

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-012***

***Grassfield – Great Bridge 115kV
57 MW Capacity / 150 MW Energy***

September / 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 solar generating facility located in Chesapeake, Virginia (City of Chesapeake). The installed facilities will have a total capability of 150 MW with 57 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC2-012 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new three breaker ring bus switching station that connects on the Grassfield – Great Bridge 115kV line #74.

Option 2 will connect via a new three breaker ring bus switching station that connects at the Great Bridge – Hickory 115kV line #16.

Cost Summary

The AC2-012 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$1,550,000
Direct Connection Network Upgrades	\$5,500,000
Non Direct Connection Network Upgrades	\$ 800,000
Total Costs	\$7,850,000

In addition, the AC2-012 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$ 42,060,000
Previously Identified Upgrades	\$258,140,000
Total Costs	\$300,200,000

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

Option One

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$550,000.

Transmission: Construct approximately one span of 115 kV Attachment line between the generation substation and a new AC2-012 Switching Station. The estimated cost for this work is \$1,000,000.

The estimated total cost of the Attachment Facilities is \$1,550,000. It is estimated to take 18-24 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase. These costs do not include CIAC Tax Gross-up.

Direct Connection Cost Estimate

Substation: Establish the new 115 kV AC2-012 Switching Substation (interconnection substation). The estimated cost of this work scope is \$5,500,000. It is estimated to take 24-36 months to complete this work.

Non-Direct Connection Cost Estimate

Outage scheduling and coordination will impact the actual completion dates for the various identified network upgrades.

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. Estimated cost is \$800,000 dollars and is estimated to take 24-30 months to complete.

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 #	Upgrade Description	Upgrade Cost
# 4	Wreck and rebuild the North Anna – Spotsylvania 500kV line of 17 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer, permit and construct (VA CPCN is required).	\$42,060,000
# 5	Wreck and rebuild the Skiffs Creek – King Mill 230kV line of 19 miles to a rating of 1047 MVA. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	\$28,200,000
# 6	Replace existing Elmont 500/230kV transformer with a larger unit. It is estimated to 24-30 months to engineer and construct.	\$17,500,000
# 7	Wreck and rebuild the Chesterfield – Bermuda 230kV line of 7 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	\$13,640,000
# 8	Wreck and rebuild the Hopewell – Bermuda 230kV line of 4 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	\$8,300,000
# 9 – 12	Wreck and rebuild the Chesapeake – Greenwich 230kV line of 11 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	\$21,200,000
# 13 – 16	Wreck and rebuild the Chesapeake – Yadkin 230kV line of 3 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	\$6,500,000
# 17 – 19	Wreck and rebuild the Chickahominy – Elmont 500kV line of 28 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer and construct.	\$84,000,000
# 20 – 22	Wreck and rebuild the Elmont – Ladysmith 500kV line of 26 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer and construct.	\$78,300,000
# 23	Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. It is estimated to 12-16 months to engineer and construct.	\$500,000
Total Network Upgrades		\$300,200,000

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.

Voltage Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for voltages and times as specified for the Eastern Interconnection in Attachment 1 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low voltage conditions, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Frequency Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for frequencies and times as specified in Attachment 2 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low frequency condition, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Reactive Power - The Generation Interconnection Customer shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals.

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.

Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

Network Impacts

The Queue Project AC2-012 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection tapping the Great Bridge – Grassfield 115 kV line in the ITO area. Project AC2-012 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-012 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
211T2124	CONTINGENCY '211T2124' /*_ HOPEWELL OPEN BRANCH FROM BUS 314303 TO BUS 314287 CKT 1 /*L211 HOPEWELL CHESTERFIELD OPEN BRANCH FROM BUS 314303 TO BUS 314269 CKT 1 /*L2124 END
262T2038	CONTINGENCY '262T2038' /* 262T2038 @ GREENWICH OPEN BRANCH FROM BUS 314449 TO BUS 314474 CKT 1 /* CHESAPEAKE - GREENWICH OPEN BRANCH FROM BUS 314474 TO BUS 314494 CKT 1 /* GREENWICH - REEVES AVE 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

Contingency Name	Description
CHESA H3TGRE	CONTINGENCY 'CHESA H3TGRE' /* H3TGREENWICH @ CHESAPEAKE OPEN BRANCH FROM BUS 314448 TO BUS 314449 CKT 1 /* CHESAPEAKE 230-115 TX#3 OPEN BRANCH FROM BUS 314449 TO BUS 314474 CKT 1 /* CHESAPEAKE - GREENWICH END
CHESA H3TYAD	CONTINGENCY 'CHESA H3TYAD' /* H3TYADKIN @ CHESAPEAKE OPEN BRANCH FROM BUS 314448 TO BUS 314449 CKT 1 /* CHESAPEAKE 230-115 TX#3 OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* CHESAPEAKE - YADKIN END
CHESA H4TGRE	CONTINGENCY 'CHESA H4TGRE' /* H4TGREENWICH @ CHESAPEAKE OPEN BRANCH FROM BUS 314448 TO BUS 314449 CKT 2 /* CHESAPEAKE 230-115 TX#4 OPEN BRANCH FROM BUS 314449 TO BUS 314474 CKT 1 /* CHESAPEAKE - GREENWICH END
CHESA H4TYAD	CONTINGENCY 'CHESA H4TYAD' /* H4TYADKIN @ CHESAPEAKE OPEN BRANCH FROM BUS 314448 TO BUS 314449 CKT 2 /* CHESAPEAKE 230-115 TX#4 OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* CHESAPEAKE - YADKIN 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
LN 228	CONTINGENCY 'LN 228' OPEN BRANCH FROM BUS 314278 TO BUS 314286 CKT 1 /* 6BERMUDA 230.00 - 6CHSTF A 230.00 OPEN BRANCH FROM BUS 314278 TO BUS 314303 CKT 1 /* 6BERMUDA 230.00 - 6HOPEWLL 230.00 OPEN BUS 314278 /* ISLAND END
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END

Contingency Name	Description
LN 262	CONTINGENCY 'LN 262-2018' OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* 6CHESAPK 230.00 - 6YADKIN 230.00 OPEN BRANCH FROM BUS 314464 TO BUS 314465 CKT 1 /* 6DOZIER 230.00 - 6ELIZ R 230.00 OPEN BRANCH FROM BUS 314464 TO BUS 314474 CKT 1 /* 6DOZIER 230.00 - 6GRENWCH 230.00 OPEN BUS 314464 /* ISLAND END
LN 262-2018	CONTINGENCY 'LN 262-2018' OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* 6CHESAPK 230.00 - 6YADKIN 230.00 OPEN BRANCH FROM BUS 314464 TO BUS 314465 CKT 1 /* 6DOZIER 230.00 - 6ELIZ R 230.00 OPEN BRANCH FROM BUS 314464 TO BUS 314474 CKT 1 /* 6DOZIER 230.00 - 6GRENWCH 230.00 OPEN BUS 314464 /* ISLAND END
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 - 8SURREY 500.00 END
LN 568	CONTINGENCY 'LN 568' OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1 /* 8LDYSMTH 500.00 - 8POSSUM 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

Contingency Name	Description
LN 594	CONTINGENCY 'LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END
LN 9036	CONTINGENCY 'LN 9036' OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* 6CHESAPK 230.00 - 6YADKIN 230.00 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

System Reinforcement responsible by ITO

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
1	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	137.9	138.73	LD	459	7.73	11
2	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	149.71	150.47	LD	459	7.73	12
3	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	149.84	150.6	LD	459	7.73	13

Item 1 – 3 **PJM baseline project (b2745)** will eliminate the identified overloads. The scheduled in service date b2745 is 06/01/2020.

Generator Deliverability

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

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
4	N-1	LN 568	DVP - DVP	8NO ANNA-8SPOTSYL 500 kV line	314918	314934	1	DC	99.84	100	ER	3219	10.97	1

Multiple Facility Contingency

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

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

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 Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
5	N-1	LN 567	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	104.64	105.13	ER	442	4.79	2
6	LFFB	H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	DC	116.81	117.88	LD	1051	24.95	3
7	LFFB	211T2124	DVP - DVP	6BERMUDA-6CHSTF A 230 kV line	314278	314286	1	DC	101.21	102.36	LD	549	13.99	4
8	LFFB	211T2124	DVP - DVP	6HOPEWLL-6BERMUDA 230 kV line	314303	314278	1	DC	101.21	102.36	LD	549	13.99	5
9	N-1	LN 9036	DVP - DVP	6CHESAPK-6GRENWCH 230 kV line	314449	314474	1	DC	153.76	156.19	ER	599	14.58	6
10	LFFB	CHESA H3TYAD	DVP - DVP	6CHESAPK-6GRENWCH 230 kV line	314449	314474	1	DC	145.9	147.37	LD	812	26.56	
11	LFFB	CHESA H4TYAD	DVP - DVP	6CHESAPK-6GRENWCH 230 kV line	314449	314474	1	DC	141.67	143.25	LD	812	28.62	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
12	DCTL	LN 262-2018	DVP - DVP	6CHESAPK-6GRENWCH 230 kV line	314449	314474	1	DC	122.39	124.4	LD	812	36.18	
13	N-1	LN 262	DVP - DVP	6CHESAPK-6YADKIN 230 kV line	314449	314514	1	DC	113.84	116	ER	984	21.26	7
14	LFFB	CHESA H3TGRE	DVP - DVP	6CHESAPK-6YADKIN 230 kV line	314449	314514	1	DC	113.74	115.05	LD	1204	34.91	
15	LFFB	CHESA H4TGRE	DVP - DVP	6CHESAPK-6YADKIN 230 kV line	314449	314514	1	DC	111.67	113.1	LD	1204	38.26	
16	LFFB	262T2038	DVP - DVP	6CHESAPK-6YADKIN 230 kV line	314449	314514	1	DC	101.04	103.15	LD	1204	56.27	
17	LFFB	57602	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.72	120.42	LD	3144	49.22	8
18	LFFB	WT576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.72	120.42	LD	3144	49.22	
19	LFFB	563T576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.71	120.42	LD	3144	49.22	
20	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.93	130.56	LD	3351	47.33	9
21	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.93	130.56	LD	3351	47.32	
22	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.85	130.49	LD	3351	47.34	
23	LFFB	557T574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	127.69	128.36	LD	3144	47.04	10

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
# 4	8NO ANNA-8SPOTSYL 500 kV line	Wreck and rebuild the line of 17 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer, permit and construct (VA CPCN is required).	Pending	\$42,060,000
Total New Network Upgrades				\$42,060,000

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
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Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 5	6SKIFF CREEK-6KINGS M 230 kV line	Wreck and rebuild the line of 19 miles to a rating of 1047 MVA. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	Pending	\$28,200,000
# 6	8ELMONT 500/230 kV transformer	Replace existing transformer with a larger unit. It is estimated to 24-30 months to engineer and construct.	Pending	\$17,500,000
# 7	6BERMUDA-6CHSTF A 230 kV line	Wreck and rebuild the line of 7 miles for a higher capacity since the overload exceeds the conductor rating. Estimated cost \$13,640,000 dollars and it is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	Pending	\$13,640,000
# 8	6HOPEWLL-6BERMUDA 230 kV line	Wreck and rebuild the line of 4 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	Pending	\$8,300,000
# 9 – 12	6CHESAPK-6GRENWCH 230 kV line	Wreck and rebuild the line of 11 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	Pending	\$21,200,000
# 13 – 16	6CHESAPK-6YADKIN 230 kV line	Wreck and rebuild the line of 3 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.	Pending	\$6,500,000
# 17 – 19	8CHCKAHM-8ELMONT 500 kV line	Wreck and rebuild the line of 28 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer and construct.	Pending	\$84,000,000
# 20 – 22	8ELMONT-8LDYSMTH 500 kV line	Wreck and rebuild the line of 26 miles for a higher capacity since the overload exceeds the conductor rating. It is estimated to 36-48 months to engineer and construct.	Pending	\$78,300,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 23	8MDLTHAN-8NO ANNA 500 kV line	Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. It is estimated to 12-16 months to engineer and construct.	Pending	\$500,000
Total New Network Upgrades				\$258,140,000

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.

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
24	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	153.08	154.21	ER	442	11.08
25	N-1	LN 563	DVP - DVP	6BERMUDA-6CHSTF A 230 kV line	314278	314286	1	DC	113.93	114.99	ER	449	10.6
26	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	164.92	165.88	ER	449	9.57
27	N-1	LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	DC	140.77	141.9	ER	442	11.08
28	N-1	LN 563	DVP - DVP	6HOPEWLL-6BERMUDA 230 kV line	314303	314278	1	DC	113.93	114.99	ER	449	10.6

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
29	N-1	LN 228	DVP - DVP	6HOPEWLL-6CHSTF B 230 kV line	314303	314287	1	DC	113.14	114.43	ER	449	12.85
30	N-1	LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	DC	144.64	145.77	ER	442	11.08
31	N-1	LN 557	DVP - DVP	6WALR209-6LIGH209 230 kV line	314415	314391	1	DC	124.99	126.12	ER	442	11.08
32	N-1	LN 9036	DVP - DVP	6CHESAPK-6GRENWCH 230 kV line	314449	314474	1	DC	164.79	167.68	ER	599	38.37
33	N-1	LN 262	DVP - DVP	6CHESAPK-6YADKIN 230 kV line	314449	314514	1	DC	123.2	125.76	ER	984	55.94
34	N-1	LN 557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	144.07	144.87	ER	2442	43.23
35	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	154.1	155.01	ER	2442	49.22
36	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	140.97	141.49	ER	2442	28.19
37	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	178.16	179.03	ER	2442	47.34
38	N-1	LN 573	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	127.15	127.62	ER	2738	28.63
39	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	124.53	124.98	ER	2442	24.63
40	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	148.09	148.88	ER	2442	42.41

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
41	N-1	LN 576	DVP - DVP	8SURREY-8CHCKAHM 500 kV line	314924	314903	1	DC	110.23	111.34	ER	1809	44.66
42	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	153.08	154.21	ER	442	11.08
43	N-1	LN 563	DVP - DVP	6BERMUDA-6CHSTF A 230 kV line	314278	314286	1	DC	113.93	114.99	ER	449	10.6

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 #AC2-012 interconnection of a 150 MW Energy (57 MW Capacity) injection into the ITO's Transmission System at a new interconnection switching station located between the Grassfield – Great Bridge 115kV line #74, 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 or Possum Point 6 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

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$550,000.

