

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-216***

***Hopewell – Surry 230kV
54.8 MW Capacity / 97.9 MW Energy***

May / 2017

Introduction

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

Preface

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

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

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

General

The IC has proposed a solar generating facility located in Surry County, VA. The installed facilities will have a total capability of 97.9 MW with 54.8 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 9/30/2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-216 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 Hopewell - Surry 230kV line # 212.

Option 2 will connect via a new three breaker ring bus switching station that connects on the Chickahominy – Surry 500kV line.

Cost Summary

The AC1-216 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$1,800,000
Direct Connection Network Upgrades	\$0
Non Direct Connection Network Upgrades	\$2,500,000
Total Costs	\$4,300,000

In addition, the AC1-216 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$0
Previously Identified Upgrades	\$24,115,000
Total Costs	\$24,115,000

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

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

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$600,000.

Transmission: Build approximately 0.5 miles of 230 kV Line. Estimated Cost \$1,200,000

The estimated total cost of the Attachment Facilities is \$1,800,000. It is estimated to take 30-36 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. The single line is shown below in Attachment 1.

Non-Direct Connection Cost Estimate

Substation: Add one 230 kV breaker at AB2-134 Substation to interconnect the proposed AC1-216 Project and associated equipment. Estimated Cost \$1,500,000.

Transmission: Re-arrange existing lines to accommodate new 230 kV Line. Estimated Cost \$1,000,000.

The estimated total cost of the Direct Connection Facilities is \$2,500,000. It is estimated to take 36-48 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.

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.

Contributions to Previously Identified System Reinforcements

Reinforcement: Upgrade the Prince George 230/115kV transformer. It is estimated to take 24-28 months to complete and it is estimated to cost \$5,500,000 to resolve this deficiency.

Reinforcement: Rebuild of the Chesterfield-Basin 230kV line. It is estimated to take 44 – 48 months to complete and it is estimated to cost \$18,615,000 to resolve the deficiency.

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>

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.

Option One

Network Impacts

The Queue Project AC1-216 was evaluated as a 97.9 MW (Capacity 54.8 MW) injection tapping the Hopewell-Surry 230kV line (AB2-134 Tap) in the ITO area. Project AC1-216 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-216 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
562T563	CONTINGENCY '562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
BASIN 230 B#2	CONTINGENCY 'BASIN 230 B#2' /* OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314274 CKT 2 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
LN 211-228	CONTINGENCY 'LN 211-228' OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B 230.00 - 6HOPEWLL 230.00 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

Contingency Name	Description
LN 217	CONTINGENCY 'LN 217' OPEN BRANCH FROM BUS 314225 TO BUS 314227 CKT 1 /* 6CHARCTY 230.00 - 6LAKESD 230.00 OPEN BRANCH FROM BUS 314225 TO BUS 314228 CKT 1 /* 6CHARCTY 230.00 - 6MESSER 230.00 OPEN BRANCH FROM BUS 314228 TO BUS 314287 CKT 1 /* 6MESSER 230.00 - 6CHSTF B 230.00 OPEN BUS 314225 /* ISLAND OPEN BUS 314228 /* ISLAND END
LN 259	CONTINGENCY 'LN 259' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 259-2065	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 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
T672B	CONTINGENCY 'T672B' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

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		
1	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	134.26	135.35	LD	459	11.16	1

