Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-107

Chickahominy 500kV
1600 MW Capacity / 1600 MW Energy

Revised May / 2017

Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Preface

The intent of the Feasibility Study is to determine a plan, with high level estimated cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the IC. The IC may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the IC 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 IC is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by ITO, the costs may be included in the study.

General

The IC has proposed a natural gas combined cycle generating facility located in Charles City, Virginia (Charles City County). The installed facilities will have a total capability of 1600 MW with 1600 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 5/1/2020. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-107 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new breaker bay in to the Chickahominy 500kV substation.

Option 2 will connect via a new breaker bay in to the Chickahominy 230kV substation.

Cost Summary

The AC1-107 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$2,200,000
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$7,500,000
Total Costs	**$9,700,000**

In addition, the AC1-107 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$157,880,000
Previously Identified Upgrades	$106,500,000
Total Costs	**$264,380,000**

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

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. For New System Upgrades, the cost allocation rule differ depending on whether the minimum amount of upgrades to resolve a single reliability criteria violation will cost less than $5,000,000. For upgrades estimated to cost less than $5,000,000 the allocation of costs will not occur outside of the Queue in which the need for the Network Upgrade was identified. Cost allocation within the Queue will be contingent each Queue projects Distribution Factor on the overloaded facility. For upgrades estimated to cost $5,000,000 or greater the allocation of costs will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

The Feasibility Study is used to make a preliminary determination of the type and scope of Attachment Facilities, Local Upgrades, and Network Upgrades that will be necessary to accommodate the Interconnection Request and to provide the Interconnection Customer a preliminary estimate of the time that will be required to construct any necessary facilities and upgrades and the Interconnection Customer's cost responsibility. The System Impact Study provides refined and comprehensive estimates of cost responsibility and construction lead times for new facilities and system upgrades. Facilities Studies will include, commensurate with the degree of engineering specificity as provided in the Facilities Study Agreement, good faith estimates of the cost, determined in accordance with Section 217 of the Tariff,

(a) to be charged to each affected New Service Customer for the Facilities and System Upgrades that are necessary to accommodate this queue project;
(b) the time required to complete detailed design and construction of the facilities and upgrades; and
(c) a description of any site-specific environmental issues or requirements that could reasonably be anticipated to affect the cost or time required to complete construction of such facilities and upgrades.
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Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost $700,000.

Transmission: Build a half mile of 500 kV attachment line to the POI. Estimated cost $1,500,000.

The estimated total cost of the Attachment Facilities is $2,200,000. It is estimated to take 20-24 months to permit (Virginia CPCN Required) and complete this work. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Non-Direct Connection Cost Estimate

Substation: Add an additional three 500 kV Breakers at Chickahominy 500 kV Switching Station may require substation expansion/re-arrangement. Estimated cost $7,500,000 and it is estimated to take 24-30 months to permit and construct.

Remote Terminal Work: During the Facilities Study, ITO's System Protection Engineering Department will review transmission line protection as well as anti-islanding required to accommodate the new generation and interconnection substation. System Protection Engineering will determine the minimal acceptable protection requirements to reliably interconnect the proposed generating facility with the transmission system. The review is based on maintaining system reliability by reviewing ITO's protection requirements with the known transmission system configuration which includes generating facilities in the area. This review may determine that transmission line protection and communication upgrades are required at remote substations.

System Reinforcement

Violation #	Ruling Violation #	Loading	Upgrade Description	Upgrade Cost
# 1, 2, 27	27 (see note)	From 102.23% to 137.57%	Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months.	$28,200,000
# 3	3	From 74.14% to 109.48%	Wreck and rebuild the Lightfoot– Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimate time 30 – 36 months.	$15,200,000
# 4, 17, 18	4	From 90.43% to 109.83%	Replace wave trap at both Carson and Midlothian 500kV Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time: 12 – 16 months.	$500,000
# 5, 6	5	From 45.84% to 103.07%	Add a second Chickahominy 500-230 kV transformer into a new breaker bay. Estimated time 24 – 30 months.	$17,500,000
# 7, 8, 19 – 21	7	From 74.9% to 113.17%	Replace wave trap at both Elmont and Chickahominy Substations. This will increase line rating by 22% to 3424 MVA. Estimated time: 14 – 16 months.	$500,000
# 9, 10	9	From 97.27% to 110.23%	Rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	$73,000,000
# 11, 12	11	From 92.75% to 104.87%	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	$50,000,000
# 13, 14	13	From 90.94% to 103.96%	Replace wave trap at both Ladysmith and Possum Point Substations. This will increase line rating by 12% to 2913 MVA. Estimated time: 14 – 16 months.	$500,000
# 15, 16, 25	25	From 96.82% to 112.33%	Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time 12 – 16 months.	$250,000
# 22, 23, 24, 28, 29	28 (see note)	From 112.56% to 138.31%	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	$78,300,000
# 26	26	From 93.59% to 100.08%	Replace the Chickahominy 50kA 230kV breaker SC122 with a 63kA breaker. Estimated time 8 months.	$430,000
			Total New Network Upgrades	**$264,380,000**

Note: the first to cause the violation will be identified during the Impact Study.

Interconnection Customer Requirements

ITO's Facility Connection Requirements as posted on PJM's website
http://www.pjm.com/~/media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The IC 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.

Option One

Network Impacts

The Queue Project AC1-107 was evaluated as a 1600.0 MW (Capacity 1600.0 MW) injection at the Chickahominy 500kV substation in the ITO area. Project AC1-107 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-107 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
57602	CONTINGENCY '57602' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 1 /*NORTH ANNA 500-230 (TX#5) END
557T574	CONTINGENCY '557T574' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574) END
563T576	CONTINGENCY '563T576' /*MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*MIDLOTHIAN TO CARSON (LINE 563) END
H2T557	CONTINGENCY 'H2T557' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2) END

Contingency Name	Description
LN 557	CONTINGENCY 'LN 557' OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00 OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00 END
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 567	CONTINGENCY 'LN 567' OPEN BRANCH FROM BUS 314903 TO BUS 314924 CKT 1 /* 8CHCKAHM 500.00 - 8SURRY 500.00 END
LN 573	CONTINGENCY 'LN 573' OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00 END
LN 574	CONTINGENCY 'LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END
LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
LN 581	CONTINGENCY 'LN 581' OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 2 /* 3CHANCE 115.00 - 8CHANCE 500.00 OPEN BRANCH FROM BUS 314905 TO BUS 314911 CKT 1 /* 8CHANCE 500.00 - 8LDYSMTH 500.00 END
LN 594	CONTINGENCY 'LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END

Contingency Name	Description
WT576	CONTINGENCY 'WT576' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 2 /*NORTH ANNA 500-230 (TX#6) END

Summer Peak Analysis - 2020

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 Contribution	Ref
1	N-1	LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	DC	89.91	125.26	ER	442	156.16	1
2	N-1	LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	DC	93.78	129.13	ER	442	156.16	2
3	N-1	LN 557	DVP - DVP	6WALR209-6LIGH209 230 kV line	314415	314391	1	DC	74.14	109.48	ER	442	156.16	3
4	N-1	LN 557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	90.43	109.83	ER	2442	473.89	4
5	N-1	LN 567	DVP - DVP	8CHCKAHM 500/230 kV transformer	314903	314214	1	DC	45.84	103.07	ER	829	474.29	5
6	N-1	LN 574	DVP - DVP	8CHCKAHM 500/230 kV transformer	314903	314214	1	DC	55.26	97.83	ER	829	352.86	
7	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	74.9	113.17	ER	2442	934.53	6
8	N-1	LN 563	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	71.41	108.96	ER	2442	916.98	
9	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	97.27	110.23	ER	2442	326	7
10	N-1	LN 573	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	95.85	108.52	ER	2442	320.37	

#	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	Ref
11	N-1	LN 573	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	92.75	104.87	ER	2738	331.95	8
12	N-1	LN 594	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	87.99	99.51	ER	2738	322.22	
13	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	90.94	102.46	ER	2442	283.14	9
14	N-1	LN 581	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	91.73	103.96	ER	2442	302.75	
15	N-1	LN 557	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	79.68	98.12	ER	2442	450.26	
16	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	91.51	98.21	ER	2442	362.94	

Multiple Facility Contingency

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

#	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	Ref
17	LFFB	557T574	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	94.1	109.43	LD	3144	501.2	
18	LFFB	H2T557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	86.37	101.23	LD	3144	485.65	
19	LFFB	563T576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	74.99	103.94	LD	3144	934.53	

#	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	Ref
20	LFFB	WT576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	74.99	103.94	LD	3144	934.45	
21	LFFB	57602	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	74.99	103.94	LD	3144	934.45	
22	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	96.07	114.83	LD	3351	628.61	
23	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	96.07	114.83	LD	3351	628.61	
24	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	95.99	114.76	LD	3351	628.98	
25	LFFB	557T574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	96.82	112.33	LD	3144	506.42	10

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 AC1-107	Duty Percent With AC1-107	Duty Percent Difference
26	DVP	1366	CHICKAHOMINY 230.kV	SC122	S	93.59	100.08	6.49

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 Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
27	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGSM 230 kV line	314209	314386	1	DC	102.23	137.57	ER	442	156.16	11
28	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	112.56	138.31	ER	2442	628.98	12
29	N-1	LN 563	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	101.33	124.94	ER	2442	576.53	

Steady-State Voltage Requirements

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

To be determined during Impact Study

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 during Impact Study

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 1	6PENNIMAN-6WALR209 230 kV line	Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months.	Pending	$28,200,000
# 2	6KINGS M-6PENNIMAN 230 kV line			
# 3	6WALR209-6LIGH209 230 kV line	Wreck and rebuild the Lightfoot– Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimate time 30 – 36 months.	Pending	$15,200,000
# 4, 17, 18	8CARSON-8MDLTHAN 500 kV line	Replace wave trap at both Carson and Midlothian 500kV Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time: 12 – 16 months.	Pending	$500,000
# 5, 6	8CHCKAHM 500/230 kV transformer	Add a second Chickahominy 500-230 kV transformer into a new breaker bay. Estimated time 24 – 30 months.	Pending	$17,500,000
# 7, 8, 19 – 21	8CHCKAHM-8ELMONT 500 kV line	Replace wave trap at both Elmont and Chickahominy Substations. This will increase line rating by 22% to 3424 MVA. Estimated time: 14 – 16 months.	Pending	$500,000
# 9, 10	8CHANCE-8BRISTER 500 kV line	Rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	Pending	$73,000,000
# 11, 12	8LDYSMTH-8CHANCE 500 kV line	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	Pending	$50,000,000
# 13, 14	8LDYSMTH-8POSSUM 500 kV line	Replace wave trap at both Ladysmith and Possum Point Substations. This will increase line rating by 12% to 2913 MVA. Estimated time: 14 – 16 months.	Pending	$500,000
# 15, 16, 25	8MDLTHAN-8NO ANNA 500 kV line	Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time 12 – 16 months.	Pending	$250,000
# 22, 23, 24	8ELMONT-8LDYSMTH 500 kV line	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	Pending	$78,300,000
# 26	Chickahominy 230kV breaker	Replace the Chickahominy 50kA 230kV breaker SC122 with a 63kA breaker. Estimated time 8 months.	Pending	$430,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
			Total New Network Upgrades	**$264,380,000**

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 27	6SKIFF CREEK-6KINGS M 230 kV line	Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months.	Pending	$28,200,000
# 28, 29	8ELMONT-8LDYSMTH 500 kV line	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	Pending	$78,300,000
			Total New Network Upgrades	**$106,500,000**

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 IC 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.

None

Light Load Analysis

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

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-107 interconnection of a 1600 MW Energy (1600 MW Capacity) injection into the ITO's Transmission System at Chickahominy 500 kV switching station, for compliance with NERC Reliability Criteria on ITO's Transmission System. The system was assessed using the summer 2020 RTEP case provided to ITO by PJM. When performing a generation analysis, ITO's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of ITO's Planning Criteria and interconnection requirements can be found in the ITO's Facility Connection Requirements which are publicly available at: http://www.dom.com.

The results of these studies evaluate the system under a limited set of operating conditions and do not guarantee the full delivery of the capacity and associated energy of this proposed generation facility under all operating conditions. NERC Planning and Operating Reliability Criteria allow for the re-dispatch of generating units to resolve projected and actual deficiencies in real time and planning studies. Specifically NERC Category C Contingency Conditions (Bus Fault, Tower Line, N-1-1, and Stuck Breaker scenarios) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For ITO's Planning Criteria the re-dispatch of generating units for these contingency conditions is allowed as long as the projected loading does not exceed 100% of a facility Load Dump Rating.

As part of its generation impact analysis, the ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions, stress system conditions and import/export system conditions (greater than 20 MW). The results of these studies are discussed in more detail below.