Transmission: Construct approximately one span of 115 kV Attachment line between the generation substation and a new AC2-012 Switching Station. The estimated cost for this work is \$1,000,000.

The estimated total cost of the Attachment Facilities is \$1,550,000. It is estimated to take 18-24 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase. These costs do not include CIAC Tax Gross-up.

Direct Connection Cost Estimate

Substation: Establish the new 115 kV AC2-012 Switching Substation (interconnection substation). The estimated cost of this work scope is \$5,500,000. It is estimated to take 24-36 months to complete this work.

Non-Direct Connection Cost Estimate

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. Estimated cost is \$800,000 dollars and is estimated to take 24-30 months to complete.

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.

Network Impacts

The Queue Project AC2-012 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection tapping the Great Bridge – Hickory 115 kV line in the ITO area. Project AC2-012 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-012 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
LN 16_A	CONTINGENCY 'LN 16_A' OPEN BRANCH FROM BUS 314468 TO BUS 931040 CKT 1 /* 3GREATBR 115.00 - AC2-012 TAP 115.00 OPEN BUS 314468 /* ISLAND END
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

Contingency Name	Description
LN 567	CONTINGENCY 'LN 567' OPEN BRANCH FROM BUS 314903 TO BUS 314924 CKT 1 /* 8CHCKAHM 500.00 - 8SURRY 500.00 END
LN 568	CONTINGENCY 'LN 568' OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1 /* 8LDYSMTH 500.00 - 8POSSUM 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 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		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
1	N-1	LN 568	DVP - DVP	8NO ANNA-8SPOTSYL 500 kV line	314918	314934	1	DC	99.84	100	ER	3219	10.93	14

Multiple Facility Contingency

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

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

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	Facility Description	Bus	Cir.	Power	Loading %	Rating	MW	Ref
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	Type	Name	Area		From	To		Flow	Initial	Final	Type	MVA	Contribution	
2	N-1	LN 567	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	104.64	105.13	ER	442	4.78	15
3	LFFB	H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	DC	116.81	117.86	LD	1051	24.45	16
4	LFFB	557T574	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	122.2	123.67	LD	3144	46.22	17
5	LFFB	H2T557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	113.44	114.87	LD	3144	44.75	
6	LFFB	WT576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.72	120.42	LD	3144	49.09	18
7	LFFB	563T576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.71	120.42	LD	3144	49.09	
8	LFFB	57602	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	119.71	120.42	LD	3144	49.09	
9	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.93	130.56	LD	3351	47	19
10	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.93	130.56	LD	3351	47	
11	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	129.85	130.49	LD	3351	47.02	
12	LFFB	557T574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	127.69	128.36	LD	3144	47.02	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.

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA	
13	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	153.08	154.21	ER	442	11.09
14	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	164.92	165.86	ER	449	9.38
15	N-1	LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	DC	140.77	141.9	ER	442	11.09
16	N-1	LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	DC	144.64	145.77	ER	442	11.09
17	N-1	LN 557	DVP - DVP	6WALR209-6LIGH209 230 kV line	314415	314391	1	DC	124.99	126.12	ER	442	11.09
18	Non	Non	DVP - DVP	6HICKORY 230/115 kV transformer	314476	314550	1	DC	0	113.41	NR	132	150

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
19	N-1	LN 16_A	DVP - DVP	6HICKORY 230/115 kV transformer	314476	314550	1	DC	0	107.53	ER	139	150
20	N-1	LN 557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	144.07	145.86	ER	2442	43.67
21	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	154.1	155.01	ER	2442	49.09
22	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	DC	140.97	141.48	ER	2442	28.02
23	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	178.16	179.03	ER	2442	47.02
24	N-1	LN 573	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	127.15	127.62	ER	2738	28.45
25	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	DC	124.53	124.98	ER	2442	24.5
26	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	148.09	148.87	ER	2442	42.37
27	N-1	LN 576	DVP - DVP	8SURRY-8CHCKAHM 500 kV line	314924	314903	1	DC	110.23	112.72	ER	1809	45.03
28	Non	Non	DVP - DVP	AC2-012 TAP-3HICKORY 115 kV line	931040	314476	1	DC	0	135.23	NR	111	150
29	N-1	LN 16_A	DVP - DVP	AC2-012 TAP-3HICKORY 115 kV line	931040	314476	1	DC	0	135.23	ER	111	150

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 #AC2-012 interconnection of a 150 MW Energy (57 MW Capacity) injection into the ITO's Transmission System at a new interconnection switching station located between the Great Bridge – Hickory 115kV section of Line # 16, 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).

Attachment 1.

Attachment 2.

Flowgate Appendices

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. 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 8NO ANNA-8SPOTSYL 500 kV line (from bus 314918 to bus 314934 ckt 1) loads from 99.84% to 100.0% (**DC power flow**) of its emergency rating (3219 MVA) for the single line contingency outage of 'LN 568'. This project contributes approximately 10.97 MW to the thermal violation.

CONTINGENCY 'LN 568'

OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1

/* 8LDYSMTH

500.00 - 8POSSUM 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315053	1BELMED1	3.21
315054	1BELMED2	3.21
315055	1BELMED3	2.67
315108	1ELIZAR1	3.71
315109	1ELIZAR2	3.64
315110	1ELIZAR3	3.75
315074	1HOPCGN1	8.79
315075	1HOPCGN2	8.67
315225	1N ANNA1	64.88
315226	1N ANNA2	63.88
315134	1ROAVALA	27.81
315135	1ROAVALB	7.42
315083	1SPRUNCA	11.38
315084	1SPRUNCB	11.38
315085	1SPRUNCC	8.44
315086	1SPRUNCD	8.44
315090	1YORKTN1	30.06
315091	1YORKTN2	31.19
314251	6S PUMP	1.01
931041	AC2-012 C OP	10.97
931501	AC2-070 C	1.69
931531	AC2-073 C	2.38
931581	AC2-078 C OP	4.35
931591	AC2-079 C OP	7.21
931631	AC2-084 C	8.65
931701	AC2-093 C	76.92
931711	AC2-094 C	15.68

931831	AC2-110 C	1.36
916301	Z1-086 C	55.4
LTF	Z2-067	18.05
921092	AA1-049 C	2.59
LTF	AA1-058	0.8
921162	AA1-063AC	8.61
921182	AA1-067 C	1.66
921292	AA1-083	3.49
921532	AA1-132 C	8.
921562	AA1-135 C	9.21
921572	AA1-138 C	10.29
921582	AA1-139 C	16.04
921622	AA1-145	59.32
921752	AA2-053 C	8.74
921762	AA2-057 C	6.88
921772	AA2-059 C	1.23
921862	AA2-068 C	2.18
LTF	AA2-074	5.36
921982	AA2-088 C	6.65
922442	AA2-165 C	0.94
922472	AA2-169 C	2.14
922512	AA2-174 C	0.4
922522	AA2-177 C	10.65
922532	AA2-178 C	9.98
922602	AB1-013 C	3.01
922682	AB1-027 C	2.57
923262	AB1-132 C OP	14.13
923272	AB1-135 C OP	2.59
923572	AB1-173 C OP	2.28
923582	AB1-173AC OP	2.28
923801	AB2-015 C OP	8.98
923831	AB2-022 C	2.45
923841	AB2-024 C	2.49
923851	AB2-025 C	2.59
923861	AB2-026 C	2.52
923911	AB2-031 C OP	2.26
923981	AB2-039 C OP	8.94
923991	AB2-040 C OP	7.44
924061	AB2-050	3.49

924071	AB2-051 C OP	147.44
924241	AB2-068 OP	195.53
924381	AB2-087 C	0.58
924491	AB2-098 C	0.55
924501	AB2-099 C	0.6
924511	AB2-100 C	11.6
924761	AB2-128 C	9.94
924811	AB2-134 C OP	13.66
924931	AB2-147 C	2.6
924941	AB2-149 C OP	3.6
924951	AB2-150 C OP	2.6
925051	AB2-160 C OP	5.8
925061	AB2-161 C OP	3.61
925121	AB2-169 C OP	6.54
925141	AB2-171 C OP	5.07
925171	AB2-174 C OP	7.14
925281	AB2-186 C	0.65
925291	AB2-188 C OP	2.46
925331	AB2-190 C	24.34
925521	AC1-027 C	2.15
925691	AC1-045 C	1.85
925701	AC1-046 C	1.86
925711	AC1-047 C	2.47
925781	AC1-054 C OP	6.85
925811	AC1-060	0.07
925821	AC1-061	0.04
925841	AC1-063	0.39
925861	AC1-065 C	3.39
926071	AC1-086 C	20.8
926201	AC1-098 C	6.07
926211	AC1-099 C	2.03
926291	AC1-107 OP	295.14
926411	AC1-112 C	2.
926441	AC1-115 C	0.92
926551	AC1-134	8.72
926591	AC1-142 C	9.16
926661	AC1-147 C	2.43
926741	AC1-159 C	146.3
926751	AC1-161 C OP	32.78

926771	<i>AC1-163 C</i>	2.15
926781	<i>AC1-164 C OP</i>	40.73
927021	<i>AC1-189 C</i>	8.36
927041	<i>AC1-191 C</i>	9.76
927051	<i>AC1-193 C</i>	3.72
927141	<i>AC1-208 C</i>	8.76
927221	<i>AC1-216 C OP</i>	10.42

Appendix 2

(DVP - DVP) The 6SKIFF CREEK-6KINGS M 230 kV line (from bus 314209 to bus 314386 ckt 1) loads from 104.64% to 105.13% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 567'. This project contributes approximately 4.79 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315099	1CHESPKB	0.55
315108	1ELIZAR1	1.62
315109	1ELIZAR2	1.59
315110	1ELIZAR3	1.64
315233	1SURRY 2	16.37
315090	1YORKTN1	25.29
315091	1YORKTN2	26.24
315092	1YORKTN3	22.24
314421	6WINCHST	0.12
931041	AC2-012 C OP	4.79
931591	AC2-079 C OP	2.41
916191	Z1-068 C	0.02
921092	AA1-049 C	1.12
921532	AA1-132 C	3.46
921562	AA1-135 C	3.01
921572	AA1-138 C	4.18
921582	AA1-139 C	6.96
921772	AA2-059 C	0.49
921982	AA2-088 C	2.21
922532	AA2-178 C	3.82
922602	AB1-013 C	1.15
923801	AB2-015 C OP	3.2
923831	AB2-022 C	1.04
924071	AB2-051 C OP	64.45
924381	AB2-087 C	0.19
924501	AB2-099 C	0.2
924941	AB2-149 C OP	1.19

925121	AB2-169 C OP	2.26
925141	AB2-171 C OP	1.76
925281	AB2-186 C	0.27
925291	AB2-188 C OP	0.94
925521	AC1-027 C	0.94
925691	AC1-045 C	0.85
925701	AC1-046 C	0.82
925711	AC1-047 C	1.08
926661	AC1-147 C	1.06
926741	AC1-159 C	63.95
926751	AC1-161 C OP	15.75
926771	AC1-163 C	0.71
927051	AC1-193 C	1.29

Appendix 3

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 116.81% to 117.88% (**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 24.95 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315067	1DARBY 1	4.47
315068	1DARBY 2	4.48
315069	1DARBY 3	4.53
315070	1DARBY 4	4.53
315043	1FRIVERA	6.02
315044	1FRIVERB	4.66
315045	1FRIVERC	6.02
315046	1FRIVERD	4.66
315047	1FRIVERE	4.66
315048	1FRIVERF	6.02
315074	1HOPCGN1	11.03
315075	1HOPCGN2	10.89
315134	1ROAVALA	22.59
315135	1ROAVALB	6.02
315083	1SPRUNCA	14.8
315084	1SPRUNCB	14.8
315085	1SPRUNCC	10.97
315086	1SPRUNCD	10.97
315073	1STONECA	9.15
314784	1WEYRHSB	1.72
315090	1YORKTN1	30.63
315091	1YORKTN2	31.78
314539	3UNCAMP	2.15

314541	3WATKINS	0.6
314229	6MT R221	1.42
314236	6NRTHEST	0.33
314189	6PAPERMILL	8.8
314251	6S PUMP	1.62
931041	AC2-012 C OP	9.48
931042	AC2-012 E OP	15.47
931501	AC2-070 C	2.92
931502	AC2-070 E	1.21
931531	AC2-073 C	3.09
931532	AC2-073 E	1.56
931581	AC2-078 C OP	4.63
931582	AC2-078 E OP	7.55
931591	AC2-079 C OP	6.69
931592	AC2-079 E OP	10.91
931831	AC2-110 C	1.74
931832	AC2-110 E	2.84
292791	U1-032 E	4.77
297087	V2-040	0.25
900672	V4-068 E	0.25
901082	W1-029 E	41.27
907092	X1-038 E	5.37
913392	Y1-086 E	1.97
916042	Z1-036 E	40.07
916192	Z1-068 E	1.73
917122	Z2-027 E	0.95
917332	Z2-043 E	0.8
917592	Z2-099 E	0.37
921092	AA1-049 C	2.2
921093	AA1-049 E	1.03
921162	AA1-063AC	6.95
921163	AA1-063AE	3.28
918512	AA1-065 E OP	3.66
918562	AA1-072 E	0.13
921292	AA1-083	6.01
921532	AA1-132 C	6.79
921533	AA1-132 E	2.91
921572	AA1-138 C	8.68
921573	AA1-138 E	3.72

