Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB1-169

Spurlock 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) has proposed a natural gas generating facility located in Mason, Kentucky. The installed facilities will have a total capability of 1150 MW with 1100 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 2020. **This study does not imply an EKPC commitment to this in-service date.**

Point of Interconnection

Option 1 has the project interconnecting with the EKPC transmission system via a new breaker position at Spurlock 345 kV substation

Option 2 has the project interconnecting with the Dayton transmission system via a new breaker position at the Stuart 345 kV substation.

Cost Summary

The AB1-169 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 1,600,000
Non Direct Connection Network Upgrades	$ 6,500,000
Total Costs	**$ 8,100,000**

In addition, the AB1-169 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 21,600,000
Previously Identified Upgrades	$ 0
Total Costs	**$ 29,700,000**

Cost allocations for these upgrades will be provided in the System Impact Study Report. No costs are provided for the second option. Only a sensitivity analysis is included.

Attachment Facilities

The Interconnection Customer will construct the attachment lines into the proposed Point of Interconnection as depicted in the one-line diagram.

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the table below:

Description	Total Cost
Interconnection metering for merchant generation at Spurlock 345kv bus. Time estimate – 12 months	$ 500,000
Build new protection control building and install relaying for new Point of Interconnection. Time estimate – 24 months	$ 1,100,000
Total	**$ 1,600,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the table below:

Description	Total Cost
Expand 345kV bus at Spurlock to accommodate Point of Interconnection. Time estimate – 24 months.	$ 6,500,000
Total	**$ 6,500,000**

Interconnection Customer Requirements

The Interconnection Customer must comply with all requirements outlined in the "EKPC Facility Connections Requirements" document located at the following link:

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

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.

EKPC 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.aspx

Option 1

Network Impacts

The Queue Project AB1-169 was evaluated as a 1150.0 MW (Capacity 1100.0 MW) injection at the Spurlock 345kV substation in the EKPC area. Project AB1-169 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-169 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
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
6190_B3_05SPORN 345-4_WOMOAB	CONTINGENCY '6190_B3_05SPORN 345-4_WOMOAB' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 OPEN BRANCH FROM BUS 242528 TO BUS 242808 CKT 4 / 242528 05SPORN 345 242808 05SPORNS 138 4 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
892_B2	CONTINGENCY '892_B2' OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1 END
B2 ZIMMER-SPURLOCK 4541-A	CONTINGENCY 'B2 ZIMMER-SPURLOCK 4541-A' OPEN BRANCH FROM BUS 249577 TO BUS 249581 CKT 1 END
C2 1445_ZIMMER	CONTINGENCY 'C2 1445_ZIMMER' OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1 /* - CKT ID FIXED OPEN BRANCH FROM BUS 249581 TO BUS 249577 CKT 1 /* - CKT ID FIXED END

Contingency Name	Description
C2 1449_ZIMMER	CONTINGENCY 'C2 1449_ZIMMER' OPEN BRANCH FROM BUS 249577 TO BUS 249580 CKT Z1 / 249577 08ZIMER 345 249580 08ZIMERG 345 1 OPEN BRANCH FROM BUS 249580 TO BUS 251968 CKT 1H / 249580 08ZIMERG 345 251968 08ZIMRHP 26.0 1H OPEN BRANCH FROM BUS 249580 TO BUS 251969 CKT 1L / 249580 08ZIMERG 345 251969 08ZIMRLP 22.0 1L OPEN BRANCH FROM BUS 249581 TO BUS 249577 CKT 1 /* - CKT ID FIXED END
C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK	CONTINGENCY 'C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK' OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 /* - CKT ID FIXED OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 /* - CKT ID FIXED END

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Generator Deliverability

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contrib.	Ref
1	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	98.8	103.87	NR	1017	114.4	1
2	N-1	892_B2	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	94.88	104.69	NR	1233	120.92	2
3	N-1	161_B3	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	93.24	102.99	NR	1233	120.21	
4	N-1	B2 ZIMMER-SPURLOCK 4541-A	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	49.71	102.53	ER	1374	728.53	

Multiple Facility Contingency

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contrib.	Ref
5	DCTL	C5 4541MELDA HLSPRLCKS TUARTSPUR LOCKDPLEK	EKPC - DEO&K	4BOONE CO-08LONGBR 138 kV line	342559	250054	1	DC	61.7	107.47	ER	284	129.96	
6	DCTL	C5 4541MELDA HLSPRLCKS TUARTSPUR LOCKDPLEK	EKPC - LGEE	4SPUR-KENT-R-4KENTON 138 kV line	342661	324267	1	DC	68.16	111.45	ER	281	121.64	