Category B Analysis (Single Contingency):

1. System Normal – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified

Category C Analysis: (Multiple Facility Analysis)

1. Bus Fault - No deficiencies identified
2. Line Stuck Breaker - No deficiencies identified
3. Tower Line – No deficiencies identified

The import and export conditions into and out of the ITO System are evaluated with any new interconnection greater than 20 MW, any new facility that is interconnected with the ITO System should not significantly decrement FCITC between utilities. These studies will be performed during the System Impact Study.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

Option Two

Network Impacts

The Queue Project AC1-107 was evaluated as a 1600.0 MW (Capacity 1600.0 MW) injection at the Chickahonomy 230kV substation in the ITO area. Project AC1-107 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-107 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
57602	CONTINGENCY '57602' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 1 /*NORTH ANNA 500-230 (TX#5) END
557T574	CONTINGENCY '557T574' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574) END
563T576	CONTINGENCY '563T576' /*MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*MIDLOTHIAN TO CARSON (LINE 563) END
H2T557	CONTINGENCY 'H2T557' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2) END

Contingency Name	Description
LN 557	CONTINGENCY 'LN 557' OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00 OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00 END
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 573	CONTINGENCY 'LN 573' OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00 END
LN 574	CONTINGENCY 'LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END
LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
LN 581	CONTINGENCY 'LN 581' OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 2 /* 3CHANCE 115.00 - 8CHANCE 500.00 OPEN BRANCH FROM BUS 314905 TO BUS 314911 CKT 1 /* 8CHANCE 500.00 - 8LDYSMTH 500.00 END
LN 594	CONTINGENCY 'LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END
WT576	CONTINGENCY 'WT576' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 2 /*NORTH ANNA 500-230 (TX#6) END

Summer Peak Analysis - 2020

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 Contribution	Ref
1	N-1	LN 574	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314150	1	DC	90.54	100.64	ER	749	168.1	13
2	N-1	LN 557	DVP - DVP	6CHSTF A-6IRON208 230 kV line	314286	314309	1	DC	72.14	100.07	ER	664	185.33	14
3	N-1	LN 563	DVP - DVP	6CHSTF A-6IRON208 230 kV line	314286	314309	1	DC	74.78	94.48	ER	664	130.75	
4	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	96.33	108.82	ER	2442	314.58	15
5	N-1	LN 573	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	94.85	107.06	ER	2442	309.01	
6	N-1	LN 563	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	99.5	118.56	ER	2442	465.52	
7	N-1	LN 573	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	91.84	103.53	ER	2738	320.1	16
8	N-1	LN 594	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	87.12	98.2	ER	2738	310.02	
9	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	89.76	100.81	ER	2442	271.46	17
10	N-1	LN 581	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	90.54	102.07	ER	2442	285.78	

#	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	Ref
11	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	90.21	97.09	ER	2442	373.12	

Multiple Facility Contingency

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

#	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	Ref
12	LFFB	H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	DC	69.37	87.48	LD	1051	422.4	18
13	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	94.55	110.88	LD	3351	547.25	
14	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	94.55	110.88	LD	3351	547.23	
15	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	94.47	110.81	LD	3351	547.55	
16	LFFB	557T574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	95.92	101.5	LD	3144	389.1	19

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 AC1-107	Duty Percent With AC1-107	Duty Percent Difference
17	DVP	1366	CHICKAHOMINY 230.kV	SC122	S	93.59	148.77	55.17
18	DVP	1366	CHICKAHOMINY 230.kV	205022	S	91.72	145.72	54.01
19	DVP	1366	CHICKAHOMINY 230.kV	209122	S	91.72	145.72	54.01
20	DVP	1366	CHICKAHOMINY 230.kV	210222-2	S	91.72	145.72	54.01
21	DVP	1366	CHICKAHOMINY 230.kV	28722	S	91.72	145.72	54.01
22	DVP	1366	CHICKAHOMINY 230.kV	H222	S	91.72	145.72	54.01
23	DVP	1366	CHICKAHOMINY 230.kV	212922	S	90.08	144.35	54.27
24	DVP	1366	CHICKAHOMINY 230.kV	287T2129	S	90.08	144.35	54.27
25	DVP	1366	CHICKAHOMINY 230.kV	202422	S	89.31	143.73	54.42
26	DVP	1366	CHICKAHOMINY 230.kV	2024T2091	S	89.31	143.73	54.42
27	DVP	1366	CHICKAHOMINY 230.kV	2050T2075	S	86.44	141.33	54.89
28	DVP	1366	CHICKAHOMINY 230.kV	210222-3	S	85.93	141.10	55.18
29	DVP	1366	CHICKAHOMINY 230.kV	207522	S	84.65	139.81	55.16
30	DVP	1366	CHICKAHOMINY 230.kV	L122	S	66.90	120.05	120.05

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AC1-107	Duty Percent With AC1-107	Duty Percent Difference
31	DVP	778	CHESTERF 5&6	H912	S	94.47	100.96	6.49

Replace 13 Chickahominy 50kA 230kV breakers with 80kA breakers, replace the Chickahominy 50kA 230kV breaker L1222 with a 63kA breaker, rebuild the 230kV rigid tubular bus and replace the ground grid overlay. Estimated time 21 months.

Replace the Chesterfield 40kA 230kV breaker H912 with a 50kA breaker. Estimated time 8 months.

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	Contribution	Ref
32	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	110.51	132.93	ER	2442	547.55	20

Steady-State Voltage Requirements

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

To be determined during Impact Study

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 during Impact Study

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 IC 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.

None

Light Load Analysis

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

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-107 interconnection of a 1600 MW Energy (1600 MW Capacity) injection into the ITO's Transmission System at Chickahominy 230 kV switching station, for compliance with NERC Reliability Criteria on ITO's Transmission System. The system was assessed using the summer 2020 RTEP case provided to ITO by PJM. When performing a generation analysis, ITO's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of ITO's Planning Criteria and interconnection requirements can be found in the ITO's Facility Connection Requirements which are publicly available at: http://www.dom.com.

The results of these studies evaluate the system under a limited set of operating conditions and do not guarantee the full delivery of the capacity and associated energy of this proposed generation facility under all operating conditions. NERC Planning and Operating Reliability Criteria allow for the re-dispatch of generating units to resolve projected and actual deficiencies in real time and planning studies. Specifically NERC Category C Contingency Conditions (Bus Fault, Tower Line, N-1-1, and Stuck Breaker scenarios) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For ITO's Planning Criteria the re-dispatch of generating units for these contingency conditions is allowed as long as the projected loading does not exceed 100% of a facility Load Dump Rating.

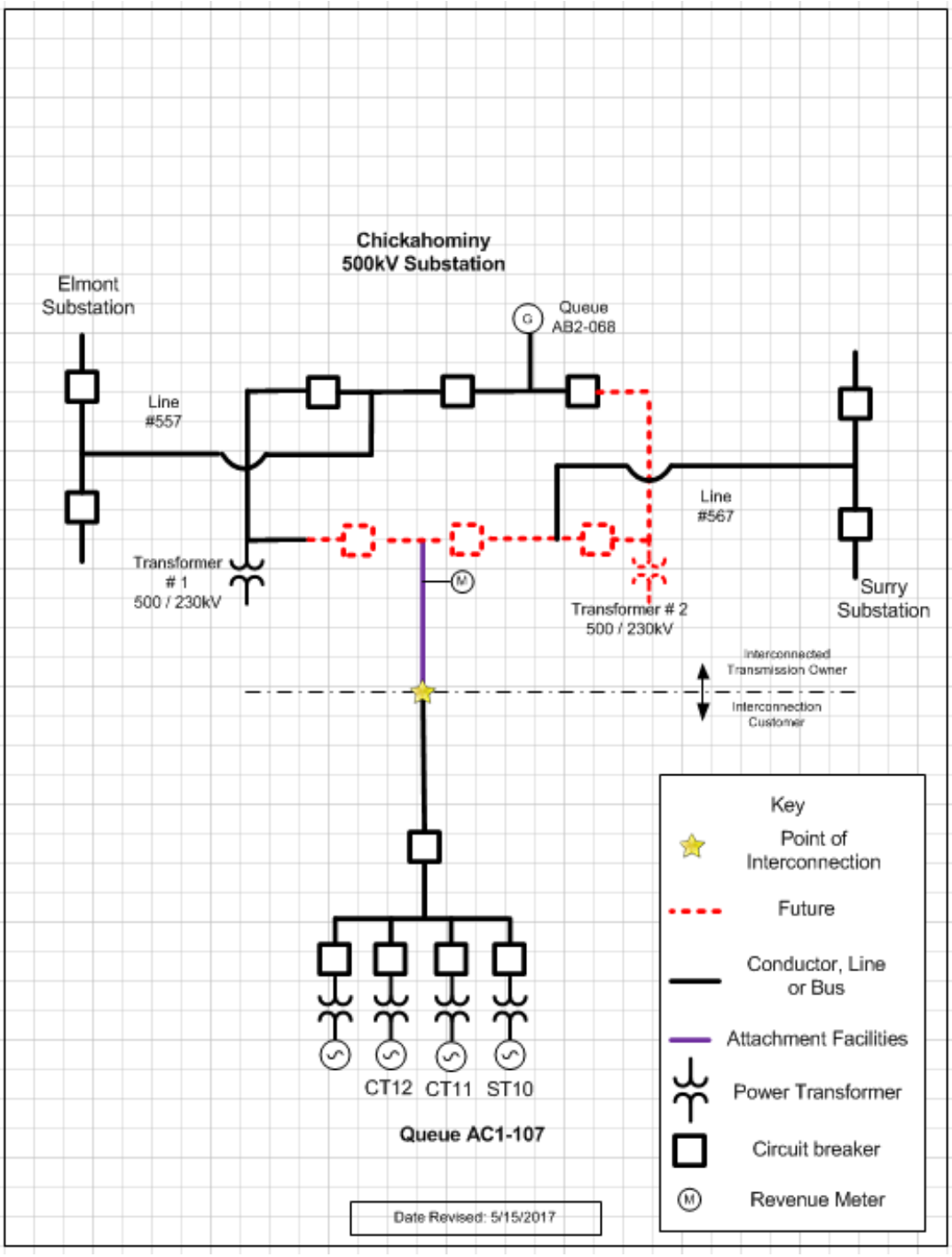
Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

Attachment 1.

System Configuration



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. When a flowgate is identified in multiple analysis the appendix is presented for only the analysis with the greatest overload.

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

(DVP - DVP) The 6PENNIMAN-6WALR209 230 kV line (from bus 314296 to bus 314415 ckt 1) loads from 89.91% to 125.26% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 156.16 MW to the thermal violation.

CONTINGENCY 'LN 557'
OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*0.52*
315108	*1ELIZAR1*	*1.53*
315109	*1ELIZAR2*	*1.51*
315110	*1ELIZAR3*	*1.55*
315233	*1SURRY 2*	*15.85*
315091	*1YORKTN2*	*23.96*
315092	*1YORKTN3*	*21.8*
314421	*6WINCHST*	*0.12*
916191	*Z1-068 C*	*0.02*
921092	*AA1-049 C*	*0.99*
921532	*AA1-132 C*	*3.05*
921542	*AA1-133 C*	*4.09*
921552	*AA1-134 C*	*3.87*
921572	*AA1-138 C*	*3.66*
921582	*AA1-139 C*	*6.14*
921772	*AA2-059 C*	*0.87*
921982	*AA2-088 C*	*1.9*
922532	*AA2-178 C*	*3.34*
922602	*AB1-013 C*	*1.01*
923801	*AB2-015 C OP*	*2.77*
923831	*AB2-022 C*	*0.92*
924071	*AB2-051 C OP*	*56.78*
924241	*AB2-068 OP*	*103.46*
924941	*AB2-149 C OP*	*1.01*
925121	*AB2-169 C OP*	*1.97*

925141	*AB2-171 C OP*	*1.52*
925281	*AB2-186 C*	*0.23*
925291	*AB2-188 C OP*	*0.82*
925361	*AC1-007 C OP*	*0.26*
925521	*AC1-027 C*	*0.83*
925691	*AC1-045 C*	*0.75*
925701	*AC1-046 C*	*0.72*
925711	*AC1-047 C*	*0.95*
926291	*AC1-107 OP*	*156.16*
926661	*AC1-147 C*	*0.93*
926741	*AC1-159 C*	*56.34*
926751	*AC1-161 C OP*	*14.1*
926781	*AC1-164 C OP*	*21.55*
927051	*AC1-193 C*	*1.12*

Appendix 2

(DVP - DVP) The 6KINGS M-6PENNIMAN 230 kV line (from bus 314386 to bus 314296 ckt 1) loads from 93.78% to 129.13% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 156.16 MW to the thermal violation.

CONTINGENCY 'LN 557'
OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*0.52*
315108	*1ELIZAR1*	*1.53*
315109	*1ELIZAR2*	*1.51*
315110	*1ELIZAR3*	*1.55*
315233	*1SURRY 2*	*15.85*
315091	*1YORKTN2*	*23.96*
315092	*1YORKTN3*	*21.8*
314421	*6WINCHST*	*0.12*
916191	*Z1-068 C*	*0.02*
921092	*AA1-049 C*	*0.99*
921532	*AA1-132 C*	*3.05*
921542	*AA1-133 C*	*4.09*
921552	*AA1-134 C*	*3.87*
921572	*AA1-138 C*	*3.66*
921582	*AA1-139 C*	*6.14*
921772	*AA2-059 C*	*0.87*
921982	*AA2-088 C*	*1.9*
922532	*AA2-178 C*	*3.34*
922602	*AB1-013 C*	*1.01*
923801	*AB2-015 C OP*	*2.77*
923831	*AB2-022 C*	*0.92*
924071	*AB2-051 C OP*	*56.78*
924241	*AB2-068 OP*	*103.46*
924941	*AB2-149 C OP*	*1.01*
925121	*AB2-169 C OP*	*1.97*

925141	*AB2-171 C OP*	*1.52*
925281	*AB2-186 C*	*0.23*
925291	*AB2-188 C OP*	*0.82*
925361	*AC1-007 C OP*	*0.26*
925521	*AC1-027 C*	*0.83*
925691	*AC1-045 C*	*0.75*
925701	*AC1-046 C*	*0.72*
925711	*AC1-047 C*	*0.95*
926291	*AC1-107 OP*	*156.16*
926661	*AC1-147 C*	*0.93*
926741	*AC1-159 C*	*56.34*
926751	*AC1-161 C OP*	*14.1*
926781	*AC1-164 C OP*	*21.55*
927051	*AC1-193 C*	*1.12*

Appendix 3

(DVP - DVP) The 6WALR209-6LIGH209 230 kV line (from bus 314415 to bus 314391 ckt 1) loads from 74.14% to 109.48% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 156.16 MW to the thermal violation.

CONTINGENCY 'LN 557'
OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*0.52*
315108	*1ELIZAR1*	*1.53*
315109	*1ELIZAR2*	*1.51*
315110	*1ELIZAR3*	*1.55*
315233	*1SURRY 2*	*15.85*
315091	*1YORKTN2*	*23.96*
315092	*1YORKTN3*	*21.8*
314421	*6WINCHST*	*0.12*
916191	*Z1-068 C*	*0.02*
921092	*AA1-049 C*	*0.99*
921532	*AA1-132 C*	*3.05*
921542	*AA1-133 C*	*4.09*
921552	*AA1-134 C*	*3.87*
921572	*AA1-138 C*	*3.66*
921582	*AA1-139 C*	*6.14*
921772	*AA2-059 C*	*0.87*
921982	*AA2-088 C*	*1.9*
922532	*AA2-178 C*	*3.34*
922602	*AB1-013 C*	*1.01*
923801	*AB2-015 C OP*	*2.77*
923831	*AB2-022 C*	*0.92*
924071	*AB2-051 C OP*	*56.78*
924241	*AB2-068 OP*	*103.46*
924941	*AB2-149 C OP*	*1.01*
925121	*AB2-169 C OP*	*1.97*

925141	*AB2-171 C OP*	*1.52*
925281	*AB2-186 C*	*0.23*
925291	*AB2-188 C OP*	*0.82*
925361	*AC1-007 C OP*	*0.26*
925521	*AC1-027 C*	*0.83*
925691	*AC1-045 C*	*0.75*
925701	*AC1-046 C*	*0.72*
925711	*AC1-047 C*	*0.95*
926291	*AC1-107 OP*	*156.16*
926661	*AC1-147 C*	*0.93*
926741	*AC1-159 C*	*56.34*
926751	*AC1-161 C OP*	*14.1*
926781	*AC1-164 C OP*	*21.55*
927051	*AC1-193 C*	*1.12*

Appendix 4

(DVP - DVP) The 8CARSON-8MDLTHAN 500 kV line (from bus 314902 to bus 314914 ckt 1) loads from 90.43% to 109.83% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 473.89 MW to the thermal violation.

