.16
927332	J196 E	4.64
927621	J333	19.77
927631	J334	22.34
900404	X3-028 C	182.81
900405	X3-028 E	243.74
LTF	Z1-070	53.7
930461	AB1-087 C OP	66.9
930462	AB1-087 E OP	3.04
930471	AB1-088 C OP	66.9
930472	AB1-088 E OP	3.04

Appendix 8

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 147.02% to 152.38% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '4704_C2_05DEQUIN 345-B1'. This project contributes approximately 69.94 MW to the thermal violation.

CONTINGENCY '4704_C2_05DEQUIN 345-B1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217 05DEQUIN
345 243878 05MEADOW 345 1

OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN
345 249525 08WESTWD 345 1

OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525 08WESTWD
345 249874 08WESTWD 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.89
247900	05FR-11G E	42.01
243862	05FR-12G C	0.88
247901	05FR-12G E	41.31
243864	05FR-21G C	0.94
247902	05FR-21G E	44.16
243866	05FR-22G C	0.9
247903	05FR-22G E	42.28
243870	05FR-3G C	1.82
247904	05FR-3G E	85.63
243873	05FR-4G C	1.41
247905	05FR-4G E	64.39
927331	J196 C	1.16
927332	J196 E	4.64
927621	J333	19.77
927631	J334	22.34
900404	X3-028 C	182.81
900405	X3-028 E	243.74
LTF	Z1-070	53.7
930461	AB1-087 C OP	66.9
930462	AB1-087 E OP	3.04
930471	AB1-088 C OP	66.9
930472	AB1-088 E OP	3.04

Appendix 9

(AEP - AEP) The 05EUGENE-05DEQUIN 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 116.81% to 121.04% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '667_B2_TOR1697'. This project contributes approximately 41.01 MW to the thermal violation.

CONTINGENCY '667_B2_TOR1697'

OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1 / 243213 05BREED 345
243217 05DEQUIN 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
927331	J196 C	1.19
927621	J333	14.96
927631	J334	15.69
900404	X3-028 C	112.08
LTF	Z1-070	52.78
930461	AB1-087 C OP	41.01
930471	AB1-088 C OP	41.01

Appendix 10

(AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 149.57% to 154.55% (**DC power flow**) of its emergency rating (1918 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 95.48 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1 / 243208 05JEFRSO
765 242865 05JEFRSO 345 1

OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO
345 248000 06CLIFTY 345 Z1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.82
247900	05FR-11G E	38.44
243862	05FR-12G C	0.8
247901	05FR-12G E	37.8
243864	05FR-21G C	0.86
247902	05FR-21G E	40.4
243866	05FR-22G C	0.82
247903	05FR-22G E	38.69
243870	05FR-3G C	1.66
247904	05FR-3G E	78.35
243873	05FR-4G C	1.29
247905	05FR-4G E	58.91
246909	05MDL-1G C	2.01
247906	05MDL-1G E	94.3
246910	05MDL-2G C	1.
247907	05MDL-2G E	46.77
246976	05MDL-3G C	1.
247912	05MDL-3G E	48.89
246979	05MDL-4G C	2.01
247913	05MDL-4G E	46.65
243442	05RKG1	18.61
243443	05RKG2	18.33
927331	J196 C	1.1
927332	J196 E	4.41
927621	J333	17.94
927631	J334	20.74
900404	X3-028 C	249.09

900405	X3-028 E	332.12
915151	Y3-038	5.98
LTF	Z1-007	5.09
LTF	Z1-029	3.12
LTF	Z1-070	71.53
LTF	AA1-001	5.14
930041	AB1-006 C	15.35
930042	AB1-006 E	102.75
LTF	AB1-023	6.18
930461	AB1-087 C OP	91.33
930462	AB1-087 E OP	4.15
930471	AB1-088 C OP	91.33
930472	AB1-088 E OP	4.15

