

***Revised Generation Interconnection  
Feasibility Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AB2-054***

***JK Smith 345kV***

**September 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), has proposed a natural gas generating facility located in Clark County, Kentucky. The installed facilities will have a total capability of 614 MW with 504 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is March 1, 2023. **This study does not imply a EKPC commitment to this in-service date.**

## Point of Interconnection

AB2-054 will interconnect with the EKPC transmission system via an existing circuit breaker position at the JK Smith 345kV substation.

## Cost Summary

The AB2-054 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrades	\$ 200,000
Non Direct Connection Network Upgrades	\$ 0
<b>Total Costs</b>	<b>\$ 200,000</b>

In addition, the AB2-054 project may be responsible for a contribution to the following costs:

<b>Description</b>	<b>Total Cost</b>
New System Upgrades	\$ 36,786,408
Previously Identified Upgrades	\$ 121,894,080
<b>Total Costs</b>	<b>\$ 158,680,488</b>

Cost allocations for these upgrades will be provided in the System Impact Study Report.

## Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

## Direct Connection Cost Estimate

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

Description	Total Cost
Direct connect generation to the JK Smith 345kV bus including Labor for Transmission related work, System Protection functions, and relay testing. Schedule: 6 Months	\$ 200,000
<b>Total Direct Connection Facility Costs</b>	<b>\$ 200,000</b>

## Non-Direct Connection Cost Estimate

No Non-Direct Connection Facilities are required to support this interconnection request.

## Revenue Metering and SCADA Requirements

### PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

### East Kentucky Power Cooperative Requirements

The Interconnection Customer will be required to comply with all EKPC Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "EKPC Facility Connection Requirements" document located at the following link:

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

## Network Impacts

The Queue Project AB2-054 was evaluated as a 614.0 MW (Capacity 614.0 MW) injection at the JK Smith 345kV substation in the EKPC area. Project AB2-054 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-054 was studied with a commercial probability of 53%. Potential network impacts were as follows:

### Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
161_B3	CONTINGENCY '161_B3'  OPEN BRANCH FROM BUS 253014 TO BUS 253027 CKT 1 / 253014 09CLINTO 345 253027 09GREENE 345 1 OPEN BRANCH FROM BUS 253014 TO BUS 253013 CKT 1 / 253014 09CLINTO 345 253013 09CLINTO 69.0 1 END
363_B2_TOR1682	CONTINGENCY '363_B2_TOR1682'  OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 END
4839_B1_05ROCKPT 765-1	CONTINGENCY '4839_B1_05ROCKPT 765-1'  OPEN BRANCH FROM BUS 243209 TO BUS 243442 CKT 1 / 243209 05ROCKPT 765 243442 05RKG1 26.0 1 REMOVE UNIT 1H FROM BUS 243442 / 243442 05RKG1 26.0 REMOVE UNIT 1L FROM BUS 243442 / 243442 05RKG1 26.0 END
892_B2	CONTINGENCY '892_B2'  OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1 END
E_C JK SMITH TO NORTH CLARK 345 KV	CONTINGENCY 'E_C JK SMITH TO NORTH CLARK 345 KV'  OPEN BRANCH FROM BUS 342835 TO BUS 342832 CKT 1 /342835 7N.CLARK 345.00 342832 7JKSMIT2 345.00 END

Contingency Name	Description
P1-#..B2 MELDAHL-SPURLOCK 4541	CONTINGENCY 'P1-#..B2 MELDAHL-SPURLOCK 4541'  OPEN BRANCH FROM BUS 249581 TO BUS 342838 CKT 1 END
P1-#..B2 PORT UNION-ZIMMER 4544	CONTINGENCY 'P1-#..B2 PORT UNION-ZIMMER 4544'  OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1 END
P1-#..B2 ZIMMER-MELDAHL 34576	CONTINGENCY 'P1-#..B2 ZIMMER-MELDAHL 34576'  OPEN BRANCH FROM BUS 249577 TO BUS 249581 CKT 1 END
P7-1..C5 4541MELDAHLSPRLCKSTU ARTSPURLOCKDPLEK	CONTINGENCY 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK'  OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 END