CONTINGENCY 'LN 557'
 OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
 OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315102	*1BRUNSWICKG1*	*17.73*
315103	*1BRUNSWICKG2*	*17.73*
315104	*1BRUNSWICKG3*	*17.73*
315105	*1BRUNSWICKS1*	*36.84*
315099	*1CHESPKB*	*2.03*
315108	*1ELIZAR1*	*5.98*
315109	*1ELIZAR2*	*5.88*
315110	*1ELIZAR3*	*6.06*
315233	*1SURRY 2*	*48.13*
315091	*1YORKTN2*	*38.41*
916191	*Z1-068 C*	*0.08*
916301	*Z1-086 C*	*108.23*
LTF	*Z2-067*	*27.58*
921092	*AA1-049 C*	*3.92*
LTF	*AA1-058*	*1.22*
921162	*AA1-063AC*	*12.23*
921172	*AA1-064 C*	*15.51*
921182	*AA1-067 C*	*2.46*
921532	*AA1-132 C*	*12.11*
921542	*AA1-133 C*	*16.2*
921552	*AA1-134 C*	*15.68*
921562	*AA1-135 C*	*13.6*
921572	*AA1-138 C*	*15.27*
921582	*AA1-139 C*	*24.3*
921752	*AA2-053 C*	*12.43*

921762	*AA2-057 C*	*10.05*
921772	*AA2-059 C*	*3.72*
921862	*AA2-068 C*	*3.17*
LTF	*AA2-074*	*8.21*
921982	*AA2-088 C*	*9.53*
922442	*AA2-165 C*	*1.37*
922472	*AA2-169 C*	*2.96*
922512	*AA2-174 C*	*0.57*
922522	*AA2-177 C*	*10.18*
922532	*AA2-178 C*	*14.85*
922602	*AB1-013 C*	*4.48*
922722	*AB1-053 C*	*1.51*
922732	*AB1-054 C*	*10.06*
922922	*AB1-081 C OP*	*12.49*
923262	*AB1-132 C OP*	*19.95*
923572	*AB1-173 C OP*	*3.15*
923582	*AB1-173AC OP*	*3.15*
923801	*AB2-015 C OP*	*12.92*
923831	*AB2-022 C*	*3.69*
923851	*AB2-025 C*	*3.4*
923911	*AB2-031 C OP*	*3.13*
923941	*AB2-035 C*	*0.48*
923981	*AB2-039 C OP*	*11.06*
923991	*AB2-040 C OP*	*10.26*
924021	*AB2-043 C OP*	*3.64*
924071	*AB2-051 C OP*	*221.45*
924151	*AB2-059 C OP*	*14.72*
924241	*AB2-068 OP*	*313.95*
924301	*AB2-077 C OP*	*2.32*
924311	*AB2-078 C OP*	*2.32*
924321	*AB2-079 C OP*	*2.32*
924381	*AB2-087 C*	*0.84*
924391	*AB2-088 C*	*0.61*
924401	*AB2-089 C*	*2.75*
924411	*AB2-090 C*	*4.59*
924491	*AB2-098 C*	*0.82*
924501	*AB2-099 C*	*0.87*
924511	*AB2-100 C*	*16.03*
924761	*AB2-128 C*	*13.73*

924811	*AB2-134 C OP*	*13.05*
924931	*AB2-147 C*	*3.52*
924941	*AB2-149 C OP*	*4.83*
924951	*AB2-150 C OP*	*3.52*
925061	*AB2-161 C OP*	*4.47*
925121	*AB2-169 C OP*	*9.71*
925141	*AB2-171 C OP*	*7.29*
925171	*AB2-174 C OP*	*9.79*
925221	*AB2-176 C*	*1.89*
925281	*AB2-186 C*	*0.97*
925291	*AB2-188 C OP*	*3.66*
925331	*AB2-190 C*	*23.27*
925361	*AC1-007 C OP*	*1.*
925521	*AC1-027 C*	*3.24*
925591	*AC1-034 C OP*	*9.7*
925691	*AC1-045 C*	*2.63*
925701	*AC1-046 C*	*2.83*
925711	*AC1-047 C*	*3.75*
925781	*AC1-054 C OP*	*9.41*
926071	*AC1-086 C*	*29.38*
926201	*AC1-098 C*	*8.81*
926211	*AC1-099 C*	*2.95*
926271	*AC1-105 C OP*	*7.02*
926281	*AC1-106*	*3.03*
926291	*AC1-107 OP*	*473.89*
926661	*AC1-147 C*	*3.63*
926741	*AC1-159 C*	*219.74*
926751	*AC1-161 C OP*	*52.59*
926771	*AC1-163 C*	*3.13*
926781	*AC1-164 C OP*	*65.4*
927021	*AC1-189 C*	*12.41*
927051	*AC1-193 C*	*5.34*
927141	*AC1-208 C*	*12.7*
927211	*AC1-215 C*	*12.6*
927221	*AC1-216 C OP*	*9.96*
927251	*AC1-221 C*	*3.98*
927261	*AC1-222 C*	*5.96*

Appendix 5

(DVP - DVP) The 8CHCKAHM 500/230 kV transformer (from bus 314903 to bus 314214 ckt 1) loads from 45.84% to 103.07% (**DC power flow**) of its emergency rating (829 MVA) for the single line contingency outage of 'LN 567'. This project contributes approximately 474.29 MW to the thermal violation.

CONTINGENCY 'LN 567'
 OPEN BRANCH FROM BUS 314903 TO BUS 314924 CKT 1 /* 8CHCKAHM 500.00 - 8SURRY 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
924241	*AB2-068 OP*	*314.22*
926291	*AC1-107 OP*	*474.29*
926781	*AC1-164 C OP*	*65.45*

Appendix 6

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 74.9% to 113.17% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 934.53 MW to the thermal violation.

CONTINGENCY 'LN 576'
 OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00
 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*2.31*
315108	*1ELIZAR1*	*6.8*
315109	*1ELIZAR2*	*6.68*
315110	*1ELIZAR3*	*6.88*
315233	*1SURRY 2*	*62.*
315091	*1YORKTN2*	*55.76*
315092	*1YORKTN3*	*50.51*
314421	*6WINCHST*	*0.28*
LTF	*Z2-067*	*22.05*
921092	*AA1-049 C*	*4.39*
LTF	*AA1-058*	*1.05*
921162	*AA1-063AC*	*12.22*
921172	*AA1-064 C*	*12.07*
921182	*AA1-067 C*	*2.38*
921532	*AA1-132 C*	*13.54*
921542	*AA1-133 C*	*18.16*
921552	*AA1-134 C*	*17.35*
921562	*AA1-135 C*	*13.56*
921572	*AA1-138 C*	*16.68*
921582	*AA1-139 C*	*27.24*
921752	*AA2-053 C*	*12.23*
921762	*AA2-057 C*	*9.48*
921772	*AA2-059 C*	*4.02*
921862	*AA2-068 C*	*3.03*
LTF	*AA2-074*	*6.69*

921982	*AA2-088 C*	*9.91*
922442	*AA2-165 C*	*1.29*
922472	*AA2-169 C*	*2.77*
922512	*AA2-174 C*	*0.56*
922522	*AA2-177 C*	*14.87*
922532	*AA2-178 C*	*15.81*
922602	*AB1-013 C*	*4.77*
922722	*AB1-053 C*	*1.45*
922732	*AB1-054 C*	*10.43*
922922	*AB1-081 C OP*	*11.46*
923262	*AB1-132 C OP*	*19.33*
923272	*AB1-135 C OP*	*4.31*
923572	*AB1-173 C OP*	*3.04*
923582	*AB1-173AC OP*	*3.04*
923801	*AB2-015 C OP*	*13.81*
923831	*AB2-022 C*	*4.11*
923841	*AB2-024 C*	*4.1*
923851	*AB2-025 C*	*3.27*
923911	*AB2-031 C OP*	*3.02*
923941	*AB2-035 C*	*0.45*
923981	*AB2-039 C OP*	*12.82*
923991	*AB2-040 C OP*	*9.92*
924071	*AB2-051 C OP*	*251.57*
924151	*AB2-059 C OP*	*13.5*
924241	*AB2-068 OP*	*619.12*
924381	*AB2-087 C*	*0.86*
924391	*AB2-088 C*	*0.57*
924401	*AB2-089 C*	*2.54*
924491	*AB2-098 C*	*0.79*
924501	*AB2-099 C*	*0.89*
924511	*AB2-100 C*	*15.48*
924761	*AB2-128 C*	*13.26*
924811	*AB2-134 C OP*	*19.06*
924931	*AB2-147 C*	*3.38*
924941	*AB2-149 C OP*	*5.5*
924951	*AB2-150 C OP*	*3.38*
924961	*AB2-152*	*3.5*
925051	*AB2-160 C OP*	*6.38*
925061	*AB2-161 C OP*	*5.18*

925121	*AB2-169 C OP*	*9.87*
925141	*AB2-171 C OP*	*7.71*
925171	*AB2-174 C OP*	*9.44*
925281	*AB2-186 C*	*1.06*
925291	*AB2-188 C OP*	*3.9*
925331	*AB2-190 C*	*33.98*
925361	*AC1-007 C OP*	*1.2*
925521	*AC1-027 C*	*3.67*
925591	*AC1-034 C OP*	*9.06*
925691	*AC1-045 C*	*3.08*
925701	*AC1-046 C*	*3.18*
925711	*AC1-047 C*	*4.22*
925781	*AC1-054 C OP*	*8.72*
925811	*AC1-060*	*3.54*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.62*
925861	*AC1-065 C*	*5.37*
926071	*AC1-086 C*	*28.46*
926201	*AC1-098 C*	*8.53*
926211	*AC1-099 C*	*2.86*
926291	*AC1-107 OP*	*934.53*
926591	*AC1-142 C*	*13.6*
926661	*AC1-147 C*	*4.13*
926741	*AC1-159 C*	*249.63*
926751	*AC1-161 C OP*	*59.77*
926771	*AC1-163 C*	*3.19*
926781	*AC1-164 C OP*	*128.96*
927021	*AC1-189 C*	*11.9*
927051	*AC1-193 C*	*5.65*
927141	*AC1-208 C*	*11.94*
927221	*AC1-216 C OP*	*14.55*

Appendix 7

(DVP - DVP) The 8CHANCE-8BRISTER 500 kV line (from bus 314905 to bus 314900 ckt 1) loads from 97.27% to 110.23% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 326.0 MW to the thermal violation.

CONTINGENCY 'LN 594'
OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.51*
315054	*1BELMED2*	*3.51*
315055	*1BELMED3*	*2.91*
315067	*1DARBY 1*	*3.2*
315068	*1DARBY 2*	*3.2*
315069	*1DARBY 3*	*3.24*
315070	*1DARBY 4*	*3.24*
315043	*1FRIVERA*	*4.31*
315044	*1FRIVERB*	*3.33*
315045	*1FRIVERC*	*4.31*
315046	*1FRIVERD*	*3.33*
315047	*1FRIVERE*	*3.33*
315048	*1FRIVERF*	*4.31*
315225	*1N ANNA1*	*48.51*
315226	*1N ANNA2*	*47.76*
315083	*1SPRUNCA*	*2.15*
315084	*1SPRUNCB*	*2.15*
315085	*1SPRUNCC*	*1.59*
315086	*1SPRUNCD*	*1.59*
315091	*1YORKTN2*	*31.52*
314309	*6IRON208*	*0.48*
314236	*6NRTHEST*	*0.23*
314251	*6S PUMP*	*1.07*
297087	*V2-040*	*0.15*
LTF	*Z2-067*	*16.76*
921092	*AA1-049 C*	*2.52*
LTF	*AA1-058*	*0.75*

921162	*AA1-063AC*	*8.24*
921172	*AA1-064 C*	*8.21*
921292	*AA1-083*	*4.*
921532	*AA1-132 C*	*7.78*
921542	*AA1-133 C*	*10.41*
921552	*AA1-134 C*	*10.17*
921562	*AA1-135 C*	*8.81*
921572	*AA1-138 C*	*9.98*
921582	*AA1-139 C*	*15.61*
921622	*AA1-145*	*68.05*
921752	*AA2-053 C*	*8.35*
921772	*AA2-059 C*	*2.41*
921862	*AA2-068 C*	*2.08*
LTF	*AA2-074*	*4.98*
921982	*AA2-088 C*	*6.4*
922512	*AA2-174 C*	*0.38*
922522	*AA2-177 C*	*10.72*
922532	*AA2-178 C*	*9.63*
922602	*AB1-013 C*	*2.91*
922672	*AB1-026 C*	*2.11*
922682	*AB1-027 C*	*2.79*
922722	*AB1-053 C*	*1.01*
922732	*AB1-054 C*	*6.75*
923262	*AB1-132 C OP*	*13.47*
923272	*AB1-135 C OP*	*2.75*
923572	*AB1-173 C OP*	*2.17*
923582	*AB1-173AC OP*	*2.17*
923801	*AB2-015 C OP*	*8.68*
923831	*AB2-022 C*	*2.38*
923841	*AB2-024 C*	*2.64*
923851	*AB2-025 C*	*2.47*
923861	*AB2-026 C*	*2.33*
923911	*AB2-031 C OP*	*2.16*
923981	*AB2-039 C OP*	*8.76*
923991	*AB2-040 C OP*	*7.09*
924061	*AB2-050*	*4.*
924071	*AB2-051 C OP*	*143.84*
924241	*AB2-068 OP*	*215.98*
924381	*AB2-087 C*	*0.55*

924501	*AB2-099 C*	*0.57*
924511	*AB2-100 C*	*11.07*
924761	*AB2-128 C*	*9.48*
924811	*AB2-134 C OP*	*13.74*
924931	*AB2-147 C*	*2.47*
924941	*AB2-149 C OP*	*3.52*
924951	*AB2-150 C OP*	*2.47*
924961	*AB2-152*	*2.89*
925051	*AB2-160 C OP*	*5.81*
925061	*AB2-161 C OP*	*3.54*
925121	*AB2-169 C OP*	*6.27*
925141	*AB2-171 C OP*	*4.89*
925171	*AB2-174 C OP*	*6.8*
925281	*AB2-186 C*	*0.63*
925291	*AB2-188 C OP*	*2.37*
925331	*AB2-190 C*	*24.5*
925361	*AC1-007 C OP*	*0.72*
925521	*AC1-027 C*	*2.1*
925691	*AC1-045 C*	*1.81*
925701	*AC1-046 C*	*1.81*
925711	*AC1-047 C*	*2.41*
925811	*AC1-060*	*2.66*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.41*
925861	*AC1-065 C*	*3.57*
926001	*AC1-076 C*	*4.68*
926071	*AC1-086 C*	*19.84*
926201	*AC1-098 C*	*5.78*
926211	*AC1-099 C*	*1.94*
926291	*AC1-107 OP*	*326.*
926411	*AC1-112 C*	*2.17*
926441	*AC1-115 C*	*1.12*
926471	*AC1-118 C*	*1.99*
926551	*AC1-134*	*10.01*
926591	*AC1-142 C*	*9.92*
926661	*AC1-147 C*	*2.37*
926731	*AC1-158 C*	*88.41*
926741	*AC1-159 C*	*142.73*
926751	*AC1-161 C OP*	*31.97*

926771	*AC1-163 C*	*2.06*
926781	*AC1-164 C OP*	*44.99*
927041	*AC1-191 C*	*10.79*
927051	*AC1-193 C*	*3.59*
927221	*AC1-216 C OP*	*10.49*

Appendix 8

(DVP - DVP) The 8LDYSMTH-8CHANCE 500 kV line (from bus 314911 to bus 314905 ckt 1) loads from 92.75% to 104.87% (**DC power flow**) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 573'. This project contributes approximately 331.95 MW to the thermal violation.