Appendix 11

(AEP - AEP) The 05SULVN3-05BREED 345 kV line (from bus 247158 to bus 243213 ckt Z3) loads from 104.94% to 135.89% (**DC power flow**) of its normal rating (1754 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 542.76 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	55.27
243443	05RKG2	54.43
915151	Y3-038	17.75
930461	AB1-087 C OP	542.76
930471	AB1-088 C OP	542.76

Appendix 12

(CE - CE) The LORETTO ; B-WILTON ; B 345 kV line (from bus 270704 to bus 270926 ckt 1) loads from 126.51% to 128.79% (**DC power flow**) of its emergency rating (1280 MVA) for the single line contingency outage of '345-L8014_T_-S'. This project contributes approximately 29.09 MW to the thermal violation.

CONTINGENCY '345-L8014_T_-S'

TRIP BRANCH FROM BUS 270853 TO BUS 270717 CKT 1 / PONTIAC ; R 345
DRESDEN ; R 345

TRIP BRANCH FROM BUS 275210 TO BUS 270853 CKT 1 / PONTIAC ;2M 138
PONTIAC ; R 345

TRIP BRANCH FROM BUS 275210 TO BUS 272261 CKT 1 / PONTIAC ;2M 138
PONTIAC ; R 138

TRIP BRANCH FROM BUS 275210 TO BUS 275310 CKT 1 / PONTIAC ;2M 138
PONTIAC ;2C 34.5

CLOSE BRANCH FROM BUS 272260 TO BUS 272261 CKT 1 / PONTIAC ; B 138
PONTIAC ; R 138

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
274863	CAYUGA RI;1U	1.38
274864	CAYUGA RI;2U	1.38
927331	J196 C	1.26
927641	J339	13.94
274650	KINCAID ;1U	9.24
274651	KINCAID ;2U	9.23
296308	R-030 C1	1.27
296271	R-030 C2	1.27
296125	R-030 C3	1.28
290261	S-027 C	1.24
290265	S-028 C	1.24
905081	W4-005 C	14.08
900404	X3-028 C	79.46
LTF	Z1-070	258.77
917501	Z2-087 C	11.65
LTF	AA1-001	5.8
918711	AA1-086 C	8.03
930451	AB1-086 C	246.94
930461	AB1-087 C OP	29.09
930471	AB1-088 C OP	29.09

Appendix 13

(CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 126.07% to 128.42% (**DC power flow**) of its emergency rating (1241 MVA) for the single line contingency outage of '345-L8014_T_-S'. This project contributes approximately 29.27 MW to the thermal violation.

CONTINGENCY '345-L8014_T_-S'

TRIP BRANCH FROM BUS 270853 TO BUS 270717 CKT 1 / PONTIAC ; R 345
DRESDEN ; R 345

TRIP BRANCH FROM BUS 275210 TO BUS 270853 CKT 1 / PONTIAC ;2M 138
PONTIAC ; R 345

TRIP BRANCH FROM BUS 275210 TO BUS 272261 CKT 1 / PONTIAC ;2M 138
PONTIAC ; R 138

TRIP BRANCH FROM BUS 275210 TO BUS 275310 CKT 1 / PONTIAC ;2M 138
PONTIAC ;2C 34.5

CLOSE BRANCH FROM BUS 272260 TO BUS 272261 CKT 1 / PONTIAC ; B 138
PONTIAC ; R 138

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
927331	J196 C	1.26
927641	J339	13.94
274650	KINCAID ;1U	9.25
274651	KINCAID ;2U	9.25
296308	R-030 C1	1.27
296271	R-030 C2	1.27
296125	R-030 C3	1.28
290261	S-027 C	1.24
290265	S-028 C	1.24
905081	W4-005 C	14.1
900404	X3-028 C	79.95
LTF	Z1-070	259.11
917501	Z2-087 C	11.65
LTF	AA1-001	5.83
918711	AA1-086 C	8.04
930451	AB1-086 C	247.12
930461	AB1-087 C OP	29.27
930471	AB1-088 C OP	29.27