## Generator Deliverability

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

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
1	N-1	P1-#..B2 PORT UNION-ZIMMER 4544	DEO&K	08ZIMER-08SGROVE 345 kV line	249577	249573	1	DC	97.05	98.39	ER	1664	49.56	1
2	N-1	E_C JK SMITH TO NORTH CLARK 345 KV	EKPC	4DALE-4BOONESBOR T 138 kV line	342574	342565	1	DC	70.58	100.89	ER	296	89.7	2
3	N-1	E_C JK SMITH TO NORTH CLARK 345 KV	EKPC	4JK SMITH-4DALE 138 kV line	342607	342574	1	DC	78.52	110.36	ER	296	94.25	3

Note: Please see Attachment 2 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

## Multiple Facility Contingency

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

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
4	DCTL	P7-1..C5 4541MELDAHLSPR LCKSTUARTSPUR LOCKDPLEK	DEO&K	08MTZION-08BUFTN1 138 kV line	250077	249991	1	DC	97.23	104.01	ER	298	44.88	

## 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)

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
5	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	AEP	05WLDCAT-05HILLSB 138 kV line	246946	243019	1	DC	106.06	113.97	ER	185	32.49	
6	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	AEP	05EMERSS- 05WLDCAT 138 kV line	247034	246946	1	DC	109.68	117.59	ER	185	32.49	
7	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	DEO&K	08LONGBR- 08MTZION 138 kV line	250054	250077	1	DC	110.52	117.9	ER	274	44.88	
8	N-1	892_B2	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	108.76	110.13	NR	1233	37.59	4
9	N-1	161_B3	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	107.17	108.54	NR	1233	37.4	
10	N-1	363_B2_TOR1682	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	150.6	156.01	ER	1370	74.16	5
11	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	123.41	130.04	NR	1134	75.14	
12	N-1	4839_B1_05ROC KPT 765-1	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	110.75	116.2	ER	1370	74.69	
13	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	LGEE - AEP	4KENTON-05EMERSS 138 kV line	324267	247034	1	DC	112.38	120.29	ER	185	32.49	

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
14	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	EKPC - DEO&K	4BOONE CO- 08LONGBR 138 kV line	342559	250054	1	DC	114.2	121.32	ER	284	44.88	
15	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	EKPC - LGEE	4SPUR-KENT-R- 4KENTON 138 kV line	342661	324267	1	DC	161.87	167.81	ER	281	37.06	
16	DCTL	P7-1..C5 4541MELDAHLSP RLCKSTUARTSP URLOCKDPLEK	EKPC	4SPURLOCK-4SPUR- KENT-R 138 kV line	342664	342661	1	DC	162.12	168.06	ER	281	37.06	
17	N-1	P1-#..B2 ZIMMER- MELDAHL 34576	EKPC - DAY	7SPURLOCK- 09STUART 345 kV line	342838	253077	1	DC	111.72	126.52	ER	1374	203.39	6
18	N-1	P1-#..B2 MELDAHL- SPURLOCK 4541	EKPC - DAY	7SPURLOCK- 09STUART 345 kV line	342838	253077	1	DC	106.6	121.42	ER	1374	203.63	

## Short Circuit

*(Summary of impacted circuit breakers)*

New circuit breakers found to be over-duty:

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AB2-054	Duty Percent With AB2-054	Duty Percent Difference
19	EKPC	0	JK SMITH 138.kV	48G UNIT 4	S	93.32%	108.70%	15.38%
20	EKPC	0	JK SMITH 138.kV	58G UNIT 5	S	93.32%	108.70%	15.38%
21	EKPC	0	JK SMITH 138.kV	68G UNIT 6	S	93.32%	108.70%	15.38%

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AB2-054	Duty Percent With AB2-054	Duty Percent Difference
22	EKPC	0	JK SMITH 138.kV	78G UNIT 7	S	93.32%	108.70%	15.38%

### **Potential Congestion due to Local Energy Deliverability**

*PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.*

None.