CONTINGENCY 'LN 573'
OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.57*
315054	*1BELMED2*	*3.57*
315055	*1BELMED3*	*2.96*
315067	*1DARBY 1*	*3.25*
315068	*1DARBY 2*	*3.26*
315069	*1DARBY 3*	*3.3*
315070	*1DARBY 4*	*3.3*
315043	*1FRIVERA*	*4.39*
315044	*1FRIVERB*	*3.4*
315045	*1FRIVERC*	*4.39*
315046	*1FRIVERD*	*3.4*
315047	*1FRIVERE*	*3.4*
315048	*1FRIVERF*	*4.39*
315037	*1LDYSMT1*	*5.69*
315039	*1LDYSMT3*	*6.02*
315040	*1LDYSMT4*	*6.03*
315041	*1LDYSMT5*	*6.05*
315225	*1N ANNA1*	*49.22*
315226	*1N ANNA2*	*48.45*
315083	*1SPRUNCA*	*2.18*
315084	*1SPRUNCB*	*2.18*
315085	*1SPRUNCC*	*1.62*
315086	*1SPRUNCD*	*1.62*
315091	*1YORKTN2*	*32.04*
314309	*6IRON208*	*0.49*
314236	*6NRTHEST*	*0.24*
314251	*6S PUMP*	*1.08*

297087	*V2-040*	*0.15*
LTF	*Z2-067*	*16.9*
921092	*AA1-049 C*	*2.56*
LTF	*AA1-058*	*0.75*
921162	*AA1-063AC*	*8.35*
921172	*AA1-064 C*	*8.31*
921182	*AA1-067 C*	*1.6*
921292	*AA1-083*	*4.08*
921532	*AA1-132 C*	*7.9*
921542	*AA1-133 C*	*10.57*
921552	*AA1-134 C*	*10.32*
921562	*AA1-135 C*	*8.93*
921572	*AA1-138 C*	*10.12*
921582	*AA1-139 C*	*15.85*
921622	*AA1-145*	*69.42*
921752	*AA2-053 C*	*8.45*
921772	*AA2-059 C*	*2.44*
921862	*AA2-068 C*	*2.1*
LTF	*AA2-074*	*5.03*
921982	*AA2-088 C*	*6.48*
922512	*AA2-174 C*	*0.39*
922522	*AA2-177 C*	*10.89*
922532	*AA2-178 C*	*9.77*
922602	*AB1-013 C*	*2.95*
922672	*AB1-026 C*	*2.16*
922682	*AB1-027 C*	*2.84*
922722	*AB1-053 C*	*1.02*
922732	*AB1-054 C*	*6.84*
923262	*AB1-132 C OP*	*13.65*
923272	*AB1-135 C OP*	*2.8*
923572	*AB1-173 C OP*	*2.2*
923582	*AB1-173AC OP*	*2.2*
923801	*AB2-015 C OP*	*8.8*
923831	*AB2-022 C*	*2.42*
923841	*AB2-024 C*	*2.68*
923851	*AB2-025 C*	*2.51*
923861	*AB2-026 C*	*2.33*
923911	*AB2-031 C OP*	*2.18*
923981	*AB2-039 C OP*	*8.9*

923991	*AB2-040 C OP*	*7.17*
924061	*AB2-050*	*4.08*
924071	*AB2-051 C OP*	*146.07*
924241	*AB2-068 OP*	*219.92*
924381	*AB2-087 C*	*0.56*
924491	*AB2-098 C*	*0.53*
924501	*AB2-099 C*	*0.58*
924511	*AB2-100 C*	*11.22*
924761	*AB2-128 C*	*9.61*
924811	*AB2-134 C OP*	*13.97*
924931	*AB2-147 C*	*2.5*
924941	*AB2-149 C OP*	*3.58*
924951	*AB2-150 C OP*	*2.5*
924961	*AB2-152*	*2.94*
925051	*AB2-160 C OP*	*5.9*
925061	*AB2-161 C OP*	*3.6*
925121	*AB2-169 C OP*	*6.36*
925141	*AB2-171 C OP*	*4.96*
925171	*AB2-174 C OP*	*6.88*
925281	*AB2-186 C*	*0.64*
925291	*AB2-188 C OP*	*2.41*
925331	*AB2-190 C*	*24.9*
925361	*AC1-007 C OP*	*0.73*
925521	*AC1-027 C*	*2.13*
925691	*AC1-045 C*	*1.84*
925701	*AC1-046 C*	*1.84*
925711	*AC1-047 C*	*2.45*
925811	*AC1-060*	*2.71*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.42*
925861	*AC1-065 C*	*3.64*
926071	*AC1-086 C*	*20.1*
926201	*AC1-098 C*	*5.85*
926211	*AC1-099 C*	*1.96*
926291	*AC1-107 OP*	*331.95*
926411	*AC1-112 C*	*2.21*
926441	*AC1-115 C*	*1.15*
926471	*AC1-118 C*	*2.04*
926551	*AC1-134*	*10.21*

926591	*AC1-142 C*	*10.11*
926661	*AC1-147 C*	*2.4*
926741	*AC1-159 C*	*144.95*
926751	*AC1-161 C OP*	*32.47*
926771	*AC1-163 C*	*2.09*
926781	*AC1-164 C OP*	*45.81*
927041	*AC1-191 C*	*10.99*
927051	*AC1-193 C*	*3.64*
927141	*AC1-208 C*	*8.42*
927221	*AC1-216 C OP*	*10.66*

Appendix 9

(DVP - DVP) The 8LDYSMTH-8POSSUM 500 kV line (from bus 314911 to bus 314922 ckt 1) loads from 90.94% to 102.46% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 283.14 MW to the thermal violation.

CONTINGENCY 'LN 594'
OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.04*
315054	*1BELMED2*	*3.04*
315055	*1BELMED3*	*2.52*
315060	*1CHESTF5*	*10.76*
315061	*1CHESTG7*	*4.22*
315063	*1CHESTG8*	*4.18*
315062	*1CHESTS7*	*1.92*
315064	*1CHESTS8*	*2.14*
315067	*1DARBY 1*	*2.76*
315068	*1DARBY 2*	*2.76*
315069	*1DARBY 3*	*2.8*
315070	*1DARBY 4*	*2.8*
315043	*1FRIVERA*	*3.63*
315045	*1FRIVERC*	*3.63*
315048	*1FRIVERF*	*3.63*
315225	*1N ANNA1*	*41.53*
315226	*1N ANNA2*	*40.88*
315083	*1SPRUNCA*	*1.86*
315084	*1SPRUNCB*	*1.86*
315085	*1SPRUNCC*	*1.38*
315086	*1SPRUNCD*	*1.38*
315091	*1YORKTN2*	*27.38*
314309	*6IRON208*	*0.42*
314236	*6NRTHEST*	*0.2*
314251	*6S PUMP*	*0.92*
297087	*V2-040*	*0.13*
921092	*AA1-049 C*	*2.21*

LTF	*AA1-058*	*0.69*
921292	*AA1-083*	*3.38*
921532	*AA1-132 C*	*6.81*
921542	*AA1-133 C*	*9.11*
921552	*AA1-134 C*	*8.92*
921572	*AA1-138 C*	*8.78*
921582	*AA1-139 C*	*13.66*
921622	*AA1-145*	*57.41*
921772	*AA2-059 C*	*2.12*
LTF	*AA2-074*	*4.71*
921982	*AA2-088 C*	*5.67*
922522	*AA2-177 C*	*9.32*
922532	*AA2-178 C*	*8.51*
922602	*AB1-013 C*	*2.57*
922682	*AB1-027 C*	*2.4*
922732	*AB1-054 C*	*5.99*
923272	*AB1-135 C OP*	*2.37*
923801	*AB2-015 C OP*	*7.66*
923831	*AB2-022 C*	*2.09*
923841	*AB2-024 C*	*2.26*
923851	*AB2-025 C*	*2.17*
923861	*AB2-026 C*	*2.1*
923981	*AB2-039 C OP*	*7.66*
924061	*AB2-050*	*3.38*
924071	*AB2-051 C OP*	*125.7*
924241	*AB2-068 OP*	*187.58*
924511	*AB2-100 C*	*9.84*
924761	*AB2-128 C*	*8.43*
924811	*AB2-134 C OP*	*11.95*
924941	*AB2-149 C OP*	*3.08*
924961	*AB2-152*	*2.51*
925051	*AB2-160 C OP*	*5.05*
925061	*AB2-161 C OP*	*3.1*
925141	*AB2-171 C OP*	*4.33*
925281	*AB2-186 C*	*0.55*
925291	*AB2-188 C OP*	*2.1*
925331	*AB2-190 C*	*21.3*
925361	*AC1-007 C OP*	*0.63*
925521	*AC1-027 C*	*1.84*

925691	*AC1-045 C*	*1.58*
925701	*AC1-046 C*	*1.59*
925711	*AC1-047 C*	*2.11*
925811	*AC1-060*	*2.28*
925821	*AC1-061*	*0.03*
925841	*AC1-063*	*0.35*
925861	*AC1-065 C*	*3.05*
926291	*AC1-107 OP*	*283.14*
926411	*AC1-112 C*	*1.87*
926441	*AC1-115 C*	*0.92*
926551	*AC1-134*	*8.44*
926661	*AC1-147 C*	*2.07*
926731	*AC1-158 C*	*74.59*
926741	*AC1-159 C*	*124.73*
926751	*AC1-161 C OP*	*27.92*
926781	*AC1-164 C OP*	*39.07*
927041	*AC1-191 C*	*9.28*
927051	*AC1-193 C*	*3.17*
927221	*AC1-216 C OP*	*9.12*

Appendix 10

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 96.82% to 112.33% (**DC power flow**) of its emergency rating (3144 MVA) for the line fault with failed breaker contingency outage of '557T574'. This project contributes approximately 506.42 MW to the thermal violation.

CONTINGENCY '557T574' /* ELMONT
OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)
OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)
OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)
END

Bus Number	*Bus Name*	*Full Contribution*
315102	*1BRUNSWICKG1*	*16.69*
315103	*1BRUNSWICKG2*	*16.69*
315104	*1BRUNSWICKG3*	*16.69*
315105	*1BRUNSWICKS1*	*34.68*
315108	*1ELIZAR1*	*6.49*
315109	*1ELIZAR2*	*6.37*
315110	*1ELIZAR3*	*6.57*
315073	*1STONECA*	*10.33*
315233	*1SURRY 2*	*51.44*
314784	*1WEYRHSB*	*3.47*
315091	*1YORKTN2*	*48.12*
314539	*3UNCAMP*	*4.08*
314541	*3WATKINS*	*1.15*
314189	*6PAPERMILL*	*8.9*
292791	*U1-032 E*	*5.38*
900672	*V4-068 E*	*0.49*
901082	*W1-029E*	*79.39*
907092	*X1-038 E*	*10.2*
913392	*Y1-086 E*	*3.79*
916042	*Z1-036 E*	*77.93*
916192	*Z1-068 E*	*3.29*
916301	*Z1-086 C*	*101.56*
916302	*Z1-086 E*	*16.82*

917122	*Z2-027 E*	*1.83*
917332	*Z2-043 E*	*1.62*
917342	*Z2-044 E*	*0.89*
LTF	*Z2-067*	*29.61*
917512	*Z2-088 E OP1*	*12.51*
917592	*Z2-099 E*	*0.73*
921092	*AA1-049 C*	*4.23*
921093	*AA1-049 E*	*1.99*
LTF	*AA1-058*	*1.31*
921162	*AA1-063AC*	*13.84*
921163	*AA1-063AE*	*6.53*
921172	*AA1-064 C*	*15.11*
921173	*AA1-064 E*	*7.11*
918512	*AA1-065 E OP*	*7.32*
921182	*AA1-067 C*	*2.69*
921183	*AA1-067 E*	*1.15*
918562	*AA1-072 E*	*0.27*
921532	*AA1-132 C*	*13.05*
921533	*AA1-132 E*	*5.59*
921542	*AA1-133 C*	*17.45*
921543	*AA1-133 E*	*7.48*
921552	*AA1-134 C*	*17.03*
921553	*AA1-134 E*	*7.3*
921562	*AA1-135 C*	*14.94*
921563	*AA1-135 E*	*6.4*
921572	*AA1-138 C*	*16.71*
921573	*AA1-138 E*	*7.16*
921582	*AA1-139 C*	*26.18*
921583	*AA1-139 E*	*11.22*
921752	*AA2-053 C*	*14.05*
921753	*AA2-053 E*	*6.03*
921762	*AA2-057 C*	*11.13*
921763	*AA2-057 E*	*5.56*
921772	*AA2-059 C*	*4.05*
921773	*AA2-059 E*	*1.86*
921862	*AA2-068 C*	*3.53*
921863	*AA2-068 E*	*1.62*
LTF	*AA2-074*	*8.78*
920022	*AA2-086 E*	*0.39*