921582	AA1-139 C	13.62
921583	AA1-139 E	5.84
921622	AA1-145	102.15
921752	AA2-053 C	6.97
921753	AA2-053 E	2.99
921772	AA2-059 C	1.03
921773	AA2-059 E	0.48
920022	AA2-086 E	0.2
921982	AA2-088 C	5.5
921983	AA2-088 E	8.97
922512	AA2-174 C	0.32
922513	AA2-174 E	0.35
922522	AA2-177 C	12.13
922523	AA2-177 E	5.2
922532	AA2-178 C	8.22
922533	AA2-178 E	3.52
922602	AB1-013 C	2.48
922603	AB1-013 E	16.61
922672	AB1-026 C	2.22
922673	AB1-026 E	0.95
922682	AB1-027 C	4.45
922683	AB1-027 E	1.91
923262	AB1-132 C OP	11.49
923263	AB1-132 E OP	4.93
923272	AB1-135 C OP	3.7
923273	AB1-135 E OP	1.59
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	7.59
923802	AB2-015 E OP	6.22
923831	AB2-022 C	2.07
923832	AB2-022 E	1.12
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	1.95

923862	AB2-026 E	0.88
923911	AB2-031 C OP	1.84
923912	AB2-031 E OP	0.91
923981	AB2-039 C OP	8.78
923982	AB2-039 E OP	7.1
923991	AB2-040 C OP	6.04
923992	AB2-040 E OP	4.94
924061	AB2-050	6.01
924071	AB2-051 C OP	127.
924072	AB2-051 E OP	17.44
924241	AB2-068 OP	175.81
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	9.75
924512	AB2-100 E	4.8
924761	AB2-128 C	8.36
924762	AB2-128 E	3.29
924811	AB2-134 C OP	15.56
924812	AB2-134 E OP	20.8
924931	AB2-147 C	2.14
924932	AB2-147 E	3.48
924941	AB2-149 C OP	3.35
924942	AB2-149 E OP	5.47
924951	AB2-150 C OP	2.14
924952	AB2-150 E OP	3.48
925051	AB2-160 C OP	7.01
925052	AB2-160 E OP	11.43
925061	AB2-161 C OP	3.55
925062	AB2-161 E OP	5.79
925121	AB2-169 C OP	5.19
925122	AB2-169 E OP	4.66
925141	AB2-171 C OP	4.25
925142	AB2-171 E OP	6.94
925171	AB2-174 C OP	5.83
925172	AB2-174 E OP	5.27
925281	AB2-186 C	0.54
925282	AB2-186 E	0.23

925291	AB2-188 C OP	2.03
925292	AB2-188 E OP	0.91
925331	AB2-190 C	27.74
925332	AB2-190 E	6.93
925521	AC1-027 C	1.85
925522	AC1-027 E	1.06
925691	AC1-045 C	1.65
925692	AC1-045 E	0.9
925701	AC1-046 C	1.59
925702	AC1-046 E	0.87
925711	AC1-047 C	2.1
925712	AC1-047 E	1.16
925811	AC1-060	0.1
925821	AC1-061	0.05
925841	AC1-063	0.5
925861	AC1-065 C	4.35
925862	AC1-065 E	7.09
926071	AC1-086 C	16.92
926072	AC1-086 E	7.7
926291	AC1-107 OP	265.38
926411	AC1-112 C	3.46
926412	AC1-112 E	1.94
926441	AC1-115 C	1.03
926442	AC1-115 E	1.67
926471	AC1-118 C	2.1
926472	AC1-118 E	1.08
926551	AC1-134	15.02
926591	AC1-142 C	11.38
926592	AC1-142 E	8.59
926661	AC1-147 C	2.1
926662	AC1-147 E	1.23
926741	AC1-159 C	126.03
926751	AC1-161 C OP	26.81
926752	AC1-161 E OP	11.44
926771	AC1-163 C	1.74
926772	AC1-163 E	0.82
926781	AC1-164 C OP	36.62
926782	AC1-164 E OP	16.45
927041	AC1-191 C	19.88

927042	<i>AC1-191 E</i>	9.9
927051	<i>AC1-193 C</i>	3.12
927052	<i>AC1-193 E</i>	5.09
927111	<i>AC1-206 C OP</i>	10.48
927112	<i>AC1-206 E OP</i>	4.96
927221	<i>AC1-216 C OP</i>	11.87
927222	<i>AC1-216 E OP</i>	9.34

Appendix 4

(DVP - DVP) The 6BERMUDA-6CHSTF A 230 kV line (from bus 314278 to bus 314286 ckt 1) loads from 101.21% to 102.36% (**DC power flow**) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of '211T2124'. This project contributes approximately 13.99 MW to the thermal violation.

CONTINGENCY '211T2124' /*_ HOPEWELL
 OPEN BRANCH FROM BUS 314303 TO BUS 314287 CKT 1 /*L211
 HOPEWELL CHESTERFIELD
 OPEN BRANCH FROM BUS 314303 TO BUS 314269 CKT 1 /*L2124
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315119	1GRAVEL3	3.84
315120	1GRAVEL4	3.85
315121	1GRAVEL5	3.79
315122	1GRAVEL6	3.86
315074	1HOPCGN1	27.85
315075	1HOPCGN2	27.49
315077	1HOPHCF1	7.89
315078	1HOPHCF2	7.89
315079	1HOPHCF3	7.89
315080	1HOPHCF4	11.98
315076	1HOPPOLC	6.74
315073	1STONECA	23.1
315116	1SURRY 1	40.09
931041	AC2-012 C OP	5.32
931042	AC2-012 E OP	8.67
292791	U1-032 E	12.03
914231	Y2-077	3.17
922522	AA2-177 C	23.88
922523	AA2-177 E	10.23
924811	AB2-134 C OP	30.61
924812	AB2-134 E OP	40.93
925331	AB2-190 C	54.58
925332	AB2-190 E	13.64
925691	AC1-045 C	0.97
925692	AC1-045 E	0.53
926661	AC1-147 C	1.17

926662	<i>AC1-147 E</i>	<i>0.69</i>
927221	<i>AC1-216 C OP</i>	<i>23.37</i>
927222	<i>AC1-216 E OP</i>	<i>18.38</i>

Appendix 5

(DVP - DVP) The 6HOPEWELL-6BERMUDA 230 kV line (from bus 314303 to bus 314278 ckt 1) loads from 101.21% to 102.36% (**DC power flow**) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of '211T2124'. This project contributes approximately 13.99 MW to the thermal violation.

CONTINGENCY '211T2124' /*_ HOPEWELL
 OPEN BRANCH FROM BUS 314303 TO BUS 314287 CKT 1 /*L211
 HOPEWELL CHESTERFIELD
 OPEN BRANCH FROM BUS 314303 TO BUS 314269 CKT 1 /*L2124
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315119	1GRAVEL3	3.84
315120	1GRAVEL4	3.85
315121	1GRAVEL5	3.79
315122	1GRAVEL6	3.86
315074	1HOPCGN1	27.85
315075	1HOPCGN2	27.49
315077	1HOPHCF1	7.89
315078	1HOPHCF2	7.89
315079	1HOPHCF3	7.89
315080	1HOPHCF4	11.98
315076	1HOPPOLC	6.74
315073	1STONECA	23.1
315116	1SURRY 1	40.09
931041	AC2-012 C OP	5.32
931042	AC2-012 E OP	8.67
292791	U1-032 E	12.03
914231	Y2-077	3.17
922522	AA2-177 C	23.88
922523	AA2-177 E	10.23
924811	AB2-134 C OP	30.61
924812	AB2-134 E OP	40.93
925331	AB2-190 C	54.58
925332	AB2-190 E	13.64
925691	AC1-045 C	0.97
925692	AC1-045 E	0.53
926661	AC1-147 C	1.17

<i>926662</i>	<i>AC1-147 E</i>	<i>0.69</i>
<i>927221</i>	<i>AC1-216 C OP</i>	<i>23.37</i>
<i>927222</i>	<i>AC1-216 E OP</i>	<i>18.38</i>

Appendix 6

(DVP - DVP) The 6CHESAPK-6GRENWCH 230 kV line (from bus 314449 to bus 314474 ckt 1) loads from 153.76% to 156.19% (**DC power flow**) of its emergency rating (599 MVA) for the single line contingency outage of 'LN 9036'. This project contributes approximately 14.58 MW to the thermal violation.

CONTINGENCY 'LN 9036'

OPEN BRANCH FROM BUS 314449 TO BUS 314514 CKT 1 /* 6CHESAPK

230.00 - 6YADKIN 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315098	1CHESPKA	0.67
315099	1CHESPKB	1.68
314507	3THOMPSN	0.51
931041	AC2-012 C OP	14.58
924071	AB2-051 C OP	493.85
926661	AC1-147 C	3.22
926741	AC1-159 C	490.05

Appendix 7

(DVP - DVP) The 6CHESAPK-6YADKIN 230 kV line (from bus 314449 to bus 314514 ckt 1) loads from 113.84% to 116.0% (**DC power flow**) of its emergency rating (984 MVA) for the single line contingency outage of 'LN 262'. This project contributes approximately 21.26 MW to the thermal violation.

CONTINGENCY 'LN 262'

OPEN BRANCH FROM BUS 314449 TO BUS 314474 CKT 1 /* 6CHESAPK

230.00 - 6GRENWCH 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315098	1CHESPKA	0.98
315099	1CHESPKB	2.45
314507	3THOMPSN	0.74
931041	AC2-012 C OP	21.26
924071	AB2-051 C OP	689.43
926661	AC1-147 C	4.7
926741	AC1-159 C	684.12

Appendix 8

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 119.72% to 120.42% (**DC power flow**) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of '57602'. This project contributes approximately 49.22 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	11.87
315132	1EDGECEMB	11.87
315074	1HOPCGN1	10.81
315075	1HOPCGN2	10.67
315134	1ROAVALA	38.67
315135	1ROAVALB	10.31
315073	1STONECA	8.96
315233	1SURRY 2	57.75
314784	1WEYRHSB	3.27
315090	1YORKTN1	53.77
315091	1YORKTN2	55.8
315092	1YORKTN3	47.06
314539	3UNCAMP	3.93
314541	3WATKINS	1.09
314189	6PAPERMILL	10.97
314421	6WINCHST	0.26
931041	AC2-012 C OP	18.7
931042	AC2-012 E OP	30.52
931531	AC2-073 C	3.9
931532	AC2-073 E	1.96
931581	AC2-078 C OP	5.62
931582	AC2-078 E OP	9.16
931591	AC2-079 C OP	11.05

931592	AC2-079 E OP	18.03
931631	AC2-084 C	12.18
931632	AC2-084 E	6.
931701	AC2-093 C	105.37
931702	AC2-093 E	60.27
931831	AC2-110 C	2.15
931832	AC2-110 E	3.51
292791	U1-032 E	4.67
900672	V4-068 E	0.46
901082	W1-029 E	80.91
907092	X1-038 E	9.82
913392	Y1-086 E	3.88
916042	Z1-036 E	78.13
916192	Z1-068 E	3.45
916302	Z1-086 E	13.69
917122	Z2-027 E	1.88
917332	Z2-043 E	1.46
917342	Z2-044 E	0.76
LTF	Z2-067	22.1
917512	Z2-088 E OP1	10.89
917592	Z2-099 E	0.68
921092	AA1-049 C	4.39
921093	AA1-049 E	2.07
LTF	AA1-058	1.05
921162	AA1-063AC	12.23
921163	AA1-063AE	5.77
918512	AA1-065 E OP	6.81
921182	AA1-067 C	2.38
921183	AA1-067 E	1.02
918562	AA1-072 E	0.24
921532	AA1-132 C	13.55
921533	AA1-132 E	5.81
921562	AA1-135 C	13.57
921563	AA1-135 E	5.82
921572	AA1-138 C	16.7
921573	AA1-138 E	7.16
921582	AA1-139 C	27.26
921583	AA1-139 E	11.68
921752	AA2-053 C	12.24

921753	AA2-053 E	5.26
921762	AA2-057 C	9.49
921763	AA2-057 E	4.75
921772	AA2-059 C	2.
921773	AA2-059 E	0.94
921862	AA2-068 C	3.03
921863	AA2-068 E	1.39
LTF	AA2-074	6.7
920022	AA2-086 E	0.36
921982	AA2-088 C	9.92
921983	AA2-088 E	16.18
922442	AA2-165 C	1.29
922443	AA2-165 E	0.63
922472	AA2-169 C	2.78
922473	AA2-169 E	1.28
922512	AA2-174 C	0.56
922513	AA2-174 E	0.61
922522	AA2-177 C	14.88
922523	AA2-177 E	6.38
922532	AA2-178 C	15.83
922533	AA2-178 E	6.78
922602	AB1-013 C	4.78
922603	AB1-013 E	31.96
922922	AB1-081 C OP	11.47
922923	AB1-081 E OP	4.92
923262	AB1-132 C OP	19.35
923263	AB1-132 E OP	8.29
923272	AB1-135 C OP	4.32
923273	AB1-135 E OP	1.85
923572	AB1-173 C OP	3.05
923573	AB1-173 E OP	1.42
923582	AB1-173AC OP	3.05
923583	AB1-173AE OP	1.42
923801	AB2-015 C OP	13.82
923802	AB2-015 E OP	11.33
923831	AB2-022 C	4.11
923832	AB2-022 E	2.21
923841	AB2-024 C	4.11
923842	AB2-024 E	1.84