Appendices for Secondary Point of Interconnection(765 kV)

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. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AEP - MISO IPL) The 05BREED-16WHEAT 345 kV line (from bus 243213 to bus 254539 ckt 1) loads from 89.89% to 100.59% (**DC power flow**) of its normal rating (1386 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 148.2 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.09
243862	05FR-12G C	0.09
243864	05FR-21G C	0.09
243866	05FR-22G C	0.09
243870	05FR-3G C	0.18
243873	05FR-4G C	0.14
243442	05RKG1	30.2
243443	05RKG2	29.74
927331	J196 C	0.7
927641	J339	4.28
274650	KINCAID ;1U	3.55
274651	KINCAID ;2U	3.55
290261	S-027 C	0.19
290265	S-028 C	0.19
905081	W4-005 C	2.82
900404	X3-028 C	404.22
915151	Y3-038	9.7
LTF	Z1-070	71.4
LTF	AA1-001	4.44
LTF	AA1-052	65.54
LTF	AA1-054	45.44
918711	AA1-086 C	1.61
930461	AB1-087 C OP	148.2
930471	AB1-088 C OP	148.2

Appendix 2

(AEP - AEP) The 05SULVN1-05BREED 345 kV line (from bus 247065 to bus 243213 ckt Z1) loads from 89.46% to 104.92% (**DC power flow**) of its normal rating (1754 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 271.15 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	55.27
243443	05RKG2	54.43
915151	Y3-038	17.75
930461	AB1-087 C OP	271.15
930471	AB1-088 C OP	271.15

Appendix 3

(AEP - AEP) The 05SULVN3-05BREED 345 kV line (from bus 247158 to bus 243213 ckt Z3) loads from 89.46% to 104.92% (**DC power flow**) of its normal rating (1754 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 271.15 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	55.27
243443	05RKG2	54.43
915151	Y3-038	17.75
930461	AB1-087 C OP	271.15
930471	AB1-088 C OP	271.15

Appendix 4

(AEP - OVEC) The 05JEFRSO-06CLIFTY 345 kV line (from bus 242865 to bus 248000 ckt Z1) loads from 121.37% to 129.07% (**DC power flow**) of its emergency rating (2354 MVA) for the line fault with failed breaker contingency outage of '1760_C2_05JEFRSO 765-A'. This project contributes approximately 181.14 MW to the thermal violation.

CONTINGENCY '1760_C2_05JEFRSO 765-A'

OPEN BRANCH FROM BUS 243207 TO BUS 243208 CKT 1 / 243207 05GRNTWN
765 243208 05JEFRSO 765 1

OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R
765 243208 05JEFRSO 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
247900	05FR-11G E	6.1
247901	05FR-12G E	6.
247902	05FR-21G E	6.41
247903	05FR-22G E	6.14
247904	05FR-3G E	12.43
247905	05FR-4G E	9.35
247906	05MDL-1G E	10.38
247907	05MDL-2G E	5.15
247912	05MDL-3G E	5.38
247913	05MDL-4G E	5.13
243442	05RKG1	54.24
243443	05RKG2	53.42
251940	08BKJGT1	-3.25
251941	08BKJGT2	-3.25
251942	08BKJGT3	-3.25
251943	08BKJGT4	-3.25
251949	08M.FRT6	-10.21
274890	CAYUG;1U E	7.61
274891	CAYUG;2U E	7.61
927331	J196 C	0.63
927332	J196 E	2.5
990901	L-005 E	7.47
296309	R-030 E1	8.98
296272	R-030 E2	8.98
296128	R-030 E3	9.09
274853	TWINGROVE;U1	11.82
274854	TWINGROVE;U2	11.82
276150	W2-048 E	5.21
905081	W4-005 C	3.64
905082	W4-005 E	24.39
909052	X2-022 E	15.77
900404	X3-028 C	356.52