Contingency			Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
#	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
2	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	110.68	112.18	ER	375	5.62	
3	N-1	LN 576	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	107.64	108.87	ER	375	4.6	
4	LFFB	T672B	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	102.21	103.19	LD	459	10.05	
5	LFFB	562T563	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	101.94	102.7	LD	459	7.8	
6	DCTL	LN 259-2065	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.76	101.74	LD	459	9.97	
7	BUS	BASIN 230 B#2	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.53	101.52	LD	459	9.99	
8	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	146.02	147.12	LD	459	11.16	2
9	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	125.08	126.57	ER	375	5.62	
10	N-1	LN 576	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	122.04	123.27	ER	375	4.6	
11	LFFB	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	113.97	114.96	LD	459	10.05	
12	LFFB	562T563	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	113.73	114.49	LD	459	7.8	
13	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.52	113.5	LD	459	9.97	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
14	BUS	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.3	113.28	LD	459	9.99	
15	DCTL	LN 211-228	DVP - DVP	6PRGEORG 230/115 kV transformer	314269	314291	1	DC	115.89	124.71	LD	220	19.4	3
16	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	146.17	147.27	LD	459	11.16	4
17	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	125.26	126.76	ER	375	5.62	
18	N-1	LN 576	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	122.23	123.46	ER	375	4.6	
19	LFFB	T672B	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	114.12	115.11	LD	459	10.05	
20	LFFB	562T563	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	113.88	114.64	LD	459	7.8	
21	DCTL	LN 259-2065	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.68	113.65	LD	459	9.97	
22	BUS	BASIN 230 B#2	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.45	113.43	LD	459	9.99	
23	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	124.31	125.67	ER	449	6.09	5
24	N-1	LN 217	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	102.92	104.44	ER	449	6.84	

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)

None

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
# 1 – 7	6CHARCTY-6LAKESD 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	\$
# 8 - 14	6MESSER-6CHARCTY 230 kV line			
# 16 – 22	6CHSTF B-6MESSER 230 kV line			
# 15	6PRGEORG 230/115 kV transformer			\$5,500,000
# 23 - 24	6CHSTF B-6BASIN 230 kV line	Rebuild of the Chesterfield-Basin 230kV line. Estimated time: 44-48 months.	Pending	\$18,615,000
Total New Network Upgrades				\$24,115,000

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	
25	N-1	LN 574	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314150	1	DC	106.47	107.02	ER	749	9.11
26	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	122.79	124	ER	375	10.04
27	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	137.19	138.4	ER	375	10.04
28	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	137.38	138.59	ER	375	10.04
29	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	151.17	152.26	ER	449	10.87
30	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	151.07	151.54	ER	2442	25.99
31	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	170.81	171.39	ER	2442	31.5
32	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	136.82	137.3	ER	2442	25.84

Light Load Analysis

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

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-216 interconnection of a 97.9 MW Energy (54.8 MW Capacity) injection into the ITO's Transmission System at the AB2-134 switching station located between Hopewell – Surry Substations on 230kV Line #212, 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 – Same as PJM identified deficiencies
2. Critical System Condition (No Surry 230 kV Unit) – Same as PJM identified deficiencies.

Category C Analysis: (Multiple Facility Analysis)

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

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

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

Option Two

Network Impacts

The Queue Project AC1-216 was evaluated as a 97.9 MW (Capacity 54.8 MW) injection tapping the Surry-Chickahominy 500kV line in the ITO area. Project AC1-216 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-216 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
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 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

Contingency Name	Description
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
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 557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	99.82	100.48	ER	2442	16.24	6

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		

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
2	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	115.94	117.16	ER	442	5.35	7
3	LFFB	H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	DC	105.22	105.92	LD	1051	16.21	8
4	N-1	LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	DC	103.63	104.84	ER	442	5.35	9
5	N-1	LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	DC	107.5	108.71	ER	442	5.35	10
6	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	119.63	120.69	LD	3351	35.44	11
7	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	119.63	120.69	LD	3351	35.44	
8	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	119.56	120.62	LD	3351	35.46	

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		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
9	N-1	LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	DC	112.86	113.83	ER	442	9.56
10	N-1	LN 574	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314150	1	DC	106.5	107.04	ER	749	8.93
11	N-1	LN 557	DVP - DVP	6NRTHEST-6ELMONT 230 kV line	314236	314218	1	DC	105.59	106.05	ER	679	6.94
12	N-1	LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	DC	100.55	101.52	ER	442	9.56
13	N-1	LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	DC	104.42	105.39	ER	442	9.56
14	N-1	LN 557	DVP - DVP	8CARSON-8MDLTHAN 500 kV line	314902	314914	1	DC	120.94	122.13	ER	2442	29.01
15	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	DC	120.43	122.37	ER	2442	47.29
16	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	164.04	165.49	ER	2442	35.46
17	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	134.13	134.58	ER	2442	24.56

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA	
18	N-1	LN 576	DVP - DVP	AC1-216 TAP-8CHCKAHM 500 kV line	927220	314903	1	DC	101.28	104.39	ER	1809	56.22

Light Load Analysis

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

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-216 interconnection of a 97.9 MW Energy (54.8 MW Capacity) injection into the ITO's Transmission System at a new interconnection switching station located between Chockmahominy – Surry Substations on 599kV Line #567, 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).