923851	AB2-025 C	3.27
923852	AB2-025 E	1.47
923911	AB2-031 C OP	3.02
923912	AB2-031 E OP	1.49
923941	AB2-035 C	0.45
923942	AB2-035 E	0.19
923981	AB2-039 C OP	12.83
923982	AB2-039 E OP	10.37
923991	AB2-040 C OP	9.93
923992	AB2-040 E OP	8.13
924071	AB2-051 C OP	251.77
924072	AB2-051 E OP	34.57
924151	AB2-059 C OP	13.52
924152	AB2-059 E OP	6.97
924241	AB2-068 OP	619.36
924381	AB2-087 C	0.86
924382	AB2-087 E	0.4
924391	AB2-088 C	0.57
924392	AB2-088 E	0.28
924401	AB2-089 C	2.54
924402	AB2-089 E	1.31
924491	AB2-098 C	0.79
924492	AB2-098 E	0.34
924501	AB2-099 C	0.89
924502	AB2-099 E	0.38
924511	AB2-100 C	15.5
924512	AB2-100 E	7.63
924761	AB2-128 C	13.28
924762	AB2-128 E	5.23
924811	AB2-134 C OP	19.08
924812	AB2-134 E OP	25.51
924931	AB2-147 C	3.38
924932	AB2-147 E	5.52
924941	AB2-149 C OP	5.51
924942	AB2-149 E OP	8.99
924951	AB2-150 C OP	3.38
924952	AB2-150 E OP	5.52
925051	AB2-160 C OP	6.38
925052	AB2-160 E OP	10.42

925061	AB2-161 C OP	5.19
925062	AB2-161 E OP	8.46
925121	AB2-169 C OP	9.88
925122	AB2-169 E OP	8.87
925141	AB2-171 C OP	7.72
925142	AB2-171 E OP	12.59
925171	AB2-174 C OP	9.45
925172	AB2-174 E OP	8.55
925281	AB2-186 C	1.07
925282	AB2-186 E	0.46
925291	AB2-188 C OP	3.9
925292	AB2-188 E OP	1.75
925331	AB2-190 C	34.01
925332	AB2-190 E	8.5
925521	AC1-027 C	3.67
925522	AC1-027 E	2.1
925591	AC1-034 C OP	9.07
925592	AC1-034 E OP	6.85
925691	AC1-045 C	3.08
925692	AC1-045 E	1.68
925701	AC1-046 C	3.19
925702	AC1-046 E	1.74
925711	AC1-047 C	4.22
925712	AC1-047 E	2.32
925781	AC1-054 C OP	8.74
925782	AC1-054 E OP	4.02
925811	AC1-060	0.1
925821	AC1-061	0.04
925841	AC1-063	0.62
925861	AC1-065 C	5.38
925862	AC1-065 E	8.77
926071	AC1-086 C	28.5
926072	AC1-086 E	12.97
926201	AC1-098 C	8.54
926202	AC1-098 E	5.09
926211	AC1-099 C	2.86
926212	AC1-099 E	1.68
926291	AC1-107 OP	934.88
926591	AC1-142 C	13.61

926592	<i>AC1-142 E</i>	<i>10.27</i>
926661	<i>AC1-147 C</i>	<i>4.13</i>
926662	<i>AC1-147 E</i>	<i>2.43</i>
926741	<i>AC1-159 C</i>	<i>249.83</i>
926751	<i>AC1-161 C OP</i>	<i>59.82</i>
926752	<i>AC1-161 E OP</i>	<i>25.53</i>
926771	<i>AC1-163 C</i>	<i>3.19</i>
926772	<i>AC1-163 E</i>	<i>1.5</i>
926781	<i>AC1-164 C OP</i>	<i>129.01</i>
926782	<i>AC1-164 E OP</i>	<i>57.96</i>
927021	<i>AC1-189 C</i>	<i>11.91</i>
927022	<i>AC1-189 E</i>	<i>5.93</i>
927051	<i>AC1-193 C</i>	<i>5.66</i>
927052	<i>AC1-193 E</i>	<i>9.23</i>
927111	<i>AC1-206 C OP</i>	<i>15.77</i>
927112	<i>AC1-206 E OP</i>	<i>7.46</i>
927141	<i>AC1-208 C</i>	<i>11.96</i>
927142	<i>AC1-208 E</i>	<i>5.31</i>
927221	<i>AC1-216 C OP</i>	<i>14.56</i>
927222	<i>AC1-216 E OP</i>	<i>11.45</i>

Appendix 9

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 129.93% to 130.56% (**DC power flow**) of its load dump rating (3351 MVA) for the line fault with failed breaker contingency outage of 'WT576'. This project contributes approximately 47.33 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315060	1CHESTF5	19.7
315061	1CHESTG7	7.72
315063	1CHESTG8	7.66
315062	1CHESTS7	3.51
315064	1CHESTS8	3.92
315067	1DARBY 1	5.03
315068	1DARBY 2	5.04
315069	1DARBY 3	5.1
315070	1DARBY 4	5.1
315074	1HOPCGN1	15.
315075	1HOPCGN2	14.8
315134	1ROAVALA	43.93
315135	1ROAVALB	11.71
315083	1SPRUNCA	18.63
315084	1SPRUNCB	18.63
315085	1SPRUNCC	13.81
315086	1SPRUNCD	13.81
315073	1STONECA	12.44
315233	1SURRY 2	50.06
314784	1WEYRHSB	3.43
315090	1YORKTN1	51.77
315091	1YORKTN2	53.73
314539	3UNCAMP	4.09

314541	3WATKINS	1.15
314229	6MT R221	1.36
314236	6NRTHEST	0.36
314189	6PAPERMILL	11.77
931041	AC2-012 C OP	17.98
931042	AC2-012 E OP	29.34
931501	AC2-070 C	3.15
931502	AC2-070 E	1.3
931531	AC2-073 C	4.15
931532	AC2-073 E	2.09
931581	AC2-078 C OP	7.11
931582	AC2-078 E OP	11.6
931591	AC2-079 C OP	11.75
931592	AC2-079 E OP	19.17
931631	AC2-084 C	13.69
931632	AC2-084 E	6.74
931701	AC2-093 C	112.39
931702	AC2-093 E	64.28
931831	AC2-110 C	2.33
931832	AC2-110 E	3.8
292791	U1-032 E	6.48
297087	V2-040	0.24
900672	V4-068 E	0.49
901082	W1-029 E	79.4
907092	X1-038 E	10.21
913392	Y1-086 E	3.79
916042	Z1-036 E	77.72
916192	Z1-068 E	3.3
916302	Z1-086 E	14.22
917122	Z2-027 E	1.83
917332	Z2-043 E	1.59
LTF	Z2-067	28.81
917592	Z2-099 E	0.73
921092	AA1-049 C	4.23
921093	AA1-049 E	1.99
LTF	AA1-058	1.25
921162	AA1-063AC	13.65
921163	AA1-063AE	6.44
918512	AA1-065 E OP	7.24

921182	AA1-067 C	2.63
921183	AA1-067 E	1.13
918562	AA1-072 E	0.27
921532	AA1-132 C	13.06
921533	AA1-132 E	5.6
921562	AA1-135 C	14.69
921563	AA1-135 E	6.3
921572	AA1-138 C	16.7
921573	AA1-138 E	7.16
921582	AA1-139 C	26.19
921583	AA1-139 E	11.23
921752	AA2-053 C	13.82
921753	AA2-053 E	5.93
921772	AA2-059 C	2.
921773	AA2-059 E	0.94
921862	AA2-068 C	3.45
921863	AA2-068 E	1.59
LTF	AA2-074	8.46
920022	AA2-086 E	0.39
921982	AA2-088 C	10.64
921983	AA2-088 E	17.35
922512	AA2-174 C	0.63
922513	AA2-174 E	0.69
922522	AA2-177 C	18.02
922523	AA2-177 E	7.72
922532	AA2-178 C	16.11
922533	AA2-178 E	6.9
922602	AB1-013 C	4.86
922603	AB1-013 E	32.54
922682	AB1-027 C	4.8
922683	AB1-027 E	2.06
923262	AB1-132 C OP	22.26
923263	AB1-132 E OP	9.54
923272	AB1-135 C OP	4.79
923273	AB1-135 E OP	2.05
923572	AB1-173 C OP	3.58
923573	AB1-173 E OP	1.67
923582	AB1-173AC OP	3.58
923583	AB1-173AE OP	1.67

923642	AB1-181	3.49
923643	AB1-181 2	3.49
923644	AB1-181 3	3.49
923801	AB2-015 C OP	14.46
923802	AB2-015 E OP	11.86
923831	AB2-022 C	3.99
923832	AB2-022 E	2.15
923841	AB2-024 C	4.41
923842	AB2-024 E	1.98
923851	AB2-025 C	4.03
923852	AB2-025 E	1.81
923861	AB2-026 C	3.56
923862	AB2-026 E	1.6
923911	AB2-031 C OP	3.55
923912	AB2-031 E OP	1.75
923981	AB2-039 C OP	14.58
923982	AB2-039 E OP	11.79
923991	AB2-040 C OP	11.66
923992	AB2-040 E OP	9.54
924071	AB2-051 C OP	241.56
924072	AB2-051 E OP	33.17
924241	AB2-068 OP	416.73
924381	AB2-087 C	0.92
924382	AB2-087 E	0.43
924491	AB2-098 C	0.88
924492	AB2-098 E	0.38
924501	AB2-099 C	0.95
924502	AB2-099 E	0.41
924511	AB2-100 C	18.21
924512	AB2-100 E	8.97
924761	AB2-128 C	15.6
924762	AB2-128 E	6.14
924811	AB2-134 C OP	23.11
924812	AB2-134 E OP	30.9
924931	AB2-147 C	4.06
924932	AB2-147 E	6.62
924941	AB2-149 C OP	5.88
924942	AB2-149 E OP	9.59
924951	AB2-150 C OP	4.06

924952	AB2-150 E OP	6.62
925051	AB2-160 C OP	9.6
925052	AB2-160 E OP	15.66
925061	AB2-161 C OP	5.89
925062	AB2-161 E OP	9.62
925121	AB2-169 C OP	10.48
925122	AB2-169 E OP	9.4
925141	AB2-171 C OP	8.15
925142	AB2-171 E OP	13.29
925171	AB2-174 C OP	11.17
925172	AB2-174 E OP	10.11
925281	AB2-186 C	1.05
925282	AB2-186 E	0.45
925291	AB2-188 C OP	3.97
925292	AB2-188 E OP	1.78
925331	AB2-190 C	41.2
925332	AB2-190 E	10.3
925521	AC1-027 C	3.52
925522	AC1-027 E	2.01
925691	AC1-045 C	3.04
925692	AC1-045 E	1.66
925701	AC1-046 C	3.05
925702	AC1-046 E	1.66
925711	AC1-047 C	4.04
925712	AC1-047 E	2.22
925811	AC1-060	0.13
925821	AC1-061	0.06
925841	AC1-063	0.67
925861	AC1-065 C	5.83
925862	AC1-065 E	9.51
926071	AC1-086 C	32.78
926072	AC1-086 E	14.92
926201	AC1-098 C	9.6
926202	AC1-098 E	5.72
926211	AC1-099 C	3.22
926212	AC1-099 E	1.89
926291	AC1-107 OP	629.02
926411	AC1-112 C	3.73
926412	AC1-112 E	2.09

926661	AC1-147 C	3.98
926662	AC1-147 E	2.33
926741	AC1-159 C	239.7
926751	AC1-161 C OP	54.02
926752	AC1-161 E OP	23.06
926771	AC1-163 C	3.44
926772	AC1-163 E	1.61
926781	AC1-164 C OP	86.81
926782	AC1-164 E OP	39.
927021	AC1-189 C	13.26
927022	AC1-189 E	6.61
927041	AC1-191 C	18.32
927042	AC1-191 E	9.12
927051	AC1-193 C	5.98
927052	AC1-193 E	9.75
927111	AC1-206 C OP	18.92
927112	AC1-206 E OP	8.94
927141	AC1-208 C	13.8
927142	AC1-208 E	6.13
927221	AC1-216 C OP	17.64
927222	AC1-216 E OP	13.87