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contrib.	Ref
7	DCTL	C5 4541MELDA HLSPRLCKS TUARTSPUR LOCKDPLEK	EKPC - EKPC	4SPURLOCK-4STANLEY PRK 138 kV line	342664	342667	1	DC	57.16	102.37	ER	255	115.29	
8	LFFB	C2 1449_ZIMME R	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	53.15	108.39	ER	1374	761.12	3
9	LFFB	C2 1445_ZIMME R	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	48.05	103.32	ER	1374	761.48	
10	DCTL	C5 4541MELDA HLSPRLCKS TUARTSPUR LOCKDPLEK	EKPC - EKPC	7SPURLOCK-7N CLARK 345 kV line	342838	342835	1	DC	44.89	102.26	ER	1151	660.24	

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 Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contrib.	Ref
11	N-1	349_B2_TOR 21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	108.53	113.84	NR	971	114.4	4
12	N-1	6190_B3_05 SPORN 345-4_WOMOAB	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	107.64	112.96	NR	971	114.59	

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 AB1-169	Duty Percent With AB1-169	Duty Percent Difference
13	EKPC	0	INLAND 1&2 138.kV	828 XFMR	S	99.25	104.35	5.1
14	EKPC	0	SPURLOCK 138.kV	864 INLAND C	S	94.18	100.82	6.65
15	EKPC	0	SPURLOCK 138.kV	18G UNIT 1	S	94.18	100.82	6.65
16	EKPC	0	SPURLOCK 138.kV	802 GENERAL	S	94.18	100.82	6.65
17	EKPC	0	SPURLOCK 138.kV	814 STANLEY	S	94.18	100.82	6.65
18	EKPC	0	SPURLOCK 138.kV	824 RENAKER	S	94.18	100.82	6.65
19	EKPC	0	SPURLOCK 138.kV	834 PLUMMVIL	S	94.18	100.82	6.65
20	EKPC	0	SPURLOCK 138.kV	844 GODDARD	S	94.18	100.82	6.65
21	EKPC	0	SPURLOCK 138.kV	854 KENTON	S	94.18	100.82	6.65
22	EKPC	0	SPURLOCK 138.kV	888 T10	S	94.18	100.82	6.65
23	EKPC	0	SPURLOCK 138.kV	90T TIE BKR	S	94.18	100.82	6.65
24	EKPC	0	SPURLOCK 138.kV	92T TIE BKR	S	93.57	100.2	6.63

Contributions to previously identified circuit breakers found to be over-duty:

None.

Steady-State Voltage Requirements

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

To be determined.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined.