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 gauge 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 6CHARCTY-6LAKESD 230 kV line (from bus 314225 to bus 314227 ckt 1) loads from 134.26% to 135.35% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 11.16 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	35.89
315077	1HOPHCF1	2.08
315078	1HOPHCF2	2.08
315079	1HOPHCF3	2.08
315080	1HOPHCF4	3.16
315076	1HOPPOLC	1.78
315073	1STONECA	5.66
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.24
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.89
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.46
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.84
916042	Z1-036 E	13.56
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	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	2.99
921573	AA1-138 E	1.28
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	0.71
921773	AA2-059 E	0.33
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	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.95
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.46

922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
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	4.91
923982	AB2-039 E OP	3.97
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.62
924071	AB2-051 C OP	38.98
924072	AB2-051 E OP	5.35
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	8.18
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.58
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18

925052	AB2-160 E OP	6.82
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	14.59
925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.24
925362	AC1-007 E OP	0.39
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	8.77
926072	AC1-086 E	3.99
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	38.68
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	6.47
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.25
927142	AC1-208 E	1.44

<i>927221</i>	<i>AC1-216 C OP</i>	<i>6.25</i>
<i>927222</i>	<i>AC1-216 E OP</i>	<i>4.91</i>

Appendix 2

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 146.02% to 147.12% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 11.16 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	35.89
315077	1HOPHCF1	2.08
315078	1HOPHCF2	2.08
315079	1HOPHCF3	2.08
315080	1HOPHCF4	3.16
315076	1HOPPOLC	1.78
315073	1STONECA	5.66
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.24
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.89
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.46
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.84
916042	Z1-036 E	13.56
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	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	2.99
921573	AA1-138 E	1.28
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	0.71
921773	AA2-059 E	0.33
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	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.95
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.46

922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
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	4.91
923982	AB2-039 E OP	3.97
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.62
924071	AB2-051 C OP	38.98
924072	AB2-051 E OP	5.35
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	8.18
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.58
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18

925052	AB2-160 E OP	6.82
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	14.59
925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.24
925362	AC1-007 E OP	0.39
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	8.77
926072	AC1-086 E	3.99
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	38.68
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	6.47
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.25
927142	AC1-208 E	1.44

<i>927221</i>	<i>AC1-216 C OP</i>	<i>6.25</i>
<i>927222</i>	<i>AC1-216 E OP</i>	<i>4.91</i>

Appendix 3

(DVP - DVP) The 6PRGEORG 230/115 kV transformer (from bus 314269 to bus 314291 ckt 1) loads from 115.89% to 124.71% (**DC power flow**) of its load dump rating (220 MVA) for the tower line contingency outage of 'LN 211-228'. This project contributes approximately 19.4 MW to the thermal violation.

CONTINGENCY 'LN 211-228'

OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B
230.00 - 6HOPEWLL 230.00

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315119	1GRAVEL3	1.89
315120	1GRAVEL4	1.89
315122	1GRAVEL6	1.9
315077	1HOPHCF1	3.97
315078	1HOPHCF2	3.97
315079	1HOPHCF3	3.97
315080	1HOPHCF4	6.02
315076	1HOPPOLC	3.39
315073	1STONECA	10.8
315116	1SURRY 1	19.71
315074	CIR_AB2-152	1.69
315075	CIR_AB2-152	1.67
292791	U1-032 E	5.63
914231	Y2-077	1.6
922522	AA2-177 C	11.1
922523	AA2-177 E	4.76
924811	AB2-134 C OP	14.23
924812	AB2-134 E OP	19.02
924961	AB2-152	4.22
925331	AB2-190 C	25.37
925332	AB2-190 E	6.34
925361	AC1-007 C OP	0.26