900405	X3-028 E	475.36
913222	Y1-054 E	-1.29
915151	Y3-038	17.42
915662	Y3-099 E	0.14
915672	Y3-100 E	0.14
LTF	Z1-043	15.54
LTF	Z1-070	90.82
LTF	Z1-112	5.89
917501	Z2-087 C	1.76
917502	Z2-087 E	11.78
LTF	AA1-001	5.83
LTF	AA1-071	3.93
918711	AA1-086 C	2.08
918712	AA1-086 E	13.89
LTF	AA2-038	16.52
930041	AB1-006 C	1.69
930042	AB1-006 E	11.31
930451	AB1-086 C	37.2
930452	AB1-086 E	1.69
930461	AB1-087 C OP	173.26
930462	AB1-087 E OP	7.88
930471	AB1-088 C OP	173.26
930472	AB1-088 E OP	7.88

Appendix 5

(AEP - AEP) The 05ROCKPT-05JEFRSO 765 kV line (from bus 243209 to bus 243208 ckt 1) loads from 104.64% to 111.14% (**DC power flow**) of its emergency rating (4253 MVA) for the tower line contingency outage of '431'. This project contributes approximately 276.52 MW to the thermal violation.

CONTINGENCY '431'

OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1 / 243213 05BREED 345
243217 05DEQUIN 345 1

OPEN BRANCH FROM BUS 243216 TO BUS 243221 CKT 1 / 243216 05DARWIN
345 243221 05EUGENE 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	74.9
243443	05RKG2	73.76
274650	KINCAID ;1U	5.51
274651	KINCAID ;2U	5.5
900404	X3-028 C	592.74
900405	X3-028 E	790.32
915151	Y3-038	24.05
LTF	Z1-070	105.04
LTF	AA1-001	8.93
930461	AB1-087 C OP	264.5
930462	AB1-087 E OP	12.02
930471	AB1-088 C OP	264.5
930472	AB1-088 E OP	12.02

Appendix 6

(AEP - AEP) The 05BREED-05DARWIN 345 kV line (from bus 243213 to bus 243216 ckt 1) loads from 141.63% to 153.93% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	24.34
243443	05RKG2	23.97
900404	X3-028 C	325.64
915151	Y3-038	7.81
930461	AB1-087 C OP	119.4
930471	AB1-088 C OP	119.4

Appendix 7

(AEP - AEP) The 05BREED-05DEQUIN 345 kV line (from bus 243213 to bus 243217 ckt 1) loads from 125.86% to 134.19% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 80.91 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	16.49
243443	05RKG2	16.24
900404	X3-028 C	220.68
915151	Y3-038	5.3
930461	AB1-087 C OP	80.91
930471	AB1-088 C OP	80.91

Appendix 8

(AEP - MISO AMIL) The 05BREED-7CASEY 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 138.67% to 152.51% (**DC power flow**) of its emergency rating (1466 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 202.88 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1 / 243208 05JEFRSO
765 242865 05JEFRSO 345 1

OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO
345 248000 06CLIFTY 345 Z1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
247900	05FR-11G E	4.67
247901	05FR-12G E	4.59
247902	05FR-21G E	4.9
247903	05FR-22G E	4.69
247904	05FR-3G E	9.51
247905	05FR-4G E	7.15
243442	05RKG1	39.56
243443	05RKG2	38.96
927421	J201 C	0.24
927422	J201 E	0.95
927501	J246 C	0.08
927502	J246 E	0.33
927581	J325 C	0.05
927582	J325 E	0.14
927591	J327 C	1.78
927592	J327 E	5.35
927611	J332	8.94
927621	J333	19.55
927631	J334	20.98
927651	J340 C	1.19
927652	J340 E	3.57
927691	J354 C	0.62
927692	J354 E	1.85
900404	X3-028 C	529.2
900405	X3-028 E	705.6
915151	Y3-038	12.7
LTF	AA1-051	5.01
LTF	AA1-053	55.82
LTF	AA1-055	182.68
930461	AB1-087 C OP	194.06