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, 11, 12	06KYGER-05SPORN 345 kV line	Reinforcement: Six Wire the Kyger-Sporn 345 kV No 1 and No 2 Circuits together. OVEC will have to evaluate this violation during the SIS phase. Cost: $0.3 Million Time: 36-48 months	Pending	**$ 300,000**
#2, 3	09ADKINS-05BEATTY 345 kV line	Reinforcement: Replace the Beatty Road Line Riser Section, Estimated cost: $100,000. This is an AEP-DAY tie line therefore, DAY's portion of the conductor needs to be reconductored/rebuilt to mitigate this overload. Cost: $100,000 Time: 12 months	Pending	**$ 100,000**
#4, 8, 9	7SPURLOCK-09STUART 345 kV line	Reinforcement: Increase MOT of Spurlock - Stuart 345kv line section 2-954 MCM 54x7 ACSR conductor to 275°F (LTE of 257°F) (3.81 miles - dbl circuit part) Cost: $510,000 Time: 12 months	Pending	**$ 510,000**
#5	4BOONE CO-08LONGBR 138 kV line	Reinforcement: Increase MOT of Boone - Longbranch 138kv line section 954 MCM 54x7 ACSR conductor to 275°F (LTE of 257°F) (2.25 miles); upgrade Boone 138kv jumpers from 750 MCM 37 CU to 954 MCM 54x7 ACSR. Cost: $170,000 Time: 12 months	Pending	**$ 170,000**
#6	4SPUR-KENT-R-4KENTON 138 kV line	Reinforcement: Increase MOT of Spurlock - Kenton 138kv line section 795 MCM 26x7 ACSR conductor to 302°F (LTE of 284°F) (4.4 miles); upgrade line trap to 1600A; upgrade 795 MCM 61 AA jumpers associated with Spurlock 138kv bus (x2) to 954 MCM 54x7 ACSR. Upgrade reactor on the Spurlock – Kenton 138 kV line from 5% to 11% impedance. Cost: $2,910,000 Time: 12 months LGEE will have to evaluate this violation during the SIS phase.	Pending	**$ 2,910,000**
#7	4SPURLOCK-4STANLEY PRK 138 kV line	Reinforcement: Increase MOT of Spurlock - Stanley Parker 138kv line section 795 MCM 26x7 ACSR conductor to 302°F (LTE of 284°F) (47.5 miles) Cost: $3.5 million Time: 24 months	Pending	**$ 3,500,000**
#10	7SPURLOCK-7N CLARK 345 kV line	Reinforcement: Increase MOT of Spurlock - North Clark 345kv transmission line 2-954 MCM 54x7 ACSR conductor to 275°F (LTE of 257°F) (45.02 miles) Cost: $6.01 Millions Time: 24 months	Pending	**$ 6,010,000**
#13	828 XFMR Breaker	Upgrade Circuit Switcher 828 at Inland Container due to being over-duty. Estimated time – 14 months	Pending	**$ 400,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#14-24	864 INLAND C 18G UNIT 1 802 GENERAL 814 STANLEY 824 RENAKER 834 PLUMMVIL 844 GODDARD 854 KENTON 888 T10 90T TIE BKR 92T TIE BKR	Upgrade breakers to 80 kA. Cost per upgrade - $700,000. Time estimate for all upgrades is 18 months	Pending	**$ 7,700,000**
			Total New Network Upgrades	**$ 21,600,000**

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)

None.

Potential Congestion due to Local Energy Deliverability

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

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
25	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	107.89	113.19	NR	1017	119.6
26	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	118.06	123.61	NR	971	119.6
27	N-1	B2 ZIMMER-SPURLOCK 4541-A	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	47.48	102.75	ER	1374	761.64

Option 2

Network Impacts

The Queue Project AB1-169 was evaluated as a 1150.0 MW (Capacity 1100.0 MW) injection at the Stuart 345kV substation in the Dayton area. This is originally an EKPC project with the secondary option injecting into the Dayton area. Project AB1-169 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-169 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
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
6190_B3_05SPORN 345-4_WOMOAB	CONTINGENCY '6190_B3_05SPORN 345-4_WOMOAB' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 OPEN BRANCH FROM BUS 242528 TO BUS 242808 CKT 4 / 242528 05SPORN 345 242808 05SPORNS 138 4 END
707_B2_TOR8315	CONTINGENCY '707_B2_TOR8315' OPEN BRANCH FROM BUS 242922 TO BUS 242928 CKT 1 / 242922 05FLTLCK 765 242928 05MARYSV 765 1 END
764_B2_TOR9237	CONTINGENCY '764_B2_TOR9237' OPEN BRANCH FROM BUS 242938 TO BUS 253038 CKT 1 / 242938 05MARQUI 345 253038 09KILLEN 345 1 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
892_B2	CONTINGENCY '892_B2' OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1 END

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Generator Deliverability

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contrib.	Ref
1	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	97.08	102.32	NR	1017	118.46	1
2	N-1	764_B2_TOR9237	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	93.34	107.78	NR	1233	178.06	2
3	N-1	892_B2	DAY - AEP	09ADKINS-05BEATTY 345 kV line	253110	243453	1	DC	93.13	105.68	NR	1233	154.74	

Multiple Facility Contingency

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

None.

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 AB1-169	Duty Percent With AB1-169	Duty Percent Difference
9	EKPC	0	INLAND 1&2 138.kV	828 XFMR	S	99.25	100.44	1.18

Contributions to previously identified circuit breakers found to be over-duty:

None.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contrib.	Ref
4	N-1	349_B2_TOR 21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	106.73	112.23	NR	971	118.46	3
5	N-1	6190_B3_05 SPORN 345-4_WOMOAB	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	105.84	111.34	NR	971	118.66	

Steady-State Voltage Requirements

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

To be determined.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined.

New System Reinforcements

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

Option #2 selections do not include cost estimates.

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)

Option #2 selections do not include cost estimates.