Appendix 10

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 127.69% to 128.36% (**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 47.04 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
  
```

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315102	1BRUNSWICKG1	15.56
315103	1BRUNSWICKG2	15.56
315104	1BRUNSWICKG3	15.56
315105	1BRUNSWICKS1	32.32
315131	1EDGECEMA	14.18
315132	1EDGECEMB	14.18
315108	1ELIZAR1	6.05
315109	1ELIZAR2	5.94
315110	1ELIZAR3	6.12
315074	1HOPCGN1	12.47
315075	1HOPCGN2	12.31
315134	1ROAVALA	44.73
315135	1ROAVALB	11.93
315083	1SPRUNCA	15.82
315084	1SPRUNCB	15.82
315085	1SPRUNCC	11.73
315086	1SPRUNCD	11.73
315073	1STONECA	10.35
315233	1SURRY 2	47.93
314784	1WEYRHSB	3.47
315090	1YORKTN1	46.42
315091	1YORKTN2	48.17
314539	3UNCAMP	4.09

314541	3WATKINS	1.15
314189	6PAPERMILL	8.91
931041	AC2-012 C OP	17.88
931042	AC2-012 E OP	29.16
931531	AC2-073 C	3.18
931532	AC2-073 E	1.6
931581	AC2-078 C OP	6.6
931582	AC2-078 E OP	10.77
931591	AC2-079 C OP	11.44
931592	AC2-079 E OP	18.67
931631	AC2-084 C	13.99
931632	AC2-084 E	6.89
931701	AC2-093 C	130.65
931702	AC2-093 E	74.73
931761	AC2-100 C	7.55
931762	AC2-100 E	3.68
931831	AC2-110 C	1.81
931832	AC2-110 E	2.95
292791	U1-032 E	5.39
900672	V4-068 E	0.49
901082	W1-029 E	79.47
907092	X1-038 E	10.21
913392	Y1-086 E	3.8
916042	Z1-036 E	78.01
916192	Z1-068 E	3.29
916301	Z1-086 C	94.64
916302	Z1-086 E	16.83
917122	Z2-027 E	1.84
917332	Z2-043 E	1.62
917342	Z2-044 E	0.89
LTF	Z2-067	29.66
917512	Z2-088 E OP1	12.53
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	13.86
921163	AA1-063AE	6.53
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
921562	AA1-135 C	14.96
921563	AA1-135 E	6.41
921572	AA1-138 C	16.72
921573	AA1-138 E	7.17
921582	AA1-139 C	26.21
921583	AA1-139 E	11.23
921752	AA2-053 C	14.07
921753	AA2-053 E	6.04
921762	AA2-057 C	11.14
921763	AA2-057 E	5.57
921772	AA2-059 C	2.01
921773	AA2-059 E	0.95
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	17.48
922442	AA2-165 C	1.52
922443	AA2-165 E	0.73
922472	AA2-169 C	3.43
922473	AA2-169 E	1.58
922512	AA2-174 C	0.64
922513	AA2-174 E	0.7
922522	AA2-177 C	15.78
922523	AA2-177 E	6.76
922532	AA2-178 C	16.23
922533	AA2-178 E	6.95
922602	AB1-013 C	4.9
922603	AB1-013 E	32.77
922922	AB1-081 C OP	13.7
922923	AB1-081 E OP	5.87
923262	AB1-132 C OP	22.69
923263	AB1-132 E OP	9.72

923272	AB1-135 C OP	3.41
923273	AB1-135 E OP	1.46
923572	AB1-173 C OP	3.65
923573	AB1-173 E OP	1.7
923582	AB1-173AC OP	3.65
923583	AB1-173AE OP	1.7
923801	AB2-015 C OP	14.49
923802	AB2-015 E OP	11.88
923831	AB2-022 C	4.
923832	AB2-022 E	2.15
923841	AB2-024 C	3.33
923842	AB2-024 E	1.5
923851	AB2-025 C	4.08
923852	AB2-025 E	1.83
923861	AB2-026 C	3.74
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	13.94
923982	AB2-039 E OP	11.27
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	240.41
924072	AB2-051 E OP	33.01
924151	AB2-059 C OP	16.15
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	335.82
924301	AB2-077 C OP	2.85
924302	AB2-077 E OP	1.9
924311	AB2-078 C OP	2.85
924312	AB2-078 E OP	1.9
924321	AB2-079 C OP	2.85
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	1.66
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	18.53
924512	AB2-100 E	9.13
924761	AB2-128 C	15.88
924762	AB2-128 E	6.25
924811	AB2-134 C OP	20.23
924812	AB2-134 E OP	27.05
924931	AB2-147 C	4.13
924932	AB2-147 E	6.75
924941	AB2-149 C OP	5.72
924942	AB2-149 E OP	9.33
924951	AB2-150 C OP	4.13
924952	AB2-150 E OP	6.75
925051	AB2-160 C OP	8.36
925052	AB2-160 E OP	13.65
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	8.18
925142	AB2-171 E OP	13.34
925171	AB2-174 C OP	11.39
925172	AB2-174 E OP	10.3
925221	AB2-176 C	2.32
925222	AB2-176 E	1.
925281	AB2-186 C	1.05
925282	AB2-186 E	0.45
925291	AB2-188 C OP	4.

925292	<i>AB2-188 E OP</i>	<i>1.8</i>
925331	<i>AB2-190 C</i>	<i>36.06</i>
925332	<i>AB2-190 E</i>	<i>9.02</i>
925521	<i>AC1-027 C</i>	<i>3.51</i>
925522	<i>AC1-027 E</i>	<i>2.01</i>
925591	<i>AC1-034 C OP</i>	<i>10.63</i>
925592	<i>AC1-034 E OP</i>	<i>8.02</i>
925611	<i>AC1-036 C</i>	<i>1.32</i>
925612	<i>AC1-036 E</i>	<i>2.15</i>
925691	<i>AC1-045 C</i>	<i>2.97</i>
925692	<i>AC1-045 E</i>	<i>1.62</i>
925701	<i>AC1-046 C</i>	<i>3.05</i>
925702	<i>AC1-046 E</i>	<i>1.67</i>
925711	<i>AC1-047 C</i>	<i>4.04</i>
925712	<i>AC1-047 E</i>	<i>2.23</i>
925781	<i>AC1-054 C OP</i>	<i>10.95</i>
925782	<i>AC1-054 E OP</i>	<i>5.04</i>
925811	<i>AC1-060</i>	<i>0.1</i>
925821	<i>AC1-061</i>	<i>0.06</i>
925831	<i>AC1-062</i>	<i>0.43</i>
925841	<i>AC1-063</i>	<i>0.52</i>
925861	<i>AC1-065 C</i>	<i>4.52</i>
925862	<i>AC1-065 E</i>	<i>7.37</i>
926071	<i>AC1-086 C</i>	<i>33.41</i>
926072	<i>AC1-086 E</i>	<i>15.21</i>
926201	<i>AC1-098 C</i>	<i>9.81</i>
926202	<i>AC1-098 E</i>	<i>5.85</i>
926211	<i>AC1-099 C</i>	<i>3.29</i>
926212	<i>AC1-099 E</i>	<i>1.93</i>
926271	<i>AC1-105 C OP</i>	<i>7.94</i>
926272	<i>AC1-105 E OP</i>	<i>3.95</i>
926291	<i>AC1-107 OP</i>	<i>506.9</i>
926661	<i>AC1-147 C</i>	<i>3.95</i>
926662	<i>AC1-147 E</i>	<i>2.32</i>
926741	<i>AC1-159 C</i>	<i>238.55</i>
926751	<i>AC1-161 C OP</i>	<i>54.44</i>
926752	<i>AC1-161 E OP</i>	<i>23.24</i>
926761	<i>AC1-162 C</i>	<i>38.43</i>
926762	<i>AC1-162 E</i>	<i>16.4</i>

926771	AC1-163 C	3.48
926772	AC1-163 E	1.63
926781	AC1-164 C OP	69.95
926782	AC1-164 E OP	31.43
927021	AC1-189 C	13.59
927022	AC1-189 E	6.77
927051	AC1-193 C	6.
927052	AC1-193 E	9.78
927111	AC1-206 C OP	19.22
927112	AC1-206 E OP	9.09
927141	AC1-208 C	14.16
927142	AC1-208 E	6.29
927211	AC1-215 C	16.13
927212	AC1-215 E	7.32
927221	AC1-216 C OP	15.44
927222	AC1-216 E OP	12.14
927251	AC1-221 C	4.27
927252	AC1-221 E	2.29

Appendix 11

(DVP - DVP) The 6CHARCTY-6LAKESD 230 kV line (from bus 314225 to bus 314227 ckt 1) loads from 137.97% to 138.73% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 7.73 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.42
315074	1HOPCGN1	6.83
315075	1HOPCGN2	6.74
315077	1HOPHCF1	1.94
315078	1HOPHCF2	1.94
315079	1HOPHCF3	1.94
315080	1HOPHCF4	2.94
315076	1HOPPOLC	1.65
315134	1ROAVALA	11.3
315135	1ROAVALB	3.01
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
931041	AC2-012 C OP	2.94
931042	AC2-012 E OP	4.79
931581	AC2-078 C OP	3.15
931582	AC2-078 E OP	5.13
931591	AC2-079 C OP	3.12
931592	AC2-079 E OP	5.09
931631	AC2-084 C	2.99

931632	AC2-084 E	1.47
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029 E	13.48
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.78
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.36
921773	AA2-059 E	0.17
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39

922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06
923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.03
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59

924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6
925332	AB2-190 E	3.65
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.73
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	6.48
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.26

927142	<i>AC1-208 E</i>	1.45
927221	<i>AC1-216 C OP</i>	6.25
927222	<i>AC1-216 E OP</i>	4.92

Appendix 12

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 149.71% to 150.47% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 7.73 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.42
315074	1HOPCGN1	6.83
315075	1HOPCGN2	6.74
315077	1HOPHCF1	1.94
315078	1HOPHCF2	1.94
315079	1HOPHCF3	1.94
315080	1HOPHCF4	2.94
315076	1HOPPOLC	1.65
315134	1ROAVALA	11.3
315135	1ROAVALB	3.01
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
931041	AC2-012 C OP	2.94
931042	AC2-012 E OP	4.79
931581	AC2-078 C OP	3.15
931582	AC2-078 E OP	5.13
931591	AC2-079 C OP	3.12
931592	AC2-079 E OP	5.09
931631	AC2-084 C	2.99

931632	AC2-084 E	1.47
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029 E	13.48
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.78
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.36
921773	AA2-059 E	0.17
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39

922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06
923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.03
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59

924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6
925332	AB2-190 E	3.65
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.73
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	6.48
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.26

927142	<i>AC1-208 E</i>	1.45
927221	<i>AC1-216 C OP</i>	6.25
927222	<i>AC1-216 E OP</i>	4.92

Appendix 13

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 149.84% to 150.6% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 7.73 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.42
315074	1HOPCGN1	6.83
315075	1HOPCGN2	6.74
315077	1HOPHCF1	1.94
315078	1HOPHCF2	1.94
315079	1HOPHCF3	1.94
315080	1HOPHCF4	2.94
315076	1HOPPOLC	1.65
315134	1ROAVALA	11.3
315135	1ROAVALB	3.01
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
931041	AC2-012 C OP	2.94
931042	AC2-012 E OP	4.79
931581	AC2-078 C OP	3.15
931582	AC2-078 E OP	5.13
931591	AC2-079 C OP	3.12
931592	AC2-079 E OP	5.09
931631	AC2-084 C	2.99

931632	AC2-084 E	1.47
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029 E	13.48
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.78
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.36
921773	AA2-059 E	0.17
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39

922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06
923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.03
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59

924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6
925332	AB2-190 E	3.65
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.73
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	6.48