930462	AB1-087 E OP	8.82
930471	AB1-088 C OP	194.06
930472	AB1-088 E OP	8.82
930972	AB1-146 E	0.1

Appendix 9

(AEP - AEP) The 05DARWIN-05EUGENE 345 kV line (from bus 243216 to bus 243221 ckt 1) loads from 141.63% to 153.93% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 119.4 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	24.34
243443	05RKG2	23.97
900404	X3-028 C	325.64
915151	Y3-038	7.81
930461	AB1-087 C OP	119.4
930471	AB1-088 C OP	119.4

Appendix 10

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 146.28% to 150.8% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '6485_C2_05DEQUIN 345-C1'. This project contributes approximately 58.97 MW to the thermal violation.

CONTINGENCY '6485_C2_05DEQUIN 345-C1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217 05DEQUIN
345 243878 05MEADOW 345 2

OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN
345 249525 08WESTWD 345 1

OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525 08WESTWD
345 249874 08WESTWD 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.89
247900	05FR-11G E	42.01
243862	05FR-12G C	0.88
247901	05FR-12G E	41.31
243864	05FR-21G C	0.94
247902	05FR-21G E	44.16
243866	05FR-22G C	0.9
247903	05FR-22G E	42.28
243870	05FR-3G C	1.82
247904	05FR-3G E	85.63
243873	05FR-4G C	1.41
247905	05FR-4G E	64.38
927331	J196 C	1.16
927332	J196 E	4.64
927621	J333	19.76
927631	J334	22.33
900404	X3-028 C	182.82
900405	X3-028 E	243.76
LTF	Z1-070	53.72
930461	AB1-087 C OP	56.4
930462	AB1-087 E OP	2.56
930471	AB1-088 C OP	56.4
930472	AB1-088 E OP	2.56

Appendix 11

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 146.28% to 150.8% (**DC power flow**) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '4704_C2_05DEQUIN 345-B1'. This project contributes approximately 58.97 MW to the thermal violation.

CONTINGENCY '4704_C2_05DEQUIN 345-B1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217 05DEQUIN
345 243878 05MEADOW 345 1

OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217 05DEQUIN
345 249525 08WESTWD 345 1

OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525 08WESTWD
345 249874 08WESTWD 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.89
247900	05FR-11G E	42.01
243862	05FR-12G C	0.88
247901	05FR-12G E	41.31
243864	05FR-21G C	0.94
247902	05FR-21G E	44.16
243866	05FR-22G C	0.9
247903	05FR-22G E	42.28
243870	05FR-3G C	1.82
247904	05FR-3G E	85.63
243873	05FR-4G C	1.41
247905	05FR-4G E	64.38
927331	J196 C	1.16
927332	J196 E	4.64
927621	J333	19.76
927631	J334	22.33
900404	X3-028 C	182.82
900405	X3-028 E	243.76
LTF	Z1-070	53.72
930461	AB1-087 C OP	56.4
930462	AB1-087 E OP	2.56
930471	AB1-088 C OP	56.4
930472	AB1-088 E OP	2.56

Appendix 12

(AEP - AEP) The 05EUGENE-05DEQUIN 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 116.09% to 119.84% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 36.45 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	7.43
243443	05RKG2	7.32
927331	J196 C	1.23
927621	J333	15.66
927631	J334	16.5
900404	X3-028 C	99.42
915151	Y3-038	2.39
LTF	Z1-070	57.1
930461	AB1-087 C OP	36.45
930471	AB1-088 C OP	36.45

Appendix 13

(AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 149.61% to 154.59% (**DC power flow**) of its emergency rating (1918 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 95.49 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1 / 243208 05JEFRSO
765 242865 05JEFRSO 345 1

OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO
345 248000 06CLIFTY 345 Z1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	0.82
247900	05FR-11G E	38.44
243862	05FR-12G C	0.8
247901	05FR-12G E	37.8
243864	05FR-21G C	0.86
247902	05FR-21G E	40.4
243866	05FR-22G C	0.82
247903	05FR-22G E	38.69
243870	05FR-3G C	1.66
247904	05FR-3G E	78.35
243873	05FR-4G C	1.29
247905	05FR-4G E	58.91
246909	05MDL-1G C	2.01
247906	05MDL-1G E	94.3
246910	05MDL-2G C	1.
247907	05MDL-2G E	46.77
246976	05MDL-3G C	1.
247912	05MDL-3G E	48.89
246979	05MDL-4G C	2.01
247913	05MDL-4G E	46.65
243442	05RKG1	18.61
243443	05RKG2	18.33
927331	J196 C	1.1
927332	J196 E	4.41
927621	J333	17.94
927631	J334	20.73
900404	X3-028 C	249.12
900405	X3-028 E	332.16
915151	Y3-038	5.98
LTF	Z1-007	5.09

<i>LTF</i>	<i>Z1-029</i>	<i>3.12</i>
<i>LTF</i>	<i>Z1-070</i>	<i>71.55</i>
<i>LTF</i>	<i>AA1-001</i>	<i>5.14</i>
<i>930041</i>	<i>AB1-006 C</i>	<i>15.35</i>
<i>930042</i>	<i>AB1-006 E</i>	<i>102.75</i>
<i>LTF</i>	<i>AB1-023</i>	<i>6.18</i>
<i>930461</i>	<i>AB1-087 C OP</i>	<i>91.34</i>
<i>930462</i>	<i>AB1-087 E OP</i>	<i>4.15</i>
<i>930471</i>	<i>AB1-088 C OP</i>	<i>91.34</i>
<i>930472</i>	<i>AB1-088 E OP</i>	<i>4.15</i>

Appendix 14

(CE - CE) The LORETTO ; B-WILTON ; B 345 kV line (from bus 270704 to bus 270926 ckt 1) loads from 101.56% to 103.71% (**DC power flow**) of its emergency rating (1280 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 27.58 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	5.62
243443	05RKG2	5.53
274863	CAYUGA RI;1U	1.09
274864	CAYUGA RI;2U	1.09
274659	DRESDEN ;3U	4.88
927331	J196 C	0.82
927641	J339	9.15
274650	KINCAID ;1U	6.58
274651	KINCAID ;2U	6.58
296308	R-030 C1	0.85
296271	R-030 C2	0.85
296125	R-030 C3	0.86
290261	S-027 C	0.85
290265	S-028 C	0.85
905081	W4-005 C	9.69
900404	X3-028 C	75.24
915151	Y3-038	1.8
LTF	Z1-070	179.79
917501	Z2-087 C	7.85
LTF	AA1-001	4.5
918711	AA1-086 C	5.52
930451	AB1-086 C	166.46
930461	AB1-087 C OP	27.58
930471	AB1-088 C OP	27.58
930762	AB1-122 2	22.56

Appendix 15

(CE - CE) The PONTIAC ; B-LORETTO ; B 345 kV line (from bus 270852 to bus 270704 ckt 1) loads from 100.38% to 102.62% (**DC power flow**) of its emergency rating (1241 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 27.75 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243442	05RKG1	5.65
243443	05RKG2	5.57
274659	DRESDEN ;3U	4.9
927331	J196 C	0.82
927641	J339	9.15
274650	KINCAID ;1U	6.6
274651	KINCAID ;2U	6.6
296308	R-030 C1	0.85
296271	R-030 C2	0.85
296125	R-030 C3	0.86
290261	S-027 C	0.85
290265	S-028 C	0.85
905081	W4-005 C	9.7
900404	X3-028 C	75.72
915151	Y3-038	1.82
LTF	Z1-070	180.13
917501	Z2-087 C	7.86
LTF	AA1-001	4.53
918711	AA1-086 C	5.53
930451	AB1-086 C	166.64
930461	AB1-087 C OP	27.75
930471	AB1-088 C OP	27.75
930762	AB1-122 2	22.67