<i>925362</i>	<i>AC1-007 E OP</i>	<i>0.43</i>
<i>927221</i>	<i>AC1-216 C OP</i>	<i>10.86</i>
<i>927222</i>	<i>AC1-216 E OP</i>	<i>8.54</i>

Appendix 4

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 146.17% to 147.27% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 11.16 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	35.89
315077	1HOPHCF1	2.08
315078	1HOPHCF2	2.08
315079	1HOPHCF3	2.08
315080	1HOPHCF4	3.16
315076	1HOPPOLC	1.78
315073	1STONECA	5.66
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.24
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.89
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.46
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.84
916042	Z1-036 E	13.56
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	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	2.99
921573	AA1-138 E	1.28
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	0.71
921773	AA2-059 E	0.33
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	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.95
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.46

922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
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	4.91
923982	AB2-039 E OP	3.97
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.62
924071	AB2-051 C OP	38.98
924072	AB2-051 E OP	5.35
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	8.18
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.58
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18

925052	AB2-160 E OP	6.82
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	14.59
925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.24
925362	AC1-007 E OP	0.39
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	8.77
926072	AC1-086 E	3.99
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	38.68
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	6.47
927112	AC1-206 E OP	3.06
927141	AC1-208 C	3.25
927142	AC1-208 E	1.44

<i>927221</i>	<i>AC1-216 C OP</i>	<i>6.25</i>
<i>927222</i>	<i>AC1-216 E OP</i>	<i>4.91</i>

Appendix 5

(DVP - DVP) The 6CHSTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 124.31% to 125.67% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'LN 563'. This project contributes approximately 6.09 MW to the thermal violation.

CONTINGENCY 'LN 563'

OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON

500.00 - 8MDLTHAN 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	36.2
315141	1GASTONB	1.73
315119	1GRAVEL3	1.38
315120	1GRAVEL4	1.38
315121	1GRAVEL5	1.36
315122	1GRAVEL6	1.39
315117	1GRAVELC	0.47
315077	1HOPHCF1	1.95
315078	1HOPHCF2	1.95
315079	1HOPHCF3	1.95
315080	1HOPHCF4	2.95
315076	1HOPPOLC	1.66
315116	1SURRY 1	14.41
314314	3LOCKS	0.96
315074	CIR_AB2-152	0.83
315075	CIR_AB2-152	0.82
914231	Y2-077	0.78
921092	AA1-049 C	0.86
921162	AA1-063AC	3.8
921182	AA1-067 C	0.65
921532	AA1-132 C	2.65
921542	AA1-133 C	3.52
921552	AA1-134 C	3.61
921562	AA1-135 C	3.65
921572	AA1-138 C	3.7
921582	AA1-139 C	5.28
921752	AA2-053 C	3.88

921762	AA2-057 C	2.89
921772	AA2-059 C	0.89
921862	AA2-068 C	0.93
921982	AA2-088 C	2.78
922442	AA2-165 C	0.39
922472	AA2-169 C	0.86
922512	AA2-174 C	0.18
922522	AA2-177 C	6.22
922532	AA2-178 C	3.67
922602	AB1-013 C	1.11
922722	AB1-053 C	0.52
922732	AB1-054 C	2.95
922922	AB1-081 C OP	3.46
923262	AB1-132 C OP	6.99
923572	AB1-173 C OP	1.14
923582	AB1-173AC OP	1.14
923801	AB2-015 C OP	3.66
923831	AB2-022 C	0.83
923851	AB2-025 C	1.79
923911	AB2-031 C OP	1.13
923941	AB2-035 C	0.13
923981	AB2-039 C OP	5.27
923991	AB2-040 C OP	3.73
924071	AB2-051 C OP	48.69
924151	AB2-059 C OP	4.07
924381	AB2-087 C	0.24
924391	AB2-088 C	0.17
924491	AB2-098 C	0.22
924501	AB2-099 C	0.25
924511	AB2-100 C	6.39
924761	AB2-128 C	5.48
924811	AB2-134 C OP	7.97
924931	AB2-147 C	1.38
924941	AB2-149 C OP	1.77
924951	AB2-150 C OP	1.38
924961	AB2-152	2.07
925051	AB2-160 C OP	3.86
925061	AB2-161 C OP	2.13
925121	AB2-169 C OP	2.51