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.26

927142	<i>AC1-208 E</i>	1.45
927221	<i>AC1-216 C OP</i>	6.25
927222	<i>AC1-216 E OP</i>	4.92

Appendix 14

(DVP - DVP) The 8NO ANNA-8SPOTSYL 500 kV line (from bus 314918 to bus 314934 ckt 1) loads from 99.84% to 100.0% (**DC power flow**) of its emergency rating (3219 MVA) for the single line contingency outage of 'LN 568'. This project contributes approximately 10.93 MW to the thermal violation.

CONTINGENCY 'LN 568'

OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1

/* 8LDYSMTH

500.00 - 8POSSUM 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315053	1BELMED1	3.21
315054	1BELMED2	3.21
315055	1BELMED3	2.67
315108	1ELIZAR1	3.71
315109	1ELIZAR2	3.64
315110	1ELIZAR3	3.75
315074	1HOPCGN1	8.79
315075	1HOPCGN2	8.67
315225	1N ANNA1	64.88
315226	1N ANNA2	63.88
315134	1ROAVALA	27.81
315135	1ROAVALB	7.42
315083	1SPRUNCA	11.38
315084	1SPRUNCB	11.38
315085	1SPRUNCC	8.44
315086	1SPRUNCD	8.44
315090	1YORKTN1	30.06
315091	1YORKTN2	31.19
314251	6S PUMP	1.01
931041	AC2-012 C OP	10.93
931501	AC2-070 C	1.69
931531	AC2-073 C	2.38
931581	AC2-078 C OP	4.34
931591	AC2-079 C OP	7.21
931631	AC2-084 C	8.65
931701	AC2-093 C	76.92
931711	AC2-094 C	15.68

931831	AC2-110 C	1.36
916301	Z1-086 C	55.4
LTF	Z2-067	18.05
921092	AA1-049 C	2.59
LTF	AA1-058	0.8
921162	AA1-063AC	8.61
921182	AA1-067 C	1.66
921292	AA1-083	3.49
921532	AA1-132 C	8.
921562	AA1-135 C	9.21
921572	AA1-138 C	10.29
921582	AA1-139 C	16.04
921622	AA1-145	59.32
921752	AA2-053 C	8.74
921762	AA2-057 C	6.88
921772	AA2-059 C	1.23
921862	AA2-068 C	2.18
LTF	AA2-074	5.36
921982	AA2-088 C	6.65
922442	AA2-165 C	0.94
922472	AA2-169 C	2.14
922512	AA2-174 C	0.4
922522	AA2-177 C	10.65
922532	AA2-178 C	9.98
922602	AB1-013 C	3.01
922682	AB1-027 C	2.57
923262	AB1-132 C OP	14.13
923272	AB1-135 C OP	2.59
923572	AB1-173 C OP	2.28
923582	AB1-173AC OP	2.28
923801	AB2-015 C OP	8.98
923831	AB2-022 C	2.45
923841	AB2-024 C	2.49
923851	AB2-025 C	2.59
923861	AB2-026 C	2.52
923911	AB2-031 C OP	2.26
923981	AB2-039 C OP	8.94
923991	AB2-040 C OP	7.44
924061	AB2-050	3.49

924071	AB2-051 C OP	147.44
924241	AB2-068 OP	195.53
924381	AB2-087 C	0.58
924491	AB2-098 C	0.55
924501	AB2-099 C	0.6
924511	AB2-100 C	11.6
924761	AB2-128 C	9.94
924811	AB2-134 C OP	13.66
924931	AB2-147 C	2.6
924941	AB2-149 C OP	3.6
924951	AB2-150 C OP	2.6
925051	AB2-160 C OP	5.8
925061	AB2-161 C OP	3.61
925121	AB2-169 C OP	6.54
925141	AB2-171 C OP	5.07
925171	AB2-174 C OP	7.14
925281	AB2-186 C	0.65
925291	AB2-188 C OP	2.46
925331	AB2-190 C	24.34
925521	AC1-027 C	2.15
925691	AC1-045 C	1.85
925701	AC1-046 C	1.86
925711	AC1-047 C	2.47
925781	AC1-054 C OP	6.85
925811	AC1-060	0.07
925821	AC1-061	0.04
925841	AC1-063	0.39
925861	AC1-065 C	3.39
926071	AC1-086 C	20.8
926201	AC1-098 C	6.07
926211	AC1-099 C	2.03
926291	AC1-107 OP	295.14
926411	AC1-112 C	2.
926441	AC1-115 C	0.92
926551	AC1-134	8.72
926591	AC1-142 C	9.16
926661	AC1-147 C	2.43
926741	AC1-159 C	146.3
926751	AC1-161 C OP	32.78

926771	AC1-163 C	2.15
926781	AC1-164 C OP	40.73
927021	AC1-189 C	8.36
927041	AC1-191 C	9.76
927051	AC1-193 C	3.72
927141	AC1-208 C	8.76
927221	AC1-216 C OP	10.42

Appendix 15

(DVP - DVP) The 6SKIFF CREEK-6KINGS M 230 kV line (from bus 314209 to bus 314386 ckt 1) loads from 104.64% to 105.13% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 567'. This project contributes approximately 4.78 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315099	1CHESPKB	0.55
315108	1ELIZAR1	1.62
315109	1ELIZAR2	1.59
315110	1ELIZAR3	1.64
315233	1SURRY 2	16.37
315090	1YORKTN1	25.29
315091	1YORKTN2	26.24
315092	1YORKTN3	22.24
314421	6WINCHST	0.12
931041	AC2-012 C OP	4.78
931591	AC2-079 C OP	2.38
916191	Z1-068 C	0.02
921092	AA1-049 C	1.12
921532	AA1-132 C	3.46
921562	AA1-135 C	3.01
921572	AA1-138 C	4.18
921582	AA1-139 C	6.96
921772	AA2-059 C	0.49
921982	AA2-088 C	2.21
922532	AA2-178 C	3.82
922602	AB1-013 C	1.15
923801	AB2-015 C OP	3.2
923831	AB2-022 C	1.04
924071	AB2-051 C OP	64.45
924381	AB2-087 C	0.19
924501	AB2-099 C	0.2
924941	AB2-149 C OP	1.19

925121	AB2-169 C OP	2.26
925141	AB2-171 C OP	1.76
925281	AB2-186 C	0.27
925291	AB2-188 C OP	0.94
925521	AC1-027 C	0.94
925691	AC1-045 C	0.85
925701	AC1-046 C	0.82
925711	AC1-047 C	1.08
926661	AC1-147 C	1.06
926741	AC1-159 C	63.95
926751	AC1-161 C OP	15.75
926771	AC1-163 C	0.71
927051	AC1-193 C	1.29

Appendix 16

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 116.81% to 117.86% (**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 24.45 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315067	1DARBY 1	4.47
315068	1DARBY 2	4.48
315069	1DARBY 3	4.53
315070	1DARBY 4	4.53
315043	1FRIVERA	6.02
315044	1FRIVERB	4.66
315045	1FRIVERC	6.02
315046	1FRIVERD	4.66
315047	1FRIVERE	4.66
315048	1FRIVERF	6.02
315074	1HOPCGN1	11.03
315075	1HOPCGN2	10.89
315134	1ROAVALA	22.59
315135	1ROAVALB	6.02
315083	1SPRUNCA	14.8
315084	1SPRUNCB	14.8
315085	1SPRUNCC	10.97
315086	1SPRUNCD	10.97
315073	1STONECA	9.15
314784	1WEYRHSB	1.72
315090	1YORKTN1	30.63
315091	1YORKTN2	31.78
314539	3UNCAMP	2.15

314541	3WATKINS	0.6
314229	6MT R221	1.42
314236	6NRTHEST	0.33
314189	6PAPERMILL	8.8
314251	6S PUMP	1.62
931041	AC2-012 C OP	9.29
931042	AC2-012 E OP	15.16
931501	AC2-070 C	2.92
931502	AC2-070 E	1.21
931531	AC2-073 C	3.09
931532	AC2-073 E	1.56
931581	AC2-078 C OP	4.26
931582	AC2-078 E OP	6.95
931591	AC2-079 C OP	6.71
931592	AC2-079 E OP	10.95
931831	AC2-110 C	1.74
931832	AC2-110 E	2.84
292791	U1-032 E	4.77
297087	V2-040	0.25
900672	V4-068 E	0.25
901082	W1-029 E	41.27
907092	X1-038 E	5.37
913392	Y1-086 E	1.97
916042	Z1-036 E	40.07
916192	Z1-068 E	1.73
917122	Z2-027 E	0.95
917332	Z2-043 E	0.8
917592	Z2-099 E	0.37
921092	AA1-049 C	2.2
921093	AA1-049 E	1.03
921162	AA1-063AC	6.95
921163	AA1-063AE	3.28
918512	AA1-065 E OP	3.66
918562	AA1-072 E	0.13
921292	AA1-083	6.01
921532	AA1-132 C	6.79
921533	AA1-132 E	2.91
921572	AA1-138 C	8.68
921573	AA1-138 E	3.72

921582	AA1-139 C	13.62
921583	AA1-139 E	5.84
921622	AA1-145	102.15
921752	AA2-053 C	6.97
921753	AA2-053 E	2.99
921772	AA2-059 C	1.03
921773	AA2-059 E	0.48
920022	AA2-086 E	0.2
921982	AA2-088 C	5.5
921983	AA2-088 E	8.97
922512	AA2-174 C	0.32
922513	AA2-174 E	0.35
922522	AA2-177 C	12.13
922523	AA2-177 E	5.2
922532	AA2-178 C	8.22
922533	AA2-178 E	3.52
922602	AB1-013 C	2.48
922603	AB1-013 E	16.61
922672	AB1-026 C	2.22
922673	AB1-026 E	0.95
922682	AB1-027 C	4.45
922683	AB1-027 E	1.91
923262	AB1-132 C OP	11.49
923263	AB1-132 E OP	4.93
923272	AB1-135 C OP	3.7
923273	AB1-135 E OP	1.59
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	7.59
923802	AB2-015 E OP	6.22
923831	AB2-022 C	2.07
923832	AB2-022 E	1.12
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	1.95

923862	AB2-026 E	0.88
923911	AB2-031 C OP	1.84
923912	AB2-031 E OP	0.91
923981	AB2-039 C OP	8.78
923982	AB2-039 E OP	7.1
923991	AB2-040 C OP	6.04
923992	AB2-040 E OP	4.94
924061	AB2-050	6.01
924071	AB2-051 C OP	127.
924072	AB2-051 E OP	17.44
924241	AB2-068 OP	175.81
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	9.75
924512	AB2-100 E	4.8
924761	AB2-128 C	8.36
924762	AB2-128 E	3.29
924811	AB2-134 C OP	15.56
924812	AB2-134 E OP	20.8
924931	AB2-147 C	2.14
924932	AB2-147 E	3.48
924941	AB2-149 C OP	3.35
924942	AB2-149 E OP	5.47
924951	AB2-150 C OP	2.14
924952	AB2-150 E OP	3.48
925051	AB2-160 C OP	7.01
925052	AB2-160 E OP	11.43
925061	AB2-161 C OP	3.55
925062	AB2-161 E OP	5.79
925121	AB2-169 C OP	5.19
925122	AB2-169 E OP	4.66
925141	AB2-171 C OP	4.25
925142	AB2-171 E OP	6.94
925171	AB2-174 C OP	5.83
925172	AB2-174 E OP	5.27
925281	AB2-186 C	0.54
925282	AB2-186 E	0.23

925291	AB2-188 C OP	2.03
925292	AB2-188 E OP	0.91
925331	AB2-190 C	27.74
925332	AB2-190 E	6.93
925521	AC1-027 C	1.85
925522	AC1-027 E	1.06
925691	AC1-045 C	1.65
925692	AC1-045 E	0.9
925701	AC1-046 C	1.59
925702	AC1-046 E	0.87
925711	AC1-047 C	2.1
925712	AC1-047 E	1.16
925811	AC1-060	0.1
925821	AC1-061	0.05
925841	AC1-063	0.5
925861	AC1-065 C	4.35
925862	AC1-065 E	7.09
926071	AC1-086 C	16.92
926072	AC1-086 E	7.7
926291	AC1-107 OP	265.38
926411	AC1-112 C	3.46
926412	AC1-112 E	1.94
926441	AC1-115 C	1.03
926442	AC1-115 E	1.67
926471	AC1-118 C	2.1
926472	AC1-118 E	1.08
926551	AC1-134	15.02
926591	AC1-142 C	11.38
926592	AC1-142 E	8.59
926661	AC1-147 C	2.1
926662	AC1-147 E	1.23
926741	AC1-159 C	126.03
926751	AC1-161 C OP	26.81
926752	AC1-161 E OP	11.44
926771	AC1-163 C	1.74
926772	AC1-163 E	0.82
926781	AC1-164 C OP	36.62
926782	AC1-164 E OP	16.45
927041	AC1-191 C	19.88

927042	<i>AC1-191 E</i>	9.9
927051	<i>AC1-193 C</i>	3.12
927052	<i>AC1-193 E</i>	5.09
927111	<i>AC1-206 C OP</i>	10.48
927112	<i>AC1-206 E OP</i>	4.96
927221	<i>AC1-216 C OP</i>	11.87
927222	<i>AC1-216 E OP</i>	9.34

Appendix 17

(DVP - DVP) The 8CARSON-8MDLTHAN 500 kV line (from bus 314902 to bus 314914 ckt 1) loads from 122.2% to 123.67% (**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 46.22 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315102	1BRUNSWICKG1	17.11
315103	1BRUNSWICKG2	17.11
315104	1BRUNSWICKG3	17.11
315105	1BRUNSWICKS1	35.54
315131	1EDGECEMA	13.77
315132	1EDGECEMB	13.77
315108	1ELIZAR1	5.91
315109	1ELIZAR2	5.8
315110	1ELIZAR3	5.98
315134	1ROAVALA	42.22
315135	1ROAVALB	11.26
315233	1SURRY 2	47.4
314784	1WEYRHSB	3.37
315090	1YORKTN1	40.33
315091	1YORKTN2	41.85
314539	3UNCAMP	3.89
314541	3WATKINS	1.1
931041	AC2-012 C OP	17.57
931042	AC2-012 E OP	28.66
931581	AC2-078 C OP	5.83
931582	AC2-078 E OP	9.52
931591	AC2-079 C OP	10.39
931592	AC2-079 E OP	16.95

931631	AC2-084 C	13.4
931632	AC2-084 E	6.6
931701	AC2-093 C	142.1
931702	AC2-093 E	81.28
931761	AC2-100 C	7.48
931762	AC2-100 E	3.65
931821	AC2-107 C OP	13.01
931822	AC2-107 E OP	6.1
900672	V4-068 E	0.47
901082	W1-029 E	77.53
907092	X1-038 E	9.72
913392	Y1-086 E	3.71
916042	Z1-036 E	76.04
916191	Z1-068 C	0.08