### **New System Reinforcements**

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1	08ZIMER-08SGROVE 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: <ul style="list-style-type: none"> <li>Reconductor Zimmer-Silver Grove 345 kV to 2045 MVA</li> </ul> The estimated schedule duration is 48 months.	To be provided in the Impact Study	\$ 32,096,408
2	4DALE-4BOONESBOR T 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: <ul style="list-style-type: none"> <li>Upgrade Dale 138kV line-side and bus-side jumpers from single-750 MCM 37 CU to double-750 MCM 37CU. New ratings will be S/N: 309 MVA, S/E: 361 MVA.</li> </ul> The estimated schedule duration is 12 months.	To be provided in the Impact Study	\$ 100,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
3	4JK SMITH-4DALE 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>Increase MOT of JK Smith - Dale 138kv line section 954 MCM 54x7 ACSR conductor to 275°F (LTE of 257°F) (9.5 miles)</li> <li>Upgrade Dale 138kV bus associated with the JK Smith - Dale 138kV line section from single-750 MCM 37 CU to double-750 MCM 37 CU. New ratings will be S/N: 305 MVA, S/E: 354 MVA.</li> </ul> <p>The estimated schedule duration is 24 months.</p>	To be provided in the Impact Study	\$ 900,000
4	08MTZION-08BUFTN1 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>Reconductor Buffington-Mt Zion 138 kV to 408 MVA</li> </ul> <p>The estimated schedule duration is 36 months.</p>	To be provided in the Impact Study	\$ 3,450,000
19, 20, 21, 22	Overdutied 138kV CB's at JK Smith Substation	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>Replace the following 138kV Circuit Breakers: 48G (Unit 4), 58G (Unit 5), 68G (Unit 6), 78G (Unit 7)</li> </ul> <p>The estimated schedule duration is 24 months.</p>	To be provided in the Impact Study	\$ 240,000
<b>Total New Network Upgrades</b>				<b>\$ 36,786,408</b>

### 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)*

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
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Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
5	05WLDCAT-05HILLSB 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>A sag check will be required for the entire 9.88 miles of the ACSR ~ 477 ~ 26/7 ~ HAWK Conductor Section 1 to determine if the line can be operated above its emergency rating of 185 MVA. New ratings will be S/N: 185 MVA S/E: 257 MVA. Estimated Cost for sag study: \$40,000. The estimated schedule duration for this study is 6-12 months.</li> <li>If deemed necessary to rebuild the entire 9.88 miles of the section of line, Estimated Cost: \$14.0 Million. The estimated schedule duration is 24-36 months.</li> </ul>	To be provided in the Impact Study	\$ 14,040,000
6	05EMERSS-05WLDCAT 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>sag check will be required for the entire 1.3 miles of the ACSR ~ 477 ~ 26/7 ~ HAWK Conductor Section 1 to determine if the line can be operated above its emergency rating of 185 MVA. New ratings will be S/N: 185 MVA S/E: 257 MVA. Estimated Cost for sag study: \$5,200. The estimated schedule duration for this study is 6-12 months.</li> <li>If deemed necessary to rebuild the entire 1.3 miles of the section of line, Estimated Cost: \$1,950,000. The estimated schedule duration is 24-36 months.</li> </ul>	To be provided in the Impact Study	\$ 1,955,200
7	08LONGBR-08MTZION 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <ul style="list-style-type: none"> <li>Reconductor Mt. Zion-Longbranch 138 kV to 408 MVA. Ownership of this line section is split between Duke and EKPC. Duke section is only 1.37 miles.</li> </ul> <p>The estimated schedule duration is 36 months.</p>	To be provided in the Impact Study	\$ 2,055,000
8, 9	09ADKINS-05BEATTY 345 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <p>Dayton:</p> <ul style="list-style-type: none"> <li>Upgrade the thermal capacity of the substation conductor at Adkins 345kV Substation. AEP will need to determine if upgrades are required on their portion of the line. New rating will be 1561/1800 MVA (SN/SE). The estimated cost is \$25k, and schedule duration is 0.5 months.</li> </ul> <p>AEP:</p> <ul style="list-style-type: none"> <li>Replace the Beatty Road Line Riser Section. New ratings will be S/N: 1339 MVA S/E: 1556 MVA. This is an AEP-Dayton Power tie line therefore; Dayton Power's portion of the conductor needs to be reconducted/rebuilt to mitigate this overload. The estimated cost is \$100k, and schedule duration is 24 months.</li> </ul>	To be provided in the Impact Study	\$ 125,000