921982	*AA2-088 C*	*10.7*
921983	*AA2-088 E*	*17.46*
922442	*AA2-165 C*	*1.52*
922443	*AA2-165 E*	*0.73*
922472	*AA2-169 C*	*3.42*
922473	*AA2-169 E*	*1.57*
922512	*AA2-174 C*	*0.64*
922513	*AA2-174 E*	*0.7*
922522	*AA2-177 C*	*15.76*
922523	*AA2-177 E*	*6.75*
922532	*AA2-178 C*	*16.21*
922533	*AA2-178 E*	*6.95*
922602	*AB1-013 C*	*4.89*
922603	*AB1-013 E*	*32.74*
922722	*AB1-053 C*	*1.71*
922723	*AB1-053 E*	*0.96*
922732	*AB1-054 C*	*11.3*
922733	*AB1-054 E*	*5.56*
922922	*AB1-081 C OP*	*13.69*
922923	*AB1-081 E OP*	*5.87*
923262	*AB1-132 C OP*	*22.66*
923263	*AB1-132 E OP*	*9.71*
923272	*AB1-135 C OP*	*3.4*
923273	*AB1-135 E OP*	*1.46*
923572	*AB1-173 C OP*	*3.64*
923573	*AB1-173 E OP*	*1.7*
923582	*AB1-173AC OP*	*3.64*
923583	*AB1-173AE OP*	*1.7*
923801	*AB2-015 C OP*	*14.47*
923802	*AB2-015 E OP*	*11.87*
923831	*AB2-022 C*	*4.*
923832	*AB2-022 E*	*2.15*
923841	*AB2-024 C*	*3.32*
923842	*AB2-024 E*	*1.49*
923851	*AB2-025 C*	*4.08*
923852	*AB2-025 E*	*1.83*
923861	*AB2-026 C*	*3.73*
923862	*AB2-026 E*	*1.68*
923911	*AB2-031 C OP*	*3.61*

923912	*AB2-031 E OP*	*1.78*
923941	*AB2-035 C*	*0.52*
923942	*AB2-035 E*	*0.22*
923981	*AB2-039 C OP*	*13.92*
923982	*AB2-039 E OP*	*11.26*
923991	*AB2-040 C OP*	*11.87*
923992	*AB2-040 E OP*	*9.71*
924021	*AB2-043 C OP*	*4.48*
924022	*AB2-043 E OP*	*7.34*
924071	*AB2-051 C OP*	*240.18*
924072	*AB2-051 E OP*	*32.98*
924151	*AB2-059 C OP*	*16.13*
924152	*AB2-059 E OP*	*8.31*
924161	*AB2-060 C OP*	*12.55*
924162	*AB2-060 E OP*	*5.9*
924241	*AB2-068 OP*	*335.5*
924301	*AB2-077 C OP*	*2.84*
924302	*AB2-077 E OP*	*1.89*
924311	*AB2-078 C OP*	*2.84*
924312	*AB2-078 E OP*	*1.89*
924321	*AB2-079 C OP*	*2.84*
924322	*AB2-079 E OP*	*1.89*
924381	*AB2-087 C*	*0.93*
924382	*AB2-087 E*	*0.44*
924391	*AB2-088 C*	*0.67*
924392	*AB2-088 E*	*0.32*
924401	*AB2-089 C*	*3.21*
924402	*AB2-089 E*	*1.65*
924411	*AB2-090 C*	*5.64*
924412	*AB2-090 E*	*2.89*
924491	*AB2-098 C*	*0.9*
924492	*AB2-098 E*	*0.38*
924501	*AB2-099 C*	*0.97*
924502	*AB2-099 E*	*0.41*
924511	*AB2-100 C*	*18.51*
924512	*AB2-100 E*	*9.12*
924761	*AB2-128 C*	*15.86*
924762	*AB2-128 E*	*6.24*
924811	*AB2-134 C OP*	*20.21*

924812	*AB2-134 E OP*	*27.02*
924931	*AB2-147 C*	*4.13*
924932	*AB2-147 E*	*6.74*
924941	*AB2-149 C OP*	*5.71*
924942	*AB2-149 E OP*	*9.32*
924951	*AB2-150 C OP*	*4.13*
924952	*AB2-150 E OP*	*6.74*
924961	*AB2-152*	*4.04*
925051	*AB2-160 C OP*	*8.36*
925052	*AB2-160 E OP*	*13.63*
925061	*AB2-161 C OP*	*5.63*
925062	*AB2-161 E OP*	*9.18*
925121	*AB2-169 C OP*	*10.62*
925122	*AB2-169 E OP*	*9.53*
925141	*AB2-171 C OP*	*8.17*
925142	*AB2-171 E OP*	*13.33*
925171	*AB2-174 C OP*	*11.37*
925172	*AB2-174 E OP*	*10.29*
925221	*AB2-176 C*	*2.32*
925222	*AB2-176 E*	*0.99*
925281	*AB2-186 C*	*1.05*
925282	*AB2-186 E*	*0.45*
925291	*AB2-188 C OP*	*3.99*
925292	*AB2-188 E OP*	*1.79*
925331	*AB2-190 C*	*36.02*
925332	*AB2-190 E*	*9.01*
925361	*AC1-007 C OP*	*1.16*
925362	*AC1-007 E OP*	*1.89*
925521	*AC1-027 C*	*3.51*
925522	*AC1-027 E*	*2.01*
925591	*AC1-034 C OP*	*10.62*
925592	*AC1-034 E OP*	*8.01*
925611	*AC1-036 C*	*1.32*
925612	*AC1-036 E*	*2.15*
925691	*AC1-045 C*	*2.96*
925692	*AC1-045 E*	*1.62*
925701	*AC1-046 C*	*3.04*
925702	*AC1-046 E*	*1.66*
925711	*AC1-047 C*	*4.04*

925712	*AC1-047 E*	*2.22*
925781	*AC1-054 C OP*	*10.93*
925782	*AC1-054 E OP*	*5.04*
925811	*AC1-060*	*3.37*
925821	*AC1-061*	*0.06*
925831	*AC1-062*	*0.43*
925841	*AC1-063*	*0.52*
925861	*AC1-065 C*	*4.51*
925862	*AC1-065 E*	*7.36*
926071	*AC1-086 C*	*33.37*
926072	*AC1-086 E*	*15.19*
926201	*AC1-098 C*	*9.8*
926202	*AC1-098 E*	*5.84*
926211	*AC1-099 C*	*3.28*
926212	*AC1-099 E*	*1.93*
926271	*AC1-105 C OP*	*7.93*
926272	*AC1-105 E OP*	*3.95*
926281	*AC1-106*	*3.72*
926291	*AC1-107 OP*	*506.42*
926661	*AC1-147 C*	*3.95*
926662	*AC1-147 E*	*2.32*
926741	*AC1-159 C*	*238.32*
926751	*AC1-161 C OP*	*54.39*
926752	*AC1-161 E OP*	*23.22*
926761	*AC1-162 C*	*38.38*
926762	*AC1-162 E*	*16.38*
926771	*AC1-163 C*	*3.48*
926772	*AC1-163 E*	*1.63*
926781	*AC1-164 C OP*	*69.89*
926782	*AC1-164 E OP*	*31.4*
927021	*AC1-189 C*	*13.57*
927022	*AC1-189 E*	*6.76*
927051	*AC1-193 C*	*5.99*
927052	*AC1-193 E*	*9.77*
927111	*AC1-206 C OP*	*19.2*
927112	*AC1-206 E OP*	*9.08*
927141	*AC1-208 C*	*14.15*
927142	*AC1-208 E*	*6.28*
927211	*AC1-215 C*	*16.11*

927212	*AC1-215 E*	*7.31*
927221	*AC1-216 C OP*	*15.42*
927222	*AC1-216 E OP*	*12.13*

Appendix 11

(DVP - DVP) The 6SKIFF CREEK-6KINGS M 230 kV line (from bus 314209 to bus 314386 ckt 1) loads from 102.23% to 137.57% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 156.16 MW to the thermal violation.

CONTINGENCY 'LN 557'
 OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
 OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*0.52*
315108	*1ELIZAR1*	*1.53*
315109	*1ELIZAR2*	*1.51*
315110	*1ELIZAR3*	*1.55*
315233	*1SURRY 2*	*15.85*
315091	*1YORKTN2*	*23.96*
315092	*1YORKTN3*	*21.8*
314421	*6WINCHST*	*0.12*
916191	*Z1-068 C*	*0.02*
921092	*AA1-049 C*	*0.99*
921532	*AA1-132 C*	*3.05*
921542	*AA1-133 C*	*4.09*
921552	*AA1-134 C*	*3.87*
921572	*AA1-138 C*	*3.66*
921582	*AA1-139 C*	*6.14*
921772	*AA2-059 C*	*0.87*
921982	*AA2-088 C*	*1.9*
922532	*AA2-178 C*	*3.34*
922602	*AB1-013 C*	*1.01*
923801	*AB2-015 C OP*	*2.77*
923831	*AB2-022 C*	*0.92*
924071	*AB2-051 C OP*	*56.78*
924241	*AB2-068 OP*	*103.46*
924941	*AB2-149 C OP*	*1.01*
925121	*AB2-169 C OP*	*1.97*

925141	*AB2-171 C OP*	*1.52*
925281	*AB2-186 C*	*0.23*
925291	*AB2-188 C OP*	*0.82*
925361	*AC1-007 C OP*	*0.26*
925521	*AC1-027 C*	*0.83*
925691	*AC1-045 C*	*0.75*
925701	*AC1-046 C*	*0.72*
925711	*AC1-047 C*	*0.95*
926291	*AC1-107 OP*	*156.16*
926661	*AC1-147 C*	*0.93*
926741	*AC1-159 C*	*56.34*
926751	*AC1-161 C OP*	*14.1*
926781	*AC1-164 C OP*	*21.55*
927051	*AC1-193 C*	*1.12*

Appendix 12

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 112.56% to 138.31% (**DC power flow**) of its load dump rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 628.98 MW to the thermal violation.

CONTINGENCY 'LN 576'
OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00
OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315058	*1CHESTF3*	*6.16*
315059	*1CHESTF4*	*9.98*
315060	*1CHESTF5*	*21.16*
315061	*1CHESTG7*	*8.29*
315063	*1CHESTG8*	*8.22*
315062	*1CHESTS7*	*3.77*
315064	*1CHESTS8*	*4.21*
315067	*1DARBY 1*	*5.4*
315068	*1DARBY 2*	*5.41*
315069	*1DARBY 3*	*5.48*
315070	*1DARBY 4*	*5.48*
315233	*1SURRY 2*	*53.75*
315091	*1YORKTN2*	*53.71*
315092	*1YORKTN3*	*48.55*
314309	*6IRON208*	*0.81*
314236	*6NRTHEST*	*0.39*
314251	*6S PUMP*	*1.75*
297087	*V2-040*	*0.26*
LTF	*Z2-067*	*28.75*
921092	*AA1-049 C*	*4.23*
LTF	*AA1-058*	*1.25*
921162	*AA1-063AC*	*13.64*
921182	*AA1-067 C*	*2.63*
921532	*AA1-132 C*	*13.05*
921542	*AA1-133 C*	*17.45*

921552	*AA1-134 C*	*17.03*
921562	*AA1-135 C*	*14.68*
921572	*AA1-138 C*	*16.68*
921582	*AA1-139 C*	*26.18*
921752	*AA2-053 C*	*13.8*
921772	*AA2-059 C*	*4.03*
921862	*AA2-068 C*	*3.44*
LTF	*AA2-074*	*8.44*
921982	*AA2-088 C*	*10.63*
922512	*AA2-174 C*	*0.63*
922522	*AA2-177 C*	*18.02*
922532	*AA2-178 C*	*16.1*
922602	*AB1-013 C*	*4.86*
922682	*AB1-027 C*	*4.79*
922722	*AB1-053 C*	*1.67*
922732	*AB1-054 C*	*11.21*
923262	*AB1-132 C OP*	*22.24*
923272	*AB1-135 C OP*	*4.79*
923572	*AB1-173 C OP*	*3.57*
923582	*AB1-173AC OP*	*3.57*
923642	*AB1-181*	*3.49*
923643	*AB1-181 2*	*3.49*
923644	*AB1-181 3*	*3.49*
923801	*AB2-015 C OP*	*14.45*
923831	*AB2-022 C*	*3.99*
923841	*AB2-024 C*	*4.41*
923851	*AB2-025 C*	*4.03*
923861	*AB2-026 C*	*3.55*
923911	*AB2-031 C OP*	*3.55*
923981	*AB2-039 C OP*	*14.57*
923991	*AB2-040 C OP*	*11.65*
924071	*AB2-051 C OP*	*241.44*
924241	*AB2-068 OP*	*416.7*
LTF	*AB2-075*	*4.54*
LTF	*AB2-076*	*5.34*
924381	*AB2-087 C*	*0.92*
924491	*AB2-098 C*	*0.88*
924501	*AB2-099 C*	*0.95*
924511	*AB2-100 C*	*18.19*

924761	*AB2-128 C*	*15.59*
924811	*AB2-134 C OP*	*23.1*
924931	*AB2-147 C*	*4.05*
924941	*AB2-149 C OP*	*5.87*
924951	*AB2-150 C OP*	*4.05*
924961	*AB2-152*	*4.86*
925051	*AB2-160 C OP*	*9.6*
925061	*AB2-161 C OP*	*5.89*
925121	*AB2-169 C OP*	*10.47*
925141	*AB2-171 C OP*	*8.14*
925171	*AB2-174 C OP*	*11.16*
925281	*AB2-186 C*	*1.05*
925291	*AB2-188 C OP*	*3.97*
925331	*AB2-190 C*	*41.18*
925361	*AC1-007 C OP*	*1.21*
925521	*AC1-027 C*	*3.52*
925691	*AC1-045 C*	*3.04*
925701	*AC1-046 C*	*3.05*
925711	*AC1-047 C*	*4.04*
925811	*AC1-060*	*4.44*
925821	*AC1-061*	*0.06*
925841	*AC1-063*	*0.67*
925861	*AC1-065 C*	*5.83*
926071	*AC1-086 C*	*32.75*
926201	*AC1-098 C*	*9.59*
926211	*AC1-099 C*	*3.21*
926291	*AC1-107 OP*	*628.98*
926411	*AC1-112 C*	*3.73*
926661	*AC1-147 C*	*3.97*
926741	*AC1-159 C*	*239.58*
926751	*AC1-161 C OP*	*53.99*
926771	*AC1-163 C*	*3.43*
926781	*AC1-164 C OP*	*86.8*
927041	*AC1-191 C*	*18.31*
927051	*AC1-193 C*	*5.97*
927221	*AC1-216 C OP*	*17.63*

Appendix 13

(DVP - DVP) The 6FRRIVER-6STJOHN 230 kV line (from bus 314212 to bus 314150 ckt 1) loads from 90.54% to 100.64% (**DC power flow**) of its emergency rating (749 MVA) for the single line contingency outage of 'LN 574'. This project contributes approximately 168.1 MW to the thermal violation.