Potential Congestion due to Local Energy Deliverability

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

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution
6	N-1	707_B2_TOR8315	AEP - AEP	05MOUNTN-05BELMON 765 kV line	242516	242920	1	DC	110.12	110.15	NR	4055	141.77
7	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	106.17	111.66	NR	1017	123.84
8	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	116.26	122	NR	971	123.84

Attachment 1

System Configuration

Attachment 2

Option 1 Flowgate Appendices

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

(OVEC - AEP) The 06KYGER-05SPORN 345 kV line (from bus 248005 to bus 242528 ckt 1) loads from 98.8% to 103.87% (**DC power flow**) of its normal rating (1017 MVA) for the single line contingency outage of '8468_B2'. This project contributes approximately 114.4 MW to the thermal violation.

CONTINGENCY '8468_B2'
OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2
END

Bus Number	*Bus Name*	*Full Contribution*
243233	*05TANNER*	*73.07*
243382	*05TANNER*	*28.34*
251937	*08BCKJD5*	*31.12*
251938	*08BCKJD6*	*66.62*
251940	*08BKJGT1*	*6.28*
251941	*08BKJGT2*	*6.28*
251942	*08BKJGT3*	*6.28*
251943	*08BKJGT4*	*6.28*
251949	*08M.FRT6*	*17.29*
251966	*08WSDLE5*	*0.78*
251967	*08WSDLE6*	*0.78*
253038	*09KILLEN*	*6.93*
253058	*09OHH C.*	*10.24*
253059	*09OHH E.*	*8.19*
253064	*09OHH W._OFF*	*9.72*
342907	*1DALE 1G*	*1.76*
342909	*1DALE 2G*	*1.76*
342910	*1DALE 3G*	*5.65*
342911	*1DALE 4G*	*5.83*
247536	*S-071 C*	*1.6*
247543	*V3-007 C*	*1.9*
247544	*V3-008 C*	*1.9*
247545	*V3-009 C*	*1.9*
247515	*V4-033 C*	*2.93*
247588	*W4-004 C*	*0.91*
247589	*W4-008 C*	*0.91*
LTF	*Y2-030*	*13.9*
LTF	*Y2-031*	*13.9*
LTF	*Y2-032*	*13.9*
915571	*Y3-073*	*5.58*
LTF	*Z1-007*	*5.66*
916261	*Z1-079 OP1*	*57.92*
917151	*Z2-029*	*2.21*

918481	*AA1-063*	*0.27*
920061	*AA2-100*	*0.71*
920501	*AA2-148 C OP*	*1.77*
930061	*AB1-014 C*	*5.31*
931181	*AB1-169 C OP*	*114.4*

Appendix 2

(DAY - AEP) The 09ADKINS-05BEATTY 345 kV line (from bus 253110 to bus 243453 ckt 1) loads from 94.88% to 104.69% (**DC power flow**) of its normal rating (1233 MVA) for the single line contingency outage of '892_B2'. This project contributes approximately 120.92 MW to the thermal violation.

CONTINGENCY '892_B2'
OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
253110	*09ADKINS*	*28.05*
253077	*09STUART*	*27.9*
342907	*1DALE 1G*	*1.24*
342909	*1DALE 2G*	*1.24*
342910	*1DALE 3G*	*3.98*
342911	*1DALE 4G*	*4.26*
342957	*1SPURLK1G*	*2.57*
342960	*1SPURLK2G*	*4.76*
342963	*1SPURLK3G*	*2.5*
342966	*1SPURLK4G*	*2.5*
915571	*Y3-073*	*3.26*
916411	*Z1-097*	*1.85*
917151	*Z2-029*	*2.89*
920061	*AA2-100*	*0.62*
930061	*AB1-014 C*	*3.87*
931181	*AB1-169 C OP*	*120.92*

Appendix 3

(EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 53.15% to 108.39% (**DC power flow**) of its emergency rating (1374 MVA) for the line fault with failed breaker contingency outage of 'C2 1449_ZIMMER'. This project contributes approximately 761.12 MW to the thermal violation.