<b>Violation #</b>	<b>Overloaded Facility</b>	<b>Upgrade Description</b>	<b>Network Upgrade Number</b>	<b>Upgrade Cost</b>
10, 11, 12	7TRIMBLE-06CLIFTY 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: <ul style="list-style-type: none"> <li>Build a second Trimble to Clifty 345 kV circuit.</li> </ul> The estimated schedule duration is 42-48 months.	To be provided in the Impact Study	\$ 62,000,000
13	4KENTON-05EMERSS 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: AEP: <ul style="list-style-type: none"> <li>A sag check will be required for the entire 22.22 miles of ACSR ~ 477 ~ 26/7 ~ HAWK Conductor Section 1 to determine if the line can be operated above its emergency rating of 185 MVA. New ratings will be S/N: 185 MVA S/E: 257 MVA. Estimated Cost for sag study: \$88,880, and schedule is 6-12 months.</li> <li>If deemed necessary to rebuild the entire 22.22 miles of the section of line, Estimated Cost: \$33.3 Million. This is an AEP-LGEE tie line therefore, PJM is going to have to coordinate this upgrade with LGEE as well to make sure that their equipment will not set a limit lower than what is specified here. LGEE's portion of the conductor needs to be reconducted/rebuilt as well as to mitigate this overload. Estimated schedule is 24-36 months.</li> </ul>	To be provided in the Impact Study	\$ 33,388,880
14	4BOONE CO-08LONGBR 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: <ul style="list-style-type: none"> <li>Increase MOT of Boone - Longbranch 138kv line section 954 MCM 54x7 ACSR conductor to 275°F (LTE of 257°F) (2.25 miles).</li> <li>Upgrade Boone 138kV bus associated with the Boone - Longbrand 138kV line section from single-750 MCM 37 CU to double-750 MCM 37 CU.</li> <li>Upgrade Boone 138kv jumpers from single-750 MCM 37 CU to double-750 MCM 37 CU. New ratings with be S/N: 297 MVA S/E: 354 MVA.</li> </ul> The estimated schedule duration is 12 months.	To be provided in the Impact Study	\$ 400,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
15, 16	4SPUR-KENT-R-4KENTON 138 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required :</p> <p>EKPC</p> <ul style="list-style-type: none"> <li>• Upgrade series reactor from 5% to 11% impedance to help lower flow</li> <li>• Increase MOT of Spurlock - Kenton 138kv line section 795 MCM 26x7 ACSR conductor to 302°F (LTE of 284°F) (4.4 miles)</li> <li>• Upgrade line trap to 1600A</li> <li>• Upgrade 795 MCM 61 AA jumpers associated with Spurlock 138kv bus (x2) to 954 MCM 54x7 ACSR</li> <li>• Spurlock - Stanley Parker 138kv MOT increase to 302°F (LTE of 284°F) (47.5 miles)</li> <li>• Replace Spurlock - Renaker 138kV Structure HD-038 for line clearance. New ratings with be S/N: 297 MVA S/E: 374 MVA</li> </ul> <p>The estimated schedule duration is 24 months.</p> <p>LGEE will have to evaluate this violation during the SIS phase.</p>	To be provided in the Impact Study	\$ 7,100,000
17, 18	7SPURLOCK-09STUART 345 kV line	<p>In order to mitigate the overloads of facilities above, the following reinforcements are required:</p> <p>EKPC:</p> <ul style="list-style-type: none"> <li>• Upgrade DPL limiting element (currently at 1374 LTE) (Costs do not include DPL work)</li> <li>• Increase MOT on the Spurlock - Stuart 345kV double-954 54x7 ACSR from 212°F to 275°F (LTE of 257°F) (3.81 miles). New ratings with be S/N: 1488 MVA S/E: 1772 MVA</li> <li>• Estimated Cost: \$800,000, and schedule is 24 months.</li> </ul> <p>Dayton</p> <ul style="list-style-type: none"> <li>• Upgrade the thermal capacity of the substation conductor at Stuart 345kV Substation. New ratings will be 1561/1800 MVA (SN/SE)</li> <li>• Estimated Cost: \$30,000, and schedule is 0.5 months.</li> </ul>	To be provided in the Impact Study	\$ 830,000
<b>Total New Network Upgrades</b>				<b>\$ 121,894,080</b>