CONTINGENCY 'LN 574'
OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*2.01*
315054	*1BELMED2*	*2.01*
315055	*1BELMED3*	*1.67*
315058	*1CHESTF3*	*2.11*
315059	*1CHESTF4*	*3.43*
315060	*1CHESTF5*	*6.91*
315061	*1CHESTG7*	*2.71*
315063	*1CHESTG8*	*2.69*
315062	*1CHESTS7*	*1.23*
315064	*1CHESTS8*	*1.37*
315067	*1DARBY 1*	*2.*
315068	*1DARBY 2*	*2.01*
315069	*1DARBY 3*	*2.03*
315070	*1DARBY 4*	*2.03*
315043	*1FRIVERA*	*6.62*
315044	*1FRIVERB*	*5.12*
315045	*1FRIVERC*	*6.62*
315046	*1FRIVERD*	*5.12*
315047	*1FRIVERE*	*5.12*
315048	*1FRIVERF*	*6.62*
315091	*1YORKTN2*	*14.*
314309	*6IRON208*	*0.28*
314236	*6NRTHEST*	*0.15*
314251	*6S PUMP*	*0.69*
315074	*CIR_AB2-152*	*4.64*
315075	*CIR_AB2-152*	*4.58*
297087	*V2-040*	*0.11*
921292	*AA1-083*	*6.06*
921622	*AA1-145*	*103.09*
922522	*AA2-177 C*	*5.21*
922682	*AB1-027 C*	*1.82*

923272	*AB1-135 C OP*	*1.47*
923841	*AB2-024 C*	*1.23*
923981	*AB2-039 C OP*	*3.9*
924061	*AB2-050*	*6.06*
924241	*AB2-068 OP*	*107.62*
924811	*AB2-134 C OP*	*6.68*
924961	*AB2-152*	*1.5*
925051	*AB2-160 C OP*	*2.95*
925061	*AB2-161 C OP*	*1.58*
925331	*AB2-190 C*	*11.92*
925811	*AC1-060*	*1.33*
925821	*AC1-061*	*0.02*
926291	*AC1-107 OP*	*168.1*
926411	*AC1-112 C*	*1.42*
926551	*AC1-134*	*15.16*
926751	*AC1-161 C OP*	*14.19*
926781	*AC1-164 C OP*	*23.2*
927041	*AC1-191 C*	*6.75*
927221	*AC1-216 C OP*	*5.*

Appendix 14

(DVP - DVP) The 6CHSTF A-6IRON208 230 kV line (from bus 314286 to bus 314309 ckt 1) loads from 72.14% to 100.07% (**DC power flow**) of its emergency rating (664 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 185.33 MW to the thermal violation.

CONTINGENCY 'LN 557'
 OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00
 OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315060	*1CHESTF5*	*15.65*
315061	*1CHESTG7*	*6.13*
315063	*1CHESTG8*	*6.08*
315062	*1CHESTS7*	*2.79*
315064	*1CHESTS8*	*3.11*
315077	*1HOPHCF1*	*1.76*
315078	*1HOPHCF2*	*1.76*
315079	*1HOPHCF3*	*1.76*
315080	*1HOPHCF4*	*2.67*
315076	*1HOPPOLC*	*1.5*
315091	*1YORKTN2*	*11.67*
314184	*3SHACKLE*	*0.34*
315074	*CIR_AB2-152*	*5.7*
315075	*CIR_AB2-152*	*5.63*
914231	*Y2-077*	*0.71*
921092	*AA1-049 C*	*0.69*
921532	*AA1-132 C*	*2.13*
921542	*AA1-133 C*	*2.85*
921582	*AA1-139 C*	*4.28*
922522	*AA2-177 C*	*5.69*
922672	*AB1-026 C*	*0.71*
923272	*AB1-135 C OP*	*1.62*
923841	*AB2-024 C*	*1.35*
923981	*AB2-039 C OP*	*2.61*
924071	*AB2-051 C OP*	*41.07*
924241	*AB2-068 OP*	*54.72*
924811	*AB2-134 C OP*	*7.29*

924941	*AB2-149 C OP*	*1.02*
924961	*AB2-152*	*1.85*
925051	*AB2-160 C OP*	*1.68*
925061	*AB2-161 C OP*	*1.06*
925331	*AB2-190 C*	*13.*
925361	*AC1-007 C OP*	*0.24*
925521	*AC1-027 C*	*0.59*
925691	*AC1-045 C*	*0.56*
925701	*AC1-046 C*	*0.5*
925711	*AC1-047 C*	*0.66*
925811	*AC1-060*	*1.16*
925821	*AC1-061*	*0.01*
925841	*AC1-063*	*0.19*
925861	*AC1-065 C*	*1.67*
926291	*AC1-107 OP*	*185.33*
926471	*AC1-118 C*	*0.67*
926591	*AC1-142 C*	*4.21*
926661	*AC1-147 C*	*0.68*
926741	*AC1-159 C*	*40.75*
926751	*AC1-161 C OP*	*12.61*
926781	*AC1-164 C OP*	*25.58*
927221	*AC1-216 C OP*	*2.83*

Appendix 15

(DVP - DVP) The 8CHANCE-8BRISTER 500 kV line (from bus 314905 to bus 314900 ckt 1) loads from 96.33% to 108.82% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 314.58 MW to the thermal violation.

CONTINGENCY 'LN 594'
OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.56*
315054	*1BELMED2*	*3.56*
315055	*1BELMED3*	*2.96*
315067	*1DARBY 1*	*3.24*
315068	*1DARBY 2*	*3.25*
315069	*1DARBY 3*	*3.29*
315070	*1DARBY 4*	*3.29*
315043	*1FRIVERA*	*4.37*
315044	*1FRIVERB*	*3.38*
315045	*1FRIVERC*	*4.37*
315046	*1FRIVERD*	*3.38*
315047	*1FRIVERE*	*3.38*
315048	*1FRIVERF*	*4.37*
315225	*1N ANNA1*	*49.21*
315226	*1N ANNA2*	*48.45*
315083	*1SPRUNCA*	*2.18*
315084	*1SPRUNCB*	*2.18*
315085	*1SPRUNCC*	*1.62*
315086	*1SPRUNCD*	*1.62*
315091	*1YORKTN2*	*31.54*
314309	*6IRON208*	*0.49*
314236	*6NRTHEST*	*0.24*
314251	*6S PUMP*	*1.07*
315074	*CIR_AB2-152*	*8.94*
315075	*CIR_AB2-152*	*8.82*
297087	*V2-040*	*0.15*
LTF	*Z2-067*	*16.78*
921092	*AA1-049 C*	*2.52*
LTF	*AA1-058*	*0.75*

921162	*AA1-063AC*	*8.25*
921172	*AA1-064 C*	*8.22*
921182	*AA1-067 C*	*1.58*
921292	*AA1-083*	*4.01*
921532	*AA1-132 C*	*7.79*
921542	*AA1-133 C*	*10.41*
921552	*AA1-134 C*	*10.17*
921562	*AA1-135 C*	*8.82*
921572	*AA1-138 C*	*9.98*
921582	*AA1-139 C*	*15.62*
921622	*AA1-145*	*68.09*
921752	*AA2-053 C*	*8.35*
921772	*AA2-059 C*	*2.41*
921862	*AA2-068 C*	*2.08*
LTF	*AA2-074*	*4.99*
921982	*AA2-088 C*	*6.4*
922512	*AA2-174 C*	*0.38*
922522	*AA2-177 C*	*10.72*
922532	*AA2-178 C*	*9.64*
922602	*AB1-013 C*	*2.91*
922672	*AB1-026 C*	*2.11*
922682	*AB1-027 C*	*2.79*
922722	*AB1-053 C*	*1.01*
922732	*AB1-054 C*	*6.75*
923262	*AB1-132 C OP*	*13.48*
923272	*AB1-135 C OP*	*2.75*
923572	*AB1-173 C OP*	*2.18*
923582	*AB1-173AC OP*	*2.18*
923801	*AB2-015 C OP*	*8.68*
923831	*AB2-022 C*	*2.38*
923841	*AB2-024 C*	*2.64*
923851	*AB2-025 C*	*2.47*
923861	*AB2-026 C*	*2.33*
923911	*AB2-031 C OP*	*2.16*
923981	*AB2-039 C OP*	*8.77*
923991	*AB2-040 C OP*	*7.09*
924061	*AB2-050*	*4.01*
924071	*AB2-051 C OP*	*143.92*
924241	*AB2-068 OP*	*216.09*
924381	*AB2-087 C*	*0.55*
924491	*AB2-098 C*	*0.53*
924501	*AB2-099 C*	*0.57*
924511	*AB2-100 C*	*11.08*
924761	*AB2-128 C*	*9.49*
924811	*AB2-134 C OP*	*13.75*

924931	*AB2-147 C*	*2.48*
924941	*AB2-149 C OP*	*3.52*
924951	*AB2-150 C OP*	*2.48*
924961	*AB2-152*	*2.9*
925051	*AB2-160 C OP*	*5.81*
925061	*AB2-161 C OP*	*3.55*
925121	*AB2-169 C OP*	*6.28*
925141	*AB2-171 C OP*	*4.9*
925171	*AB2-174 C OP*	*6.8*
925281	*AB2-186 C*	*0.62*
925291	*AB2-188 C OP*	*2.38*
925331	*AB2-190 C*	*24.51*
925361	*AC1-007 C OP*	*0.71*
925521	*AC1-027 C*	*2.1*
925691	*AC1-045 C*	*1.81*
925701	*AC1-046 C*	*1.82*
925711	*AC1-047 C*	*2.41*
925811	*AC1-060*	*2.66*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.41*
925861	*AC1-065 C*	*3.58*
926001	*AC1-076 C*	*4.69*
926071	*AC1-086 C*	*19.86*
926201	*AC1-098 C*	*5.78*
926211	*AC1-099 C*	*1.94*
926291	*AC1-107 OP*	*314.58*
926411	*AC1-112 C*	*2.17*
926441	*AC1-115 C*	*1.12*
926471	*AC1-118 C*	*1.99*
926551	*AC1-134*	*10.01*
926591	*AC1-142 C*	*9.93*
926661	*AC1-147 C*	*2.37*
926731	*AC1-158 C*	*88.45*
926741	*AC1-159 C*	*142.81*
926751	*AC1-161 C OP*	*31.89*
926771	*AC1-163 C*	*2.07*
926781	*AC1-164 C OP*	*43.41*
927041	*AC1-191 C*	*10.24*
927051	*AC1-193 C*	*3.59*
927221	*AC1-216 C OP*	*10.85*

Appendix 16

(DVP - DVP) The 8LDYSMTH-8CHANCE 500 kV line (from bus 314911 to bus 314905 ckt 1) loads from 91.84% to 103.53% (**DC power flow**) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 573'. This project contributes approximately 320.1 MW to the thermal violation.

CONTINGENCY 'LN 573'
OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.62*
315054	*1BELMED2*	*3.62*
315055	*1BELMED3*	*3.*
315067	*1DARBY 1*	*3.3*
315068	*1DARBY 2*	*3.3*
315069	*1DARBY 3*	*3.35*
315070	*1DARBY 4*	*3.35*
315043	*1FRIVERA*	*4.46*
315044	*1FRIVERB*	*3.45*
315045	*1FRIVERC*	*4.46*
315046	*1FRIVERD*	*3.45*
315047	*1FRIVERE*	*3.45*
315048	*1FRIVERF*	*4.46*
315037	*1LDYSMT1*	*5.77*
315039	*1LDYSMT3*	*6.1*
315040	*1LDYSMT4*	*6.11*
315041	*1LDYSMT5*	*6.13*
315225	*1N ANNA1*	*49.92*
315226	*1N ANNA2*	*49.15*
315083	*1SPRUNCA*	*2.22*
315084	*1SPRUNCB*	*2.22*
315085	*1SPRUNCC*	*1.64*
315086	*1SPRUNCD*	*1.64*
315091	*1YORKTN2*	*32.06*
314309	*6IRON208*	*0.5*
314236	*6NRTHEST*	*0.24*
314251	*6S PUMP*	*1.09*
315074	*CIR_AB2-152*	*9.08*
315075	*CIR_AB2-152*	*8.97*

297087	*V2-040*	*0.16*
LTF	*Z2-067*	*16.92*
921092	*AA1-049 C*	*2.56*
LTF	*AA1-058*	*0.75*
921162	*AA1-063AC*	*8.35*
921172	*AA1-064 C*	*8.32*
921182	*AA1-067 C*	*1.6*
921292	*AA1-083*	*4.09*
921532	*AA1-132 C*	*7.91*
921542	*AA1-133 C*	*10.57*
921552	*AA1-134 C*	*10.32*
921562	*AA1-135 C*	*8.93*
921572	*AA1-138 C*	*10.13*
921582	*AA1-139 C*	*15.86*
921622	*AA1-145*	*69.46*
921752	*AA2-053 C*	*8.46*
921772	*AA2-059 C*	*2.45*
921862	*AA2-068 C*	*2.1*
LTF	*AA2-074*	*5.03*
921982	*AA2-088 C*	*6.49*
922512	*AA2-174 C*	*0.39*
922522	*AA2-177 C*	*10.9*
922532	*AA2-178 C*	*9.78*
922602	*AB1-013 C*	*2.95*
922672	*AB1-026 C*	*2.16*
922682	*AB1-027 C*	*2.84*
922722	*AB1-053 C*	*1.03*
922732	*AB1-054 C*	*6.85*
923262	*AB1-132 C OP*	*13.66*
923272	*AB1-135 C OP*	*2.8*
923572	*AB1-173 C OP*	*2.2*
923582	*AB1-173AC OP*	*2.2*
923801	*AB2-015 C OP*	*8.81*
923831	*AB2-022 C*	*2.42*
923841	*AB2-024 C*	*2.68*
923851	*AB2-025 C*	*2.51*
923861	*AB2-026 C*	*2.34*
923911	*AB2-031 C OP*	*2.19*
923981	*AB2-039 C OP*	*8.91*
923991	*AB2-040 C OP*	*7.18*
924061	*AB2-050*	*4.09*
924071	*AB2-051 C OP*	*146.16*
924241	*AB2-068 OP*	*220.03*
924381	*AB2-087 C*	*0.56*
924491	*AB2-098 C*	*0.53*

924501	*AB2-099 C*	*0.58*
924511	*AB2-100 C*	*11.23*
924761	*AB2-128 C*	*9.62*
924811	*AB2-134 C OP*	*13.97*
924931	*AB2-147 C*	*2.51*
924941	*AB2-149 C OP*	*3.58*
924951	*AB2-150 C OP*	*2.51*
924961	*AB2-152*	*2.94*
925051	*AB2-160 C OP*	*5.9*
925061	*AB2-161 C OP*	*3.6*
925121	*AB2-169 C OP*	*6.36*
925141	*AB2-171 C OP*	*4.96*
925171	*AB2-174 C OP*	*6.89*
925281	*AB2-186 C*	*0.62*
925291	*AB2-188 C OP*	*2.41*
925331	*AB2-190 C*	*24.91*
925361	*AC1-007 C OP*	*0.73*
925521	*AC1-027 C*	*2.13*
925691	*AC1-045 C*	*1.84*
925701	*AC1-046 C*	*1.84*
925711	*AC1-047 C*	*2.45*
925811	*AC1-060*	*2.71*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.42*
925861	*AC1-065 C*	*3.64*
926071	*AC1-086 C*	*20.11*
926201	*AC1-098 C*	*5.86*
926211	*AC1-099 C*	*1.96*
926291	*AC1-107 OP*	*320.1*
926411	*AC1-112 C*	*2.21*
926441	*AC1-115 C*	*1.15*
926471	*AC1-118 C*	*2.04*
926551	*AC1-134*	*10.22*
926591	*AC1-142 C*	*10.12*
926661	*AC1-147 C*	*2.41*
926741	*AC1-159 C*	*145.03*
926751	*AC1-161 C OP*	*32.4*
926771	*AC1-163 C*	*2.09*
926781	*AC1-164 C OP*	*44.17*
927041	*AC1-191 C*	*10.43*
927051	*AC1-193 C*	*3.64*
927221	*AC1-216 C OP*	*11.03*

Appendix 17

(DVP - DVP) The 8LDYSMTH-8POSSUM 500 kV line (from bus 314911 to bus 314922 ckt 1) loads from 89.76% to 100.81% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 271.46 MW to the thermal violation.