916192	Z1-068 E	3.23
916301	Z1-086 C	104.37
916302	Z1-086 E	18.56
917122	Z2-027 E	1.8
917332	Z2-043 E	1.55
917342	Z2-044 E	0.86
LTF	Z2-067	29.5
917512	Z2-088 E OP1	12.18
917592	Z2-099 E	0.69
921092	AA1-049 C	4.15
921093	AA1-049 E	1.95
LTF	AA1-058	1.3
921162	AA1-063AC	13.06
921163	AA1-063AE	6.16
918512	AA1-065 E OP	7.07
921182	AA1-067 C	2.62
921183	AA1-067 E	1.12
918562	AA1-072 E	0.26
921532	AA1-132 C	12.82
921533	AA1-132 E	5.5
921562	AA1-135 C	14.48
921563	AA1-135 E	6.2
921572	AA1-138 C	16.22
921573	AA1-138 E	6.95
921582	AA1-139 C	25.74

921583	AA1-139 E	11.03
921752	AA2-053 C	13.27
921753	AA2-053 E	5.7
921762	AA2-057 C	10.71
921763	AA2-057 E	5.36
921772	AA2-059 C	1.96
921773	AA2-059 E	0.92
921862	AA2-068 C	3.38
921863	AA2-068 E	1.55
LTF	AA2-074	8.75
920022	AA2-086 E	0.37
921982	AA2-088 C	10.17
921983	AA2-088 E	16.59
922442	AA2-165 C	1.46
922443	AA2-165 E	0.71
922472	AA2-169 C	3.17
922473	AA2-169 E	1.46
922512	AA2-174 C	0.61
922513	AA2-174 E	0.66
922522	AA2-177 C	11.55
922523	AA2-177 E	4.95
922532	AA2-178 C	15.77
922533	AA2-178 E	6.76
922602	AB1-013 C	4.76
922603	AB1-013 E	31.85
922922	AB1-081 C OP	13.3
922923	AB1-081 E OP	5.7
923262	AB1-132 C OP	21.33
923263	AB1-132 E OP	9.14
923572	AB1-173 C OP	3.37
923573	AB1-173 E OP	1.57
923582	AB1-173AC OP	3.37
923583	AB1-173AE OP	1.57
923801	AB2-015 C OP	13.78
923802	AB2-015 E OP	11.3
923831	AB2-022 C	3.92
923832	AB2-022 E	2.11
923851	AB2-025 C	3.66
923852	AB2-025 E	1.64

923911	AB2-031 C OP	3.35
923912	AB2-031 E OP	1.65
923941	AB2-035 C	0.51
923942	AB2-035 E	0.22
923981	AB2-039 C OP	12.03
923982	AB2-039 E OP	9.72
923991	AB2-040 C OP	11.
923992	AB2-040 E OP	9.
924021	AB2-043 C OP	3.92
924022	AB2-043 E OP	6.43
924071	AB2-051 C OP	234.78
924072	AB2-051 E OP	32.23
924151	AB2-059 C OP	15.68
924152	AB2-059 E OP	8.08
924241	AB2-068 OP	332.14
924301	AB2-077 C OP	2.5
924302	AB2-077 E OP	1.67
924311	AB2-078 C OP	2.5
924312	AB2-078 E OP	1.67
924321	AB2-079 C OP	2.5
924322	AB2-079 E OP	1.67
924381	AB2-087 C	0.9
924382	AB2-087 E	0.42
924391	AB2-088 C	0.65
924392	AB2-088 E	0.31
924401	AB2-089 C	2.95
924402	AB2-089 E	1.52
924411	AB2-090 C	4.94
924412	AB2-090 E	2.53
924491	AB2-098 C	0.87
924492	AB2-098 E	0.37
924501	AB2-099 C	0.93
924502	AB2-099 E	0.4
924511	AB2-100 C	17.17
924512	AB2-100 E	8.46
924761	AB2-128 C	14.71
924762	AB2-128 E	5.79
924811	AB2-134 C OP	14.81
924812	AB2-134 E OP	19.8

924931	AB2-147 C	3.78
924932	AB2-147 E	6.17
924941	AB2-149 C OP	5.19
924942	AB2-149 E OP	8.47
924951	AB2-150 C OP	3.78
924952	AB2-150 E OP	6.17
925061	AB2-161 C OP	4.86
925062	AB2-161 E OP	7.93
925121	AB2-169 C OP	10.33
925122	AB2-169 E OP	9.27
925141	AB2-171 C OP	7.77
925142	AB2-171 E OP	12.68
925171	AB2-174 C OP	10.49
925172	AB2-174 E OP	9.5
925221	AB2-176 C	2.03
925222	AB2-176 E	0.87
925281	AB2-186 C	1.03
925282	AB2-186 E	0.44
925291	AB2-188 C OP	3.89
925292	AB2-188 E OP	1.75
925331	AB2-190 C	26.4
925332	AB2-190 E	6.6
925521	AC1-027 C	3.44
925522	AC1-027 E	1.96
925591	AC1-034 C OP	10.33
925592	AC1-034 E OP	7.79
925691	AC1-045 C	2.81
925692	AC1-045 E	1.53
925701	AC1-046 C	3.
925702	AC1-046 E	1.64
925711	AC1-047 C	3.98
925712	AC1-047 E	2.19
925781	AC1-054 C OP	10.08
925782	AC1-054 E OP	4.64
926071	AC1-086 C	31.42
926072	AC1-086 E	14.3
926201	AC1-098 C	9.4
926202	AC1-098 E	5.6
926211	AC1-099 C	3.15

926212	AC1-099 E	1.85
926271	AC1-105 C OP	7.49
926272	AC1-105 E OP	3.73
926291	AC1-107 OP	501.34
926661	AC1-147 C	3.85
926662	AC1-147 E	2.26
926741	AC1-159 C	232.97
926751	AC1-161 C OP	55.33
926752	AC1-161 E OP	23.62
926771	AC1-163 C	3.33
926772	AC1-163 E	1.56
926781	AC1-164 C OP	69.19
926782	AC1-164 E OP	31.08
927021	AC1-189 C	13.21
927022	AC1-189 E	6.58
927051	AC1-193 C	5.7
927052	AC1-193 E	9.3
927111	AC1-206 C OP	17.57
927112	AC1-206 E OP	8.3
927141	AC1-208 C	13.55
927142	AC1-208 E	6.02
927211	AC1-215 C	13.62
927212	AC1-215 E	6.18
927221	AC1-216 C OP	11.3
927222	AC1-216 E OP	8.89
927251	AC1-221 C	4.23
927252	AC1-221 E	2.27
927261	AC1-222 C	6.37
927262	AC1-222 E	3.09

Appendix 18

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 119.72% to 120.42% (**DC power flow**) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of 'WT576'. This project contributes approximately 49.09 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	11.87
315132	1EDGECEMB	11.87
315074	1HOPCGN1	10.81
315075	1HOPCGN2	10.67
315134	1ROAVALA	38.67
315135	1ROAVALB	10.31
315073	1STONECA	8.96
315233	1SURRY 2	57.75
314784	1WEYRHSB	3.27
315090	1YORKTN1	53.77
315091	1YORKTN2	55.8
315092	1YORKTN3	47.06
314539	3UNCAMP	3.93
314541	3WATKINS	1.09
314189	6PAPERMILL	10.97
314421	6WINCHST	0.26
931041	AC2-012 C OP	18.65
931042	AC2-012 E OP	30.43
931531	AC2-073 C	3.9
931532	AC2-073 E	1.96
931581	AC2-078 C OP	6.22
931582	AC2-078 E OP	10.15
931591	AC2-079 C OP	11.01

931592	AC2-079 E OP	17.97
931631	AC2-084 C	12.18
931632	AC2-084 E	6.
931701	AC2-093 C	105.37
931702	AC2-093 E	60.27
931831	AC2-110 C	2.15
931832	AC2-110 E	3.51
292791	U1-032 E	4.67
900672	V4-068 E	0.46
901082	W1-029 E	80.91
907092	X1-038 E	9.82
913392	Y1-086 E	3.88
916042	Z1-036 E	78.13
916192	Z1-068 E	3.45
916302	Z1-086 E	13.69
917122	Z2-027 E	1.88
917332	Z2-043 E	1.46
917342	Z2-044 E	0.76
LTF	Z2-067	22.1
917512	Z2-088 E OP1	10.89
917592	Z2-099 E	0.68
921092	AA1-049 C	4.39
921093	AA1-049 E	2.07
LTF	AA1-058	1.05
921162	AA1-063AC	12.23
921163	AA1-063AE	5.77
918512	AA1-065 E OP	6.81
921182	AA1-067 C	2.38
921183	AA1-067 E	1.02
918562	AA1-072 E	0.24
921532	AA1-132 C	13.55
921533	AA1-132 E	5.81
921562	AA1-135 C	13.57
921563	AA1-135 E	5.82
921572	AA1-138 C	16.7
921573	AA1-138 E	7.16
921582	AA1-139 C	27.26
921583	AA1-139 E	11.68
921752	AA2-053 C	12.24

921753	AA2-053 E	5.26
921762	AA2-057 C	9.49
921763	AA2-057 E	4.75
921772	AA2-059 C	2.
921773	AA2-059 E	0.94
921862	AA2-068 C	3.03
921863	AA2-068 E	1.39
LTF	AA2-074	6.7
920022	AA2-086 E	0.36
921982	AA2-088 C	9.92
921983	AA2-088 E	16.18
922442	AA2-165 C	1.29
922443	AA2-165 E	0.63
922472	AA2-169 C	2.78
922473	AA2-169 E	1.28
922512	AA2-174 C	0.56
922513	AA2-174 E	0.61
922522	AA2-177 C	14.88
922523	AA2-177 E	6.38
922532	AA2-178 C	15.83
922533	AA2-178 E	6.78
922602	AB1-013 C	4.78
922603	AB1-013 E	31.96
922922	AB1-081 C OP	11.47
922923	AB1-081 E OP	4.92
923262	AB1-132 C OP	19.35
923263	AB1-132 E OP	8.29
923272	AB1-135 C OP	4.32
923273	AB1-135 E OP	1.85
923572	AB1-173 C OP	3.05
923573	AB1-173 E OP	1.42
923582	AB1-173AC OP	3.05
923583	AB1-173AE OP	1.42
923801	AB2-015 C OP	13.82
923802	AB2-015 E OP	11.33
923831	AB2-022 C	4.11
923832	AB2-022 E	2.21
923841	AB2-024 C	4.11
923842	AB2-024 E	1.84

923851	AB2-025 C	3.27
923852	AB2-025 E	1.47
923911	AB2-031 C OP	3.02
923912	AB2-031 E OP	1.49
923941	AB2-035 C	0.45
923942	AB2-035 E	0.19
923981	AB2-039 C OP	12.83
923982	AB2-039 E OP	10.37
923991	AB2-040 C OP	9.93
923992	AB2-040 E OP	8.13
924071	AB2-051 C OP	251.77
924072	AB2-051 E OP	34.57
924151	AB2-059 C OP	13.52
924152	AB2-059 E OP	6.97
924241	AB2-068 OP	619.37
924381	AB2-087 C	0.86
924382	AB2-087 E	0.4
924391	AB2-088 C	0.57
924392	AB2-088 E	0.28
924401	AB2-089 C	2.54
924402	AB2-089 E	1.31
924491	AB2-098 C	0.79
924492	AB2-098 E	0.34
924501	AB2-099 C	0.89
924502	AB2-099 E	0.38
924511	AB2-100 C	15.5
924512	AB2-100 E	7.63
924761	AB2-128 C	13.28
924762	AB2-128 E	5.23
924811	AB2-134 C OP	19.08
924812	AB2-134 E OP	25.51
924931	AB2-147 C	3.38
924932	AB2-147 E	5.52
924941	AB2-149 C OP	5.51
924942	AB2-149 E OP	8.99
924951	AB2-150 C OP	3.38
924952	AB2-150 E OP	5.52
925051	AB2-160 C OP	6.38
925052	AB2-160 E OP	10.42

925061	AB2-161 C OP	5.19
925062	AB2-161 E OP	8.46
925121	AB2-169 C OP	9.88
925122	AB2-169 E OP	8.87
925141	AB2-171 C OP	7.72
925142	AB2-171 E OP	12.59
925171	AB2-174 C OP	9.45
925172	AB2-174 E OP	8.55
925281	AB2-186 C	1.07
925282	AB2-186 E	0.46
925291	AB2-188 C OP	3.9
925292	AB2-188 E OP	1.75
925331	AB2-190 C	34.01
925332	AB2-190 E	8.5
925521	AC1-027 C	3.67
925522	AC1-027 E	2.1
925591	AC1-034 C OP	9.07
925592	AC1-034 E OP	6.85
925691	AC1-045 C	3.08
925692	AC1-045 E	1.68
925701	AC1-046 C	3.19
925702	AC1-046 E	1.74
925711	AC1-047 C	4.22
925712	AC1-047 E	2.32
925781	AC1-054 C OP	8.74
925782	AC1-054 E OP	4.02
925811	AC1-060	0.1
925821	AC1-061	0.04
925841	AC1-063	0.62
925861	AC1-065 C	5.38
925862	AC1-065 E	8.77
926071	AC1-086 C	28.5
926072	AC1-086 E	12.97
926201	AC1-098 C	8.54
926202	AC1-098 E	5.09
926211	AC1-099 C	2.86
926212	AC1-099 E	1.68
926291	AC1-107 OP	934.9
926591	AC1-142 C	13.61

926592	<i>AC1-142 E</i>	<i>10.27</i>
926661	<i>AC1-147 C</i>	<i>4.13</i>
926662	<i>AC1-147 E</i>	<i>2.43</i>
926741	<i>AC1-159 C</i>	<i>249.83</i>
926751	<i>AC1-161 C OP</i>	<i>59.82</i>
926752	<i>AC1-161 E OP</i>	<i>25.53</i>
926771	<i>AC1-163 C</i>	<i>3.19</i>
926772	<i>AC1-163 E</i>	<i>1.5</i>
926781	<i>AC1-164 C OP</i>	<i>129.02</i>
926782	<i>AC1-164 E OP</i>	<i>57.96</i>
927021	<i>AC1-189 C</i>	<i>11.91</i>
927022	<i>AC1-189 E</i>	<i>5.93</i>
927051	<i>AC1-193 C</i>	<i>5.66</i>
927052	<i>AC1-193 E</i>	<i>9.23</i>
927111	<i>AC1-206 C OP</i>	<i>15.77</i>
927112	<i>AC1-206 E OP</i>	<i>7.46</i>
927141	<i>AC1-208 C</i>	<i>11.96</i>
927142	<i>AC1-208 E</i>	<i>5.31</i>
927221	<i>AC1-216 C OP</i>	<i>14.56</i>
927222	<i>AC1-216 E OP</i>	<i>11.45</i>

Appendix 19

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 129.93% to 130.56% (**DC power flow**) of its load dump rating (3351 MVA) for the line fault with failed breaker contingency outage of 'WT576'. This project contributes approximately 47.0 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315060	1CHESTF5	19.7
315061	1CHESTG7	7.72
315063	1CHESTG8	7.66
315062	1CHESTS7	3.51
315064	1CHESTS8	3.92
315067	1DARBY 1	5.03
315068	1DARBY 2	5.04
315069	1DARBY 3	5.1
315070	1DARBY 4	5.1
315074	1HOPCGN1	15.
315075	1HOPCGN2	14.8
315134	1ROAVALA	43.93
315135	1ROAVALB	11.71
315083	1SPRUNCA	18.63
315084	1SPRUNCB	18.63
315085	1SPRUNCC	13.81
315086	1SPRUNCD	13.81