CONTINGENCY 'C2 1449_ZIMMER'
OPEN BRANCH FROM BUS 249577 TO BUS 249580 CKT Z1 / 249577 08ZIMER 345 249580 08ZIMERG 345 1
OPEN BRANCH FROM BUS 249580 TO BUS 251968 CKT 1H / 249580 08ZIMERG 345 251968 08ZIMRHP 26.0 1H
OPEN BRANCH FROM BUS 249580 TO BUS 251969 CKT 1L / 249580 08ZIMERG 345 251969 08ZIMRLP 22.0 1L
OPEN BRANCH FROM BUS 249581 TO BUS 249577 CKT 1 /* -CKT ID FIXED
END

Bus Number	*Bus Name*	*Full Contribution*
342907	*1DALE 1G*	*6.42*
342909	*1DALE 2G*	*6.42*
342910	*1DALE 3G*	*20.65*
342911	*1DALE 4G*	*22.48*
342957	*1SPURLK1G*	*15.1*
342960	*1SPURLK2G*	*28.67*
342963	*1SPURLK3G*	*15.06*
342966	*1SPURLK4G*	*15.06*
894753	*V3-045*	*2.1*
894754	*V3-045*	*2.1*
894755	*V3-045*	*2.1*
LTF	*Y2-030*	*8.77*
LTF	*Y2-031*	*8.77*
LTF	*Y2-032*	*8.77*
LTF	*Z1-007*	*5.53*
LTF	*Z1-071*	*5.83*
931181	*AB1-169 C OP*	*728.02*
931182	*AB1-169 E OP*	*33.09*

Appendix 4

(OVEC - AEP) The 06KYGER-05SPORN 345 kV line (from bus 248005 to bus 242528 ckt 2) loads from 108.53% to 113.84% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '349_B2_TOR21'. This project contributes approximately 114.4 MW to the thermal violation.

CONTINGENCY '349_B2_TOR21'
OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
243233	*05TANNER*	*73.07*
243382	*05TANNER*	*28.34*
251937	*08BCKJD5*	*31.12*
251938	*08BCKJD6*	*66.62*
251940	*08BKJGT1*	*6.28*
251941	*08BKJGT2*	*6.28*
251942	*08BKJGT3*	*6.28*
251943	*08BKJGT4*	*6.28*
251949	*08M.FRT6*	*17.29*
251966	*08WSDLE5*	*0.78*
251967	*08WSDLE6*	*0.78*
253038	*09KILLEN*	*6.93*
253058	*09OHH C.*	*10.24*
253059	*09OHH E.*	*8.19*
253064	*09OHH W._OFF*	*9.72*
342907	*1DALE 1G*	*1.76*
342909	*1DALE 2G*	*1.76*
342910	*1DALE 3G*	*5.65*
342911	*1DALE 4G*	*5.83*
247536	*S-071 C*	*1.6*
247543	*V3-007 C*	*1.9*
247544	*V3-008 C*	*1.9*
247545	*V3-009 C*	*1.9*
247515	*V4-033 C*	*2.93*
247588	*W4-004 C*	*0.91*
247589	*W4-008 C*	*0.91*
LTF	*Y2-030*	*13.9*
LTF	*Y2-031*	*13.9*
LTF	*Y2-032*	*13.9*
915571	*Y3-073*	*5.58*
LTF	*Z1-007*	*5.66*
LTF	*Z1-070*	*49.08*
916261	*Z1-079 OP1*	*57.92*

917151	*Z2-029*	*2.21*
918481	*AA1-063*	*0.27*
920061	*AA2-100*	*0.71*
920501	*AA2-148 C OP*	*1.77*
930061	*AB1-014 C*	*5.31*
931181	*AB1-169 C OP*	*114.4*

Attachment 3

Option 2 Flowgate Appendices

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

(OVEC - AEP) The 06KYGER-05SPORN 345 kV line (from bus 248005 to bus 242528 ckt 1) loads from 97.08% to 102.32% (**DC power flow**) of its normal rating (1017 MVA) for the single line contingency outage of '8468_B2'. This project contributes approximately 118.46 MW to the thermal violation.

CONTINGENCY '8468_B2'
OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2
END