CONTINGENCY 'LN 594'
OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.08*
315054	*1BELMED2*	*3.08*
315055	*1BELMED3*	*2.56*
315060	*1CHESTF5*	*10.92*
315061	*1CHESTG7*	*4.28*
315063	*1CHESTG8*	*4.24*
315062	*1CHESTS7*	*1.95*
315064	*1CHESTS8*	*2.17*
315067	*1DARBY 1*	*2.8*
315068	*1DARBY 2*	*2.8*
315069	*1DARBY 3*	*2.84*
315070	*1DARBY 4*	*2.84*
315043	*1FRIVERA*	*3.69*
315045	*1FRIVERC*	*3.69*
315048	*1FRIVERF*	*3.69*
315225	*1N ANNA1*	*42.12*
315226	*1N ANNA2*	*41.47*
315083	*1SPRUNCA*	*1.89*
315084	*1SPRUNCB*	*1.89*
315085	*1SPRUNCC*	*1.4*
315086	*1SPRUNCD*	*1.4*
315091	*1YORKTN2*	*27.39*
314309	*6IRON208*	*0.42*
314236	*6NRTHEST*	*0.2*
314251	*6S PUMP*	*0.92*
315074	*CIR_AB2-152*	*7.76*
315075	*CIR_AB2-152*	*7.65*
297087	*V2-040*	*0.13*
921092	*AA1-049 C*	*2.21*

LTF	*AA1-058*	*0.69*
921292	*AA1-083*	*3.38*
921532	*AA1-132 C*	*6.82*
921542	*AA1-133 C*	*9.11*
921552	*AA1-134 C*	*8.93*
921572	*AA1-138 C*	*8.78*
921582	*AA1-139 C*	*13.67*
921622	*AA1-145*	*57.45*
921772	*AA2-059 C*	*2.12*
LTF	*AA2-074*	*4.72*
921982	*AA2-088 C*	*5.67*
922522	*AA2-177 C*	*9.32*
922532	*AA2-178 C*	*8.52*
922602	*AB1-013 C*	*2.57*
922682	*AB1-027 C*	*2.4*
922732	*AB1-054 C*	*5.99*
923272	*AB1-135 C OP*	*2.38*
923801	*AB2-015 C OP*	*7.67*
923831	*AB2-022 C*	*2.09*
923841	*AB2-024 C*	*2.26*
923851	*AB2-025 C*	*2.18*
923861	*AB2-026 C*	*2.1*
923981	*AB2-039 C OP*	*7.66*
924061	*AB2-050*	*3.38*
924071	*AB2-051 C OP*	*125.76*
924241	*AB2-068 OP*	*187.68*
924511	*AB2-100 C*	*9.85*
924761	*AB2-128 C*	*8.44*
924811	*AB2-134 C OP*	*11.95*
924941	*AB2-149 C OP*	*3.08*
924961	*AB2-152*	*2.51*
925051	*AB2-160 C OP*	*5.05*
925061	*AB2-161 C OP*	*3.1*
925141	*AB2-171 C OP*	*4.33*
925281	*AB2-186 C*	*0.54*
925291	*AB2-188 C OP*	*2.1*
925331	*AB2-190 C*	*21.31*
925361	*AC1-007 C OP*	*0.62*
925521	*AC1-027 C*	*1.84*
925691	*AC1-045 C*	*1.58*
925701	*AC1-046 C*	*1.59*
925711	*AC1-047 C*	*2.11*
925811	*AC1-060*	*2.29*
925821	*AC1-061*	*0.03*
925841	*AC1-063*	*0.35*

925861	*AC1-065 C*	*3.05*
926291	*AC1-107 OP*	*271.46*
926411	*AC1-112 C*	*1.87*
926441	*AC1-115 C*	*0.92*
926551	*AC1-134*	*8.45*
926661	*AC1-147 C*	*2.07*
926731	*AC1-158 C*	*74.62*
926741	*AC1-159 C*	*124.79*
926751	*AC1-161 C OP*	*27.79*
926781	*AC1-164 C OP*	*37.46*
927041	*AC1-191 C*	*8.67*
927051	*AC1-193 C*	*3.17*
927221	*AC1-216 C OP*	*9.44*

Appendix 18

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 69.37% to 87.48% (**DC power flow**) of its load dump rating (1051 MVA) for the line fault with failed breaker contingency outage of 'H2T557'. This project contributes approximately 422.4 MW to the thermal violation.

CONTINGENCY 'H2T557' /* ELMONT
OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)
OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)
OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2)
END

Bus Number	*Bus Name*	*Full Contribution*
315067	*1DARBY 1*	*4.87*
315068	*1DARBY 2*	*4.87*
315069	*1DARBY 3*	*4.93*
315070	*1DARBY 4*	*4.93*
315043	*1FRIVERA*	*6.55*
315044	*1FRIVERB*	*5.07*
315045	*1FRIVERC*	*6.55*
315046	*1FRIVERD*	*5.07*
315047	*1FRIVERE*	*5.07*
315048	*1FRIVERF*	*6.55*
315073	*1STONECA*	*9.14*
314784	*1WEYRHSB*	*1.71*
315091	*1YORKTN2*	*31.74*
314539	*3UNCAMP*	*2.15*
314541	*3WATKINS*	*0.6*
314229	*6MT R221*	*1.42*
314236	*6NRTHEST*	*0.36*
314189	*6PAPERMILL*	*8.79*
314251	*6S PUMP*	*1.65*
315074	*CIR_AB2-152*	*11.02*
315075	*CIR_AB2-152*	*10.88*
292791	*U1-032 E*	*4.76*
297087	*V2-040*	*0.27*
900672	*V4-068 E*	*0.25*
901082	*W1-029E*	*41.21*

907092	*X1-038 E*	*5.37*
913392	*Y1-086 E*	*1.96*
916042	*Z1-036 E*	*40.01*
916192	*Z1-068 E*	*1.73*
917122	*Z2-027 E*	*0.95*
917592	*Z2-099 E*	*0.37*
921092	*AA1-049 C*	*2.19*
921093	*AA1-049 E*	*1.03*
921162	*AA1-063AC*	*6.94*
921163	*AA1-063AE*	*3.27*
918512	*AA1-065 E OP*	*3.65*
921292	*AA1-083*	*6.*
921532	*AA1-132 C*	*6.77*
921533	*AA1-132 E*	*2.9*
921542	*AA1-133 C*	*9.06*
921543	*AA1-133 E*	*3.88*
921552	*AA1-134 C*	*8.84*
921553	*AA1-134 E*	*3.79*
921572	*AA1-138 C*	*8.66*
921573	*AA1-138 E*	*3.71*
921582	*AA1-139 C*	*13.6*
921583	*AA1-139 E*	*5.83*
921622	*AA1-145*	*102.06*
921772	*AA2-059 C*	*2.07*
921773	*AA2-059 E*	*0.95*
920022	*AA2-086 E*	*0.2*
921982	*AA2-088 C*	*5.49*
921983	*AA2-088 E*	*8.96*
922522	*AA2-177 C*	*12.12*
922523	*AA2-177 E*	*5.19*
922532	*AA2-178 C*	*8.21*
922533	*AA2-178 E*	*3.52*
922602	*AB1-013 C*	*2.48*
922603	*AB1-013 E*	*16.58*
922672	*AB1-026 C*	*2.22*
922673	*AB1-026 E*	*0.95*
922682	*AB1-027 C*	*4.44*
922683	*AB1-027 E*	*1.9*
922722	*AB1-053 C*	*0.85*
922723	*AB1-053 E*	*0.48*
922732	*AB1-054 C*	*5.79*
922733	*AB1-054 E*	*2.85*
923262	*AB1-132 C OP*	*11.47*
923263	*AB1-132 E OP*	*4.92*
923272	*AB1-135 C OP*	*3.7*

923273	*AB1-135 E OP*	*1.58*
923572	*AB1-173 C OP*	*1.85*
923573	*AB1-173 E OP*	*0.86*
923582	*AB1-173AC OP*	*1.85*
923583	*AB1-173AE OP*	*0.86*
923801	*AB2-015 C OP*	*7.57*
923802	*AB2-015 E OP*	*6.21*
923831	*AB2-022 C*	*2.07*
923832	*AB2-022 E*	*1.11*
923841	*AB2-024 C*	*3.3*
923842	*AB2-024 E*	*1.48*
923851	*AB2-025 C*	*2.36*
923852	*AB2-025 E*	*1.06*
923861	*AB2-026 C*	*1.94*
923862	*AB2-026 E*	*0.87*
923911	*AB2-031 C OP*	*1.84*
923912	*AB2-031 E OP*	*0.9*
923981	*AB2-039 C OP*	*8.77*
923982	*AB2-039 E OP*	*7.09*
923991	*AB2-040 C OP*	*6.03*
923992	*AB2-040 E OP*	*4.93*
924061	*AB2-050*	*6.*
924071	*AB2-051 C OP*	*126.81*
924072	*AB2-051 E OP*	*17.41*
924241	*AB2-068 OP*	*175.54*
924381	*AB2-087 C*	*0.47*
924382	*AB2-087 E*	*0.22*
924501	*AB2-099 C*	*0.48*
924502	*AB2-099 E*	*0.21*
924511	*AB2-100 C*	*9.74*
924512	*AB2-100 E*	*4.8*
924761	*AB2-128 C*	*8.34*
924762	*AB2-128 E*	*3.28*
924811	*AB2-134 C OP*	*15.54*
924812	*AB2-134 E OP*	*20.78*
924931	*AB2-147 C*	*2.13*
924932	*AB2-147 E*	*3.48*
924941	*AB2-149 C OP*	*3.35*
924942	*AB2-149 E OP*	*5.46*
924951	*AB2-150 C OP*	*2.13*
924952	*AB2-150 E OP*	*3.48*
924961	*AB2-152*	*3.57*
925051	*AB2-160 C OP*	*7.*
925052	*AB2-160 E OP*	*11.42*
925061	*AB2-161 C OP*	*3.55*

925062	*AB2-161 E OP*	*5.78*
925141	*AB2-171 C OP*	*4.24*
925142	*AB2-171 E OP*	*6.92*
925171	*AB2-174 C OP*	*5.82*
925172	*AB2-174 E OP*	*5.26*
925281	*AB2-186 C*	*0.53*
925282	*AB2-186 E*	*0.23*
925291	*AB2-188 C OP*	*2.02*
925292	*AB2-188 E OP*	*0.91*
925331	*AB2-190 C*	*27.7*
925332	*AB2-190 E*	*6.93*
925361	*AC1-007 C OP*	*0.68*
925362	*AC1-007 E OP*	*1.11*
925521	*AC1-027 C*	*1.84*
925522	*AC1-027 E*	*1.05*
925691	*AC1-045 C*	*1.65*
925692	*AC1-045 E*	*0.9*
925701	*AC1-046 C*	*1.58*
925702	*AC1-046 E*	*0.86*
925711	*AC1-047 C*	*2.1*
925712	*AC1-047 E*	*1.16*
925811	*AC1-060*	*3.44*
925821	*AC1-061*	*0.05*
925841	*AC1-063*	*0.5*
925861	*AC1-065 C*	*4.34*
925862	*AC1-065 E*	*7.08*
926071	*AC1-086 C*	*16.89*
926072	*AC1-086 E*	*7.69*
926291	*AC1-107 OP*	*422.4*
926411	*AC1-112 C*	*3.46*
926412	*AC1-112 E*	*1.94*
926441	*AC1-115 C*	*1.03*
926442	*AC1-115 E*	*1.66*
926471	*AC1-118 C*	*2.09*
926472	*AC1-118 E*	*1.08*
926551	*AC1-134*	*15.01*
926591	*AC1-142 C*	*11.37*
926592	*AC1-142 E*	*8.58*
926661	*AC1-147 C*	*2.09*
926662	*AC1-147 E*	*1.23*
926741	*AC1-159 C*	*125.84*
926751	*AC1-161 C OP*	*31.85*
926752	*AC1-161 E OP*	*13.59*
926771	*AC1-163 C*	*1.74*
926772	*AC1-163 E*	*0.81*

926781	*AC1-164 C OP*	*58.29*
926782	*AC1-164 E OP*	*26.19*
927041	*AC1-191 C*	*17.62*
927042	*AC1-191 E*	*8.78*
927051	*AC1-193 C*	*3.11*
927052	*AC1-193 E*	*5.08*
927111	*AC1-206 C OP*	*9.6*
927112	*AC1-206 E OP*	*4.54*
927221	*AC1-216 C OP*	*9.08*
927222	*AC1-216 E OP*	*7.14*

Appendix 19

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 95.92% to 101.5% (**DC power flow**) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of '557T574'. This project contributes approximately 389.1 MW to the thermal violation.