315073	1STONECA	12.44
315233	1SURRY 2	50.06
314784	1WEYRHSB	3.43
315090	1YORKTN1	51.77
315091	1YORKTN2	53.73
314539	3UNCAMP	4.09

314541	3WATKINS	1.15
314229	6MT R221	1.36
314236	6NRTHEST	0.36
314189	6PAPERMILL	11.77
931041	AC2-012 C OP	17.86
931042	AC2-012 E OP	29.14
931501	AC2-070 C	3.15
931502	AC2-070 E	1.3
931531	AC2-073 C	4.15
931532	AC2-073 E	2.09
931581	AC2-078 C OP	7.07
931582	AC2-078 E OP	11.54
931591	AC2-079 C OP	11.75
931592	AC2-079 E OP	19.17
931631	AC2-084 C	13.69
931632	AC2-084 E	6.74
931701	AC2-093 C	112.39
931702	AC2-093 E	64.28
931831	AC2-110 C	2.33
931832	AC2-110 E	3.8
292791	U1-032 E	6.48
297087	V2-040	0.24
900672	V4-068 E	0.49
901082	W1-029 E	79.4
907092	X1-038 E	10.21
913392	Y1-086 E	3.79
916042	Z1-036 E	77.72
916192	Z1-068 E	3.3
916302	Z1-086 E	14.22
917122	Z2-027 E	1.83
917332	Z2-043 E	1.59
LTF	Z2-067	28.81
917592	Z2-099 E	0.73
921092	AA1-049 C	4.23
921093	AA1-049 E	1.99
LTF	AA1-058	1.25
921162	AA1-063AC	13.65
921163	AA1-063AE	6.44
918512	AA1-065 E OP	7.24

921182	AA1-067 C	2.63
921183	AA1-067 E	1.13
918562	AA1-072 E	0.27
921532	AA1-132 C	13.06
921533	AA1-132 E	5.6
921562	AA1-135 C	14.69
921563	AA1-135 E	6.3
921572	AA1-138 C	16.7
921573	AA1-138 E	7.16
921582	AA1-139 C	26.19
921583	AA1-139 E	11.23
921752	AA2-053 C	13.82
921753	AA2-053 E	5.93
921772	AA2-059 C	2.
921773	AA2-059 E	0.94
921862	AA2-068 C	3.45
921863	AA2-068 E	1.59
LTF	AA2-074	8.46
920022	AA2-086 E	0.39
921982	AA2-088 C	10.64
921983	AA2-088 E	17.35
922512	AA2-174 C	0.63
922513	AA2-174 E	0.69
922522	AA2-177 C	18.02
922523	AA2-177 E	7.72
922532	AA2-178 C	16.11
922533	AA2-178 E	6.9
922602	AB1-013 C	4.86
922603	AB1-013 E	32.54
922682	AB1-027 C	4.8
922683	AB1-027 E	2.06
923262	AB1-132 C OP	22.26
923263	AB1-132 E OP	9.54
923272	AB1-135 C OP	4.79
923273	AB1-135 E OP	2.05
923572	AB1-173 C OP	3.58
923573	AB1-173 E OP	1.67
923582	AB1-173AC OP	3.58
923583	AB1-173AE OP	1.67

923642	AB1-181	3.49
923643	AB1-181 2	3.49
923644	AB1-181 3	3.49
923801	AB2-015 C OP	14.46
923802	AB2-015 E OP	11.86
923831	AB2-022 C	3.99
923832	AB2-022 E	2.15
923841	AB2-024 C	4.41
923842	AB2-024 E	1.98
923851	AB2-025 C	4.03
923852	AB2-025 E	1.81
923861	AB2-026 C	3.56
923862	AB2-026 E	1.6
923911	AB2-031 C OP	3.55
923912	AB2-031 E OP	1.75
923981	AB2-039 C OP	14.58
923982	AB2-039 E OP	11.79
923991	AB2-040 C OP	11.66
923992	AB2-040 E OP	9.54
924071	AB2-051 C OP	241.56
924072	AB2-051 E OP	33.17
924241	AB2-068 OP	416.73
924381	AB2-087 C	0.92
924382	AB2-087 E	0.43
924491	AB2-098 C	0.88
924492	AB2-098 E	0.38
924501	AB2-099 C	0.95
924502	AB2-099 E	0.41
924511	AB2-100 C	18.21
924512	AB2-100 E	8.97
924761	AB2-128 C	15.6
924762	AB2-128 E	6.14
924811	AB2-134 C OP	23.11
924812	AB2-134 E OP	30.9
924931	AB2-147 C	4.06
924932	AB2-147 E	6.62
924941	AB2-149 C OP	5.88
924942	AB2-149 E OP	9.59
924951	AB2-150 C OP	4.06

924952	AB2-150 E OP	6.62
925051	AB2-160 C OP	9.6
925052	AB2-160 E OP	15.66
925061	AB2-161 C OP	5.89
925062	AB2-161 E OP	9.62
925121	AB2-169 C OP	10.48
925122	AB2-169 E OP	9.4
925141	AB2-171 C OP	8.15
925142	AB2-171 E OP	13.29
925171	AB2-174 C OP	11.17
925172	AB2-174 E OP	10.11
925281	AB2-186 C	1.05
925282	AB2-186 E	0.45
925291	AB2-188 C OP	3.97
925292	AB2-188 E OP	1.78
925331	AB2-190 C	41.2
925332	AB2-190 E	10.3
925521	AC1-027 C	3.52
925522	AC1-027 E	2.01
925691	AC1-045 C	3.04
925692	AC1-045 E	1.66
925701	AC1-046 C	3.05
925702	AC1-046 E	1.66
925711	AC1-047 C	4.04
925712	AC1-047 E	2.22
925811	AC1-060	0.13
925821	AC1-061	0.06
925841	AC1-063	0.67
925861	AC1-065 C	5.83
925862	AC1-065 E	9.51
926071	AC1-086 C	32.78
926072	AC1-086 E	14.92
926201	AC1-098 C	9.6
926202	AC1-098 E	5.72
926211	AC1-099 C	3.22
926212	AC1-099 E	1.89
926291	AC1-107 OP	629.02
926411	AC1-112 C	3.73
926412	AC1-112 E	2.09

926661	AC1-147 C	3.98
926662	AC1-147 E	2.33
926741	AC1-159 C	239.7
926751	AC1-161 C OP	54.02
926752	AC1-161 E OP	23.06
926771	AC1-163 C	3.44
926772	AC1-163 E	1.61
926781	AC1-164 C OP	86.81
926782	AC1-164 E OP	39.
927021	AC1-189 C	13.26
927022	AC1-189 E	6.61
927041	AC1-191 C	18.32
927042	AC1-191 E	9.12
927051	AC1-193 C	5.98
927052	AC1-193 E	9.75
927111	AC1-206 C OP	18.92
927112	AC1-206 E OP	8.94
927141	AC1-208 C	13.8
927142	AC1-208 E	6.13
927221	AC1-216 C OP	17.64
927222	AC1-216 E OP	13.87

Appendix 20

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 127.69% to 128.36% (**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 47.02 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315102	1BRUNSWICKG1	15.56
315103	1BRUNSWICKG2	15.56
315104	1BRUNSWICKG3	15.56
315105	1BRUNSWICKS1	32.32
315131	1EDGECEMA	14.18
315132	1EDGECEMB	14.18
315108	1ELIZAR1	6.05
315109	1ELIZAR2	5.94
315110	1ELIZAR3	6.12
315074	1HOPCGN1	12.47
315075	1HOPCGN2	12.31
315134	1ROAVALA	44.73
315135	1ROAVALB	11.93
315083	1SPRUNCA	15.82
315084	1SPRUNCB	15.82
315085	1SPRUNCC	11.73
315086	1SPRUNCD	11.73
315073	1STONECA	10.35
315233	1SURRY 2	47.93
314784	1WEYRHSB	3.47
315090	1YORKTN1	46.42
315091	1YORKTN2	48.17
314539	3UNCAMP	4.09

314541	3WATKINS	1.15
314189	6PAPERMILL	8.91
931041	AC2-012 C OP	17.87
931042	AC2-012 E OP	29.15
931531	AC2-073 C	3.18
931532	AC2-073 E	1.6
931581	AC2-078 C OP	6.76
931582	AC2-078 E OP	11.03
931591	AC2-079 C OP	11.43
931592	AC2-079 E OP	18.65
931631	AC2-084 C	13.99
931632	AC2-084 E	6.89
931701	AC2-093 C	130.65
931702	AC2-093 E	74.73
931761	AC2-100 C	7.55
931762	AC2-100 E	3.68
931831	AC2-110 C	1.81
931832	AC2-110 E	2.95
292791	U1-032 E	5.39
900672	V4-068 E	0.49
901082	W1-029 E	79.47
907092	X1-038 E	10.21
913392	Y1-086 E	3.8
916042	Z1-036 E	78.01
916192	Z1-068 E	3.29
916301	Z1-086 C	94.64
916302	Z1-086 E	16.83
917122	Z2-027 E	1.84
917332	Z2-043 E	1.62
917342	Z2-044 E	0.89
LTF	Z2-067	29.66
917512	Z2-088 E OP1	12.53
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	13.86
921163	AA1-063AE	6.53
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
921562	AA1-135 C	14.96
921563	AA1-135 E	6.41
921572	AA1-138 C	16.72
921573	AA1-138 E	7.17
921582	AA1-139 C	26.21
921583	AA1-139 E	11.23
921752	AA2-053 C	14.07
921753	AA2-053 E	6.04
921762	AA2-057 C	11.14
921763	AA2-057 E	5.57
921772	AA2-059 C	2.01
921773	AA2-059 E	0.95
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	17.48
922442	AA2-165 C	1.52
922443	AA2-165 E	0.73
922472	AA2-169 C	3.43
922473	AA2-169 E	1.58
922512	AA2-174 C	0.64
922513	AA2-174 E	0.7
922522	AA2-177 C	15.78
922523	AA2-177 E	6.76
922532	AA2-178 C	16.23
922533	AA2-178 E	6.95
922602	AB1-013 C	4.9
922603	AB1-013 E	32.77
922922	AB1-081 C OP	13.7
922923	AB1-081 E OP	5.87
923262	AB1-132 C OP	22.69
923263	AB1-132 E OP	9.72

923272	AB1-135 C OP	3.41
923273	AB1-135 E OP	1.46
923572	AB1-173 C OP	3.65
923573	AB1-173 E OP	1.7
923582	AB1-173AC OP	3.65
923583	AB1-173AE OP	1.7
923801	AB2-015 C OP	14.49
923802	AB2-015 E OP	11.88
923831	AB2-022 C	4.
923832	AB2-022 E	2.15
923841	AB2-024 C	3.33
923842	AB2-024 E	1.5
923851	AB2-025 C	4.08
923852	AB2-025 E	1.83
923861	AB2-026 C	3.74
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	13.94
923982	AB2-039 E OP	11.27
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	240.41
924072	AB2-051 E OP	33.01
924151	AB2-059 C OP	16.15
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	335.82
924301	AB2-077 C OP	2.85
924302	AB2-077 E OP	1.9
924311	AB2-078 C OP	2.85
924312	AB2-078 E OP	1.9
924321	AB2-079 C OP	2.85
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	1.66
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	18.53
924512	AB2-100 E	9.13
924761	AB2-128 C	15.88
924762	AB2-128 E	6.25
924811	AB2-134 C OP	20.23
924812	AB2-134 E OP	27.05
924931	AB2-147 C	4.13
924932	AB2-147 E	6.75
924941	AB2-149 C OP	5.72
924942	AB2-149 E OP	9.33
924951	AB2-150 C OP	4.13
924952	AB2-150 E OP	6.75
925051	AB2-160 C OP	8.36
925052	AB2-160 E OP	13.65
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	8.18
925142	AB2-171 E OP	13.34
925171	AB2-174 C OP	11.39
925172	AB2-174 E OP	10.3
925221	AB2-176 C	2.32
925222	AB2-176 E	1.
925281	AB2-186 C	1.05
925282	AB2-186 E	0.45
925291	AB2-188 C OP	4.

925292	<i>AB2-188 E OP</i>	<i>1.8</i>
925331	<i>AB2-190 C</i>	<i>36.06</i>
925332	<i>AB2-190 E</i>	<i>9.02</i>
925521	<i>AC1-027 C</i>	<i>3.51</i>
925522	<i>AC1-027 E</i>	<i>2.01</i>
925591	<i>AC1-034 C OP</i>	<i>10.63</i>
925592	<i>AC1-034 E OP</i>	<i>8.02</i>
925611	<i>AC1-036 C</i>	<i>1.32</i>
925612	<i>AC1-036 E</i>	<i>2.15</i>
925691	<i>AC1-045 C</i>	<i>2.97</i>
925692	<i>AC1-045 E</i>	<i>1.62</i>
925701	<i>AC1-046 C</i>	<i>3.05</i>
925702	<i>AC1-046 E</i>	<i>1.67</i>
925711	<i>AC1-047 C</i>	<i>4.04</i>
925712	<i>AC1-047 E</i>	<i>2.23</i>
925781	<i>AC1-054 C OP</i>	<i>10.95</i>
925782	<i>AC1-054 E OP</i>	<i>5.04</i>
925811	<i>AC1-060</i>	<i>0.1</i>
925821	<i>AC1-061</i>	<i>0.06</i>
925831	<i>AC1-062</i>	<i>0.43</i>
925841	<i>AC1-063</i>	<i>0.52</i>
925861	<i>AC1-065 C</i>	<i>4.52</i>
925862	<i>AC1-065 E</i>	<i>7.37</i>
926071	<i>AC1-086 C</i>	<i>33.41</i>
926072	<i>AC1-086 E</i>	<i>15.21</i>
926201	<i>AC1-098 C</i>	<i>9.81</i>
926202	<i>AC1-098 E</i>	<i>5.85</i>
926211	<i>AC1-099 C</i>	<i>3.29</i>
926212	<i>AC1-099 E</i>	<i>1.93</i>
926271	<i>AC1-105 C OP</i>	<i>7.94</i>
926272	<i>AC1-105 E OP</i>	<i>3.95</i>
926291	<i>AC1-107 OP</i>	<i>506.9</i>
926661	<i>AC1-147 C</i>	<i>3.95</i>
926662	<i>AC1-147 E</i>	<i>2.32</i>
926741	<i>AC1-159 C</i>	<i>238.55</i>
926751	<i>AC1-161 C OP</i>	<i>54.44</i>
926752	<i>AC1-161 E OP</i>	<i>23.24</i>
926761	<i>AC1-162 C</i>	<i>38.43</i>
926762	<i>AC1-162 E</i>	<i>16.4</i>

926771	AC1-163 C	3.48
926772	AC1-163 E	1.63
926781	AC1-164 C OP	69.95
926782	AC1-164 E OP	31.43
927021	AC1-189 C	13.59
927022	AC1-189 E	6.77
927051	AC1-193 C	6.
927052	AC1-193 E	9.78
927111	AC1-206 C OP	19.22
927112	AC1-206 E OP	9.09
927141	AC1-208 C	14.16
927142	AC1-208 E	6.29
927211	AC1-215 C	16.13
927212	AC1-215 E	7.32
927221	AC1-216 C OP	15.44
927222	AC1-216 E OP	12.14
927251	AC1-221 C	4.27
927252	AC1-221 E	2.29