**Attachment 1**  
*System Configuration*

## Attachment 2

### Flowgate Details

### 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. 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

(DEO&K - DEO&K) The 08ZIMER-08SGROVE 345 kV line (from bus 249577 to bus 249573 ckt 1) loads from 97.05% to 98.39% (**DC power flow**) of its emergency rating (1664 MVA) for the single line contingency outage of 'P1-#..B2 PORT UNION-ZIMMER 4544'. This project contributes approximately 49.56 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
251970	08MELDL1	3.38
251971	08MELDL2	3.38
251972	08MELDL3	3.39
251968	08ZIMRHP	92.3
251969	08ZIMRLP	50.6
342910	1DALE 3G	4.71
342911	1DALE 4G	5.27

Bus Number	Bus Name	Full Contribution
342957	1SPURLK1G	9.69
342960	1SPURLK2G	19.04
342963	1SPURLK3G	10.01
342966	1SPURLK4G	10.01
923522	AB1-169 C OP	209.07
924101	AB2-054	49.56
925001	AB2-156	26.94

## Appendix 2

(EKPC - EKPC) The 4DALE-4BOONESBOR T 138 kV line (from bus 342574 to bus 342565 ckt 1) loads from 70.58% to 100.89% (**DC power flow**) of its emergency rating (296 MVA) for the single line contingency outage of 'E\_C JK SMITH TO NORTH CLARK 345 KV'. This project contributes approximately 89.7 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
342900	1COOPER1 G	1.26
342903	1COOPER2 G	2.44
342910	1DALE 3G	19.47
342911	1DALE 4G	26.53
342918	1JKCT 1G	4.05
342921	1JKCT 2G	4.05
342924	1JKCT 3G	4.05
342927	1JKCT 4G	2.69

Bus Number	Bus Name	Full Contribution
342930	1JKCT 5G	2.69
342933	1JKCT 6G	2.69
342936	1JKCT 7G	2.69
342939	1JKCT 9G	2.18
342942	1JKCT 10G	2.18
342945	1LAUREL 1G	0.95
924101	AB2-054	89.7

## Appendix 3

(EKPC - EKPC) The 4JK SMITH-4DALE 138 kV line (from bus 342607 to bus 342574 ckt 1) loads from 78.52% to 110.36% (**DC power flow**) of its emergency rating (296 MVA) for the single line contingency outage of 'E\_C JK SMITH TO NORTH CLARK 345 KV'. This project contributes approximately 94.25 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
342918	1JKCT 1G	4.41
342921	1JKCT 2G	4.41
342924	1JKCT 3G	4.41
342927	1JKCT 4G	2.93
342930	1JKCT 5G	2.93