Bus Number	*Bus Name*	*Full Contribution*
243233	*05TANNER*	*73.07*
243382	*05TANNER*	*28.34*
251937	*08BCKJD5*	*31.12*
251938	*08BCKJD6*	*66.62*
251940	*08BKJGT1*	*6.28*
251941	*08BKJGT2*	*6.28*
251942	*08BKJGT3*	*6.28*
251943	*08BKJGT4*	*6.28*
251949	*08M.FRT6*	*17.29*
251966	*08WSDLE5*	*0.78*
251967	*08WSDLE6*	*0.78*
253038	*09KILLEN*	*6.92*
253058	*09OHH C.*	*10.24*
253059	*09OHH E.*	*8.19*
253064	*09OHH W._OFF*	*9.72*
342907	*1DALE 1G*	*1.76*
342909	*1DALE 2G*	*1.76*
342910	*1DALE 3G*	*5.65*
342911	*1DALE 4G*	*5.83*
247536	*S-071 C*	*1.6*
247543	*V3-007 C*	*1.9*
247544	*V3-008 C*	*1.9*
247545	*V3-009 C*	*1.9*
247515	*V4-033 C*	*2.93*
247588	*W4-004 C*	*0.91*
247589	*W4-008 C*	*0.91*
LTF	*Y2-030*	*13.9*
LTF	*Y2-031*	*13.9*
LTF	*Y2-032*	*13.9*
915571	*Y3-073*	*5.57*
LTF	*Z1-007*	*5.66*
916261	*Z1-079 OP1*	*57.91*
917151	*Z2-029*	*2.21*

918481	*AA1-063*	*0.27*
920061	*AA2-100*	*0.71*
920501	*AA2-148 C OP*	*1.77*
930061	*AB1-014 C*	*5.3*
931181	*AB1-169 C OP*	*118.46*

Appendix 2

(DAY - AEP) The 09ADKINS-05BEATTY 345 kV line (from bus 253110 to bus 243453 ckt 1) loads from 93.34% to 107.78% (**DC power flow**) of its normal rating (1233 MVA) for the single line contingency outage of '764_B2_TOR9237'. This project contributes approximately 178.06 MW to the thermal violation.

CONTINGENCY '764_B2_TOR9237'
OPEN BRANCH FROM BUS 242938 TO BUS 253038 CKT 1 / 242938 05MARQUI 345 253038 09KILLEN 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
253110	*09ADKINS*	*28.44*
253077	*09STUART*	*32.*
342907	*1DALE 1G*	*1.44*
342909	*1DALE 2G*	*1.44*
342910	*1DALE 3G*	*4.62*
342911	*1DALE 4G*	*4.93*
915571	*Y3-073*	*3.97*
916261	*Z1-079 OP1*	*26.22*
916411	*Z1-097*	*1.87*
917151	*Z2-029*	*3.32*
920061	*AA2-100*	*0.73*
930061	*AB1-014 C*	*4.69*
931181	*AB1-169 C OP*	*178.06*

Appendix 3

(OVEC - AEP) The 06KYGER-05SPORN 345 kV line (from bus 248005 to bus 242528 ckt 2) loads from 106.73% to 112.23% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of '349_B2_TOR21'. This project contributes approximately 118.46 MW to the thermal violation.

CONTINGENCY '349_B2_TOR21'
OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
243233	*05TANNER*	*73.07*
243382	*05TANNER*	*28.34*
251937	*08BCKJD5*	*31.12*
251938	*08BCKJD6*	*66.62*
251940	*08BKJGT1*	*6.28*
251941	*08BKJGT2*	*6.28*
251942	*08BKJGT3*	*6.28*
251943	*08BKJGT4*	*6.28*
251949	*08M.FRT6*	*17.29*
251966	*08WSDLE5*	*0.78*
251967	*08WSDLE6*	*0.78*
253038	*09KILLEN*	*6.92*
253058	*09OHH C.*	*10.24*
253059	*09OHH E.*	*8.19*
253064	*09OHH W._OFF*	*9.72*
342907	*1DALE 1G*	*1.76*
342909	*1DALE 2G*	*1.76*
342910	*1DALE 3G*	*5.65*
342911	*1DALE 4G*	*5.83*
247536	*S-071 C*	*1.6*
247543	*V3-007 C*	*1.9*
247544	*V3-008 C*	*1.9*
247545	*V3-009 C*	*1.9*
247515	*V4-033 C*	*2.93*
247588	*W4-004 C*	*0.91*
247589	*W4-008 C*	*0.91*
LTF	*Y2-030*	*13.9*
LTF	*Y2-031*	*13.9*
LTF	*Y2-032*	*13.9*
915571	*Y3-073*	*5.57*
LTF	*Z1-007*	*5.66*
LTF	*Z1-070*	*49.09*
916261	*Z1-079 OP1*	*57.91*

917151	*Z2-029*	*2.21*
918481	*AA1-063*	*0.27*
920061	*AA2-100*	*0.71*
920501	*AA2-148 C OP*	*1.77*
930061	*AB1-014 C*	*5.3*
931181	*AB1-169 C OP*	*118.46*