CONTINGENCY '557T574' /* ELMONT
OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)
OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)
OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)
END

Bus Number	*Bus Name*	*Full Contribution*
315102	*1BRUNSWICKG1*	*16.93*
315103	*1BRUNSWICKG2*	*16.93*
315104	*1BRUNSWICKG3*	*16.93*
315105	*1BRUNSWICKS1*	*35.18*
315108	*1ELIZAR1*	*6.58*
315109	*1ELIZAR2*	*6.47*
315110	*1ELIZAR3*	*6.67*
315073	*1STONECA*	*10.34*
315233	*1SURRY 2*	*52.18*
314784	*1WEYRHSB*	*3.47*
315091	*1YORKTN2*	*48.15*
314539	*3UNCAMP*	*4.08*
314541	*3WATKINS*	*1.15*
314189	*6PAPERMILL*	*8.9*
315074	*CIR_AB2-152*	*12.47*
315075	*CIR_AB2-152*	*12.31*
292791	*U1-032 E*	*5.39*
900672	*V4-068 E*	*0.49*
901082	*W1-029E*	*79.43*
907092	*X1-038 E*	*10.21*
913392	*Y1-086 E*	*3.79*
916042	*Z1-036 E*	*77.97*
916192	*Z1-068 E*	*3.29*
916301	*Z1-086 C*	*103.02*
916302	*Z1-086 E*	*16.82*

917122	*Z2-027 E*	*1.84*
917332	*Z2-043 E*	*1.62*
917342	*Z2-044 E*	*0.89*
LTF	*Z2-067*	*29.63*
917512	*Z2-088 E OP1*	*12.52*
917592	*Z2-099 E*	*0.73*
921092	*AA1-049 C*	*4.23*
921093	*AA1-049 E*	*1.99*
LTF	*AA1-058*	*1.31*
921162	*AA1-063AC*	*13.85*
921163	*AA1-063AE*	*6.53*
921172	*AA1-064 C*	*15.11*
921173	*AA1-064 E*	*7.11*
918512	*AA1-065 E OP*	*7.33*
921182	*AA1-067 C*	*2.69*
921183	*AA1-067 E*	*1.15*
918562	*AA1-072 E*	*0.27*
921532	*AA1-132 C*	*13.06*
921533	*AA1-132 E*	*5.6*
921542	*AA1-133 C*	*17.46*
921543	*AA1-133 E*	*7.48*
921552	*AA1-134 C*	*17.04*
921553	*AA1-134 E*	*7.3*
921562	*AA1-135 C*	*14.95*
921563	*AA1-135 E*	*6.41*
921572	*AA1-138 C*	*16.71*
921573	*AA1-138 E*	*7.16*
921582	*AA1-139 C*	*26.19*
921583	*AA1-139 E*	*11.23*
921752	*AA2-053 C*	*14.06*
921753	*AA2-053 E*	*6.04*
921762	*AA2-057 C*	*11.13*
921763	*AA2-057 E*	*5.57*
921772	*AA2-059 C*	*4.05*
921773	*AA2-059 E*	*1.86*
921862	*AA2-068 C*	*3.53*
921863	*AA2-068 E*	*1.62*
LTF	*AA2-074*	*8.79*
920022	*AA2-086 E*	*0.39*
921982	*AA2-088 C*	*10.71*
921983	*AA2-088 E*	*17.47*
922442	*AA2-165 C*	*1.52*
922443	*AA2-165 E*	*0.73*
922472	*AA2-169 C*	*3.42*
922473	*AA2-169 E*	*1.57*

922512	*AA2-174 C*	*0.64*
922513	*AA2-174 E*	*0.7*
922522	*AA2-177 C*	*15.77*
922523	*AA2-177 E*	*6.76*
922532	*AA2-178 C*	*16.22*
922533	*AA2-178 E*	*6.95*
922602	*AB1-013 C*	*4.89*
922603	*AB1-013 E*	*32.76*
922722	*AB1-053 C*	*1.71*
922723	*AB1-053 E*	*0.96*
922732	*AB1-054 C*	*11.3*
922733	*AB1-054 E*	*5.57*
922922	*AB1-081 C OP*	*13.7*
922923	*AB1-081 E OP*	*5.87*
923262	*AB1-132 C OP*	*22.68*
923263	*AB1-132 E OP*	*9.72*
923272	*AB1-135 C OP*	*3.4*
923273	*AB1-135 E OP*	*1.46*
923572	*AB1-173 C OP*	*3.64*
923573	*AB1-173 E OP*	*1.7*
923582	*AB1-173AC OP*	*3.64*
923583	*AB1-173AE OP*	*1.7*
923801	*AB2-015 C OP*	*14.48*
923802	*AB2-015 E OP*	*11.87*
923831	*AB2-022 C*	*4.*
923832	*AB2-022 E*	*2.15*
923841	*AB2-024 C*	*3.33*
923842	*AB2-024 E*	*1.49*
923851	*AB2-025 C*	*4.08*
923852	*AB2-025 E*	*1.83*
923861	*AB2-026 C*	*3.73*
923862	*AB2-026 E*	*1.68*
923911	*AB2-031 C OP*	*3.62*
923912	*AB2-031 E OP*	*1.78*
923941	*AB2-035 C*	*0.52*
923942	*AB2-035 E*	*0.22*
923981	*AB2-039 C OP*	*13.93*
923982	*AB2-039 E OP*	*11.26*
923991	*AB2-040 C OP*	*11.88*
923992	*AB2-040 E OP*	*9.72*
924021	*AB2-043 C OP*	*4.48*
924022	*AB2-043 E OP*	*7.35*
924071	*AB2-051 C OP*	*240.29*
924072	*AB2-051 E OP*	*32.99*
924151	*AB2-059 C OP*	*16.14*

924152	*AB2-059 E OP*	*8.32*
924161	*AB2-060 C OP*	*12.56*
924162	*AB2-060 E OP*	*5.91*
924241	*AB2-068 OP*	*335.66*
924301	*AB2-077 C OP*	*2.84*
924302	*AB2-077 E OP*	*1.9*
924311	*AB2-078 C OP*	*2.84*
924312	*AB2-078 E OP*	*1.9*
924321	*AB2-079 C OP*	*2.84*
924322	*AB2-079 E OP*	*1.9*
924381	*AB2-087 C*	*0.94*
924382	*AB2-087 E*	*0.44*
924391	*AB2-088 C*	*0.67*
924392	*AB2-088 E*	*0.32*
924401	*AB2-089 C*	*3.21*
924402	*AB2-089 E*	*1.65*
924411	*AB2-090 C*	*5.64*
924412	*AB2-090 E*	*2.89*
924491	*AB2-098 C*	*0.9*
924492	*AB2-098 E*	*0.38*
924501	*AB2-099 C*	*0.97*
924502	*AB2-099 E*	*0.41*
924511	*AB2-100 C*	*18.52*
924512	*AB2-100 E*	*9.12*
924761	*AB2-128 C*	*15.87*
924762	*AB2-128 E*	*6.25*
924811	*AB2-134 C OP*	*20.22*
924812	*AB2-134 E OP*	*27.03*
924931	*AB2-147 C*	*4.13*
924932	*AB2-147 E*	*6.74*
924941	*AB2-149 C OP*	*5.71*
924942	*AB2-149 E OP*	*9.32*
924951	*AB2-150 C OP*	*4.13*
924952	*AB2-150 E OP*	*6.74*
924961	*AB2-152*	*4.04*
925051	*AB2-160 C OP*	*8.36*
925052	*AB2-160 E OP*	*13.64*
925061	*AB2-161 C OP*	*5.63*
925062	*AB2-161 E OP*	*9.19*
925121	*AB2-169 C OP*	*10.63*
925122	*AB2-169 E OP*	*9.54*
925141	*AB2-171 C OP*	*8.17*
925142	*AB2-171 E OP*	*13.33*
925171	*AB2-174 C OP*	*11.38*
925172	*AB2-174 E OP*	*10.3*

925221	*AB2-176 C*	*2.32*
925222	*AB2-176 E*	*1.*
925281	*AB2-186 C*	*1.03*
925282	*AB2-186 E*	*0.44*
925291	*AB2-188 C OP*	*4.*
925292	*AB2-188 E OP*	*1.8*
925331	*AB2-190 C*	*36.04*
925332	*AB2-190 E*	*9.01*
925361	*AC1-007 C OP*	*1.14*
925362	*AC1-007 E OP*	*1.87*
925521	*AC1-027 C*	*3.51*
925522	*AC1-027 E*	*2.01*
925591	*AC1-034 C OP*	*10.45*
925592	*AC1-034 E OP*	*7.88*
925611	*AC1-036 C*	*1.32*
925612	*AC1-036 E*	*2.15*
925691	*AC1-045 C*	*2.97*
925692	*AC1-045 E*	*1.62*
925701	*AC1-046 C*	*3.05*
925702	*AC1-046 E*	*1.66*
925711	*AC1-047 C*	*4.04*
925712	*AC1-047 E*	*2.22*
925781	*AC1-054 C OP*	*10.97*
925782	*AC1-054 E OP*	*5.06*
925811	*AC1-060*	*3.37*
925821	*AC1-061*	*0.06*
925831	*AC1-062*	*0.43*
925841	*AC1-063*	*0.52*
925861	*AC1-065 C*	*4.52*
925862	*AC1-065 E*	*7.37*
926071	*AC1-086 C*	*33.39*
926072	*AC1-086 E*	*15.2*
926201	*AC1-098 C*	*9.81*
926202	*AC1-098 E*	*5.84*
926211	*AC1-099 C*	*3.29*
926212	*AC1-099 E*	*1.93*
926271	*AC1-105 C OP*	*8.94*
926272	*AC1-105 E OP*	*4.45*
926281	*AC1-106*	*3.72*
926291	*AC1-107 OP*	*389.1*
926661	*AC1-147 C*	*3.95*
926662	*AC1-147 E*	*2.32*
926741	*AC1-159 C*	*238.44*
926751	*AC1-161 C OP*	*50.07*
926752	*AC1-161 E OP*	*21.37*

926761	*AC1-162 C*	*38.4*
926762	*AC1-162 E*	*16.39*
926771	*AC1-163 C*	*3.48*
926772	*AC1-163 E*	*1.63*
926781	*AC1-164 C OP*	*53.7*
926782	*AC1-164 E OP*	*24.12*
927021	*AC1-189 C*	*13.58*
927022	*AC1-189 E*	*6.77*
927051	*AC1-193 C*	*5.99*
927052	*AC1-193 E*	*9.78*
927111	*AC1-206 C OP*	*18.52*
927112	*AC1-206 E OP*	*8.76*
927141	*AC1-208 C*	*13.89*
927142	*AC1-208 E*	*6.17*
927211	*AC1-215 C*	*16.12*
927212	*AC1-215 E*	*7.31*
927221	*AC1-216 C OP*	*17.36*
927222	*AC1-216 E OP*	*13.65*
927251	*AC1-221 C*	*4.27*
927252	*AC1-221 E*	*2.29*

Appendix 20

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 110.51% to 132.93% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 547.55 MW to the thermal violation.

CONTINGENCY 'LN 576'
 OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00
 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315058	*1CHESTF3*	*6.24*
315059	*1CHESTF4*	*10.12*
315060	*1CHESTF5*	*21.46*
315061	*1CHESTG7*	*8.41*
315063	*1CHESTG8*	*8.34*
315062	*1CHESTS7*	*3.82*
315064	*1CHESTS8*	*4.27*
315067	*1DARBY 1*	*5.48*
315068	*1DARBY 2*	*5.49*
315069	*1DARBY 3*	*5.56*
315070	*1DARBY 4*	*5.56*
315233	*1SURRY 2*	*54.53*
315091	*1YORKTN2*	*53.74*
315092	*1YORKTN3*	*49.25*
314309	*6IRON208*	*0.82*
314236	*6NRTHEST*	*0.4*
314251	*6S PUMP*	*1.76*
315074	*CIR_AB2-152*	*15.*
315075	*CIR_AB2-152*	*14.81*
297087	*V2-040*	*0.26*
LTF	*Z2-067*	*28.78*
921092	*AA1-049 C*	*4.23*
LTF	*AA1-058*	*1.25*
921162	*AA1-063AC*	*13.65*
921182	*AA1-067 C*	*2.63*
921532	*AA1-132 C*	*13.06*
921542	*AA1-133 C*	*17.46*

921552	*AA1-134 C*	*17.04*
921562	*AA1-135 C*	*14.69*
921572	*AA1-138 C*	*16.69*
921582	*AA1-139 C*	*26.2*
921752	*AA2-053 C*	*13.81*
921772	*AA2-059 C*	*4.03*
921862	*AA2-068 C*	*3.45*
LTF	*AA2-074*	*8.45*
921982	*AA2-088 C*	*10.63*
922512	*AA2-174 C*	*0.63*
922522	*AA2-177 C*	*18.03*
922532	*AA2-178 C*	*16.11*
922602	*AB1-013 C*	*4.86*
922682	*AB1-027 C*	*4.8*
922722	*AB1-053 C*	*1.67*
922732	*AB1-054 C*	*11.22*
923262	*AB1-132 C OP*	*22.25*
923272	*AB1-135 C OP*	*4.79*
923572	*AB1-173 C OP*	*3.58*
923582	*AB1-173AC OP*	*3.58*
923801	*AB2-015 C OP*	*14.46*
923831	*AB2-022 C*	*3.99*
923841	*AB2-024 C*	*4.41*
923851	*AB2-025 C*	*4.03*
923861	*AB2-026 C*	*3.55*
923911	*AB2-031 C OP*	*3.55*
923981	*AB2-039 C OP*	*14.58*
923991	*AB2-040 C OP*	*11.65*
924071	*AB2-051 C OP*	*241.58*
924241	*AB2-068 OP*	*416.9*
LTF	*AB2-075*	*4.54*
LTF	*AB2-076*	*5.35*
924381	*AB2-087 C*	*0.92*
924491	*AB2-098 C*	*0.88*
924501	*AB2-099 C*	*0.95*
924511	*AB2-100 C*	*18.21*
924761	*AB2-128 C*	*15.6*
924811	*AB2-134 C OP*	*23.11*
924931	*AB2-147 C*	*4.05*
924941	*AB2-149 C OP*	*5.88*
924951	*AB2-150 C OP*	*4.05*
924961	*AB2-152*	*4.86*
925051	*AB2-160 C OP*	*9.6*
925061	*AB2-161 C OP*	*5.89*
925121	*AB2-169 C OP*	*10.48*

925141	*AB2-171 C OP*	*8.15*
925171	*AB2-174 C OP*	*11.17*
925281	*AB2-186 C*	*1.03*
925291	*AB2-188 C OP*	*3.97*
925331	*AB2-190 C*	*41.2*
925361	*AC1-007 C OP*	*1.2*
925521	*AC1-027 C*	*3.52*
925691	*AC1-045 C*	*3.04*
925701	*AC1-046 C*	*3.05*
925711	*AC1-047 C*	*4.04*
925811	*AC1-060*	*4.44*
925821	*AC1-061*	*0.06*
925841	*AC1-063*	*0.68*
925861	*AC1-065 C*	*5.83*
926071	*AC1-086 C*	*32.77*
926201	*AC1-098 C*	*9.6*
926211	*AC1-099 C*	*3.22*
926291	*AC1-107 OP*	*547.55*
926411	*AC1-112 C*	*3.74*
926661	*AC1-147 C*	*3.98*
926741	*AC1-159 C*	*239.72*
926751	*AC1-161 C OP*	*53.66*
926771	*AC1-163 C*	*3.44*
926781	*AC1-164 C OP*	*75.56*
927041	*AC1-191 C*	*16.46*
927051	*AC1-193 C*	*5.97*
927221	*AC1-216 C OP*	*19.85*