Bus Number	Bus Name	Full Contribution
342933	1JKCT 6G	2.93
342936	1JKCT 7G	2.93
342939	1JKCT 9G	2.29
342942	1JKCT 10G	2.29
924101	AB2-054	94.25

## Appendix 4

(DAY - AEP) The 09ADKINS-05BEATTY 345 kV line (from bus 253110 to bus 243453 ckt 1) loads from 108.76% to 110.13% (**DC power flow**) of its normal rating (1233 MVA) for the single line contingency outage of '892\_B2'. This project contributes approximately 37.59 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
253110	09ADKINS	69.08
253077	09STUART	64.06
342910	1DALE 3G	4.01
342911	1DALE 4G	4.28

Bus Number	Bus Name	Full Contribution
916411	Z1-097	4.26
920662	Z2-029	0.56
922002	AA2-100	0.46
922612	AB1-014 C	3.85

Bus Number	Bus Name	Full Contribution
342960	1SPURLK2G	10.9
342963	1SPURLK3G	5.73
342966	1SPURLK4G	5.73
247592	W4-036	1.01

Bus Number	Bus Name	Full Contribution
923522	AB1-169 C OP	119.65
924101	AB2-054	37.59
925001	AB2-156	3.21

## Appendix 5

(LGEE - OVEC) The 7TRIMBLE-06CLIFTY 345 kV line (from bus 324114 to bus 248000 ckt 1) loads from 150.6% to 156.01% (**DC power flow**) of its emergency rating (1370 MVA) for the single line contingency outage of '363\_B2\_TOR1682'. This project contributes approximately 74.16 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
247286	05AND G2	0.41
247287	05AND G3	0.85
243442	05RKG1	19.54
243443	05RKG2	19.24
342900	1COOPER1 G	3.35
342903	1COOPER2 G	6.51
342910	1DALE 3G	9.7
342911	1DALE 4G	9.4
342918	1JKCT 1G	2.65
342921	1JKCT 2G	2.65
342924	1JKCT 3G	2.65
342927	1JKCT 4G	1.76
342930	1JKCT 5G	1.76
342933	1JKCT 6G	1.76
342936	1JKCT 7G	1.76
342939	1JKCT 9G	1.8

Bus Number	Bus Name	Full Contribution
342942	1JKCT 10G	1.8
342945	1LAUREL 1G	1.89
900405	X3-028 E	150.82
LTF	Y2-006	16.69
247629	Y3-038	2.71
LTF	Z1-046	19.54
LTF	AA1-001	5.7
LTF	AA1-004	15.85
LTF	AB1-023	12.64
922982	AB1-087 C OP	41.46
922992	AB1-088 C OP	41.46
LTF	AB2-005	10.68
924101	AB2-054	74.16
LTF	AB2-075	2.58
LTF	AB2-076	3.27

## Appendix 6

(EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 111.72% to 126.52% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'P1-#.B2 ZIMMER-MELDAHL 34576'. This project contributes approximately 203.39 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
251970	08MELDL1	4.83

Bus Number	Bus Name	Full Contribution
342933	1JKCT 6G	4.47

Bus Number	Bus Name	Full Contribution
251971	08MELDL2	4.83
251972	08MELDL3	4.84
342903	1COOPER2 G	6.36
342910	1DALE 3G	20.78
342911	1DALE 4G	22.56
342918	1JKCT 1G	6.73
342921	1JKCT 2G	6.73
342924	1JKCT 3G	6.73
342927	1JKCT 4G	4.47
342930	1JKCT 5G	4.47

Bus Number	Bus Name	Full Contribution
342936	1JKCT 7G	4.47
342939	1JKCT 9G	4.95
342942	1JKCT 10G	4.95
342945	1LAUREL 1G	2.19
342957	1SPURLK1G	34.46
342960	1SPURLK2G	65.99
342963	1SPURLK3G	34.68
342966	1SPURLK4G	34.68
923522	AB1-169 C OP	724.41
924101	AB2-054	203.39