925141	AB2-171 C OP	2.09
925171	AB2-174 C OP	3.66
925281	AB2-186 C	0.23
925291	AB2-188 C OP	0.9
925331	AB2-190 C	14.22
925361	AC1-007 C OP	0.27
925521	AC1-027 C	0.71
925591	AC1-034 C OP	2.65
925691	AC1-045 C	0.64
925701	AC1-046 C	0.61
925711	AC1-047 C	0.81
925821	AC1-061	0.03
926071	AC1-086 C	10.3
926201	AC1-098 C	2.56
926211	AC1-099 C	0.86
926661	AC1-147 C	0.81
926741	AC1-159 C	48.32
926771	AC1-163 C	0.88
927021	AC1-189 C	3.3
927051	AC1-193 C	1.53
927141	AC1-208 C	3.95
927221	AC1-216 C OP	6.09

Appendix 6

(DVP - DVP) The 8CARSON-8MDLTHAN 500 kV line (from bus 314902 to bus 314914 ckt 1) loads from 99.82% to 100.48% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 16.24 MW to the thermal violation.

CONTINGENCY 'LN 557'

OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM
230.00 - 8CHCKAHM 500.00

OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM
500.00 - 8ELMONT 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315102	1BRUNSWICKG1	17.98
315103	1BRUNSWICKG2	17.98
315104	1BRUNSWICKG3	17.98
315105	1BRUNSWICKS1	37.36
315099	1CHESPKB	2.06
315108	1ELIZAR1	6.07
315109	1ELIZAR2	5.96
315110	1ELIZAR3	6.15
315233	1SURRY 2	48.81
315091	1YORKTN2	38.42
916191	Z1-068 C	0.08
916301	Z1-086 C	109.76
LTF	Z2-067	27.59
921092	AA1-049 C	3.92
LTF	AA1-058	1.22
921162	AA1-063AC	12.23
921172	AA1-064 C	15.51
921182	AA1-067 C	2.46
921532	AA1-132 C	12.11
921542	AA1-133 C	16.21
921552	AA1-134 C	15.69
921562	AA1-135 C	13.61
921572	AA1-138 C	15.28
921582	AA1-139 C	24.31
921752	AA2-053 C	12.43
921762	AA2-057 C	10.05
921772	AA2-059 C	3.72
921862	AA2-068 C	3.17
LTF	AA2-074	8.21

921982	AA2-088 C	9.54
922442	AA2-165 C	1.37
922472	AA2-169 C	2.96
922512	AA2-174 C	0.57
922522	AA2-177 C	10.18
922532	AA2-178 C	14.85
922602	AB1-013 C	4.48
922722	AB1-053 C	1.51
922732	AB1-054 C	10.06
922922	AB1-081 C OP	12.49
923262	AB1-132 C OP	19.96
923572	AB1-173 C OP	3.15
923582	AB1-173AC OP	3.15
923801	AB2-015 C OP	12.93
923831	AB2-022 C	3.7
923851	AB2-025 C	3.4
923911	AB2-031 C OP	3.13
923941	AB2-035 C	0.48
923981	AB2-039 C OP	11.06
923991	AB2-040 C OP	10.27
924021	AB2-043 C OP	3.64
924071	AB2-051 C OP	221.51
924151	AB2-059 C OP	14.72
924241	AB2-068 OP	314.04
924301	AB2-077 C OP	2.33
924311	AB2-078 C OP	2.33
924321	AB2-079 C OP	2.33
924381	AB2-087 C	0.84
924391	AB2-088 C	0.61
924401	AB2-089 C	2.76
924411	AB2-090 C	4.59
924491	AB2-098 C	0.82
924501	AB2-099 C	0.87
924511	AB2-100 C	16.03
924761	AB2-128 C	13.73
924811	AB2-134 C OP	13.06
924931	AB2-147 C	3.52
924941	AB2-149 C OP	4.83
924951	AB2-150 C OP	3.52
925061	AB2-161 C OP	4.47
925121	AB2-169 C OP	9.71
925141	AB2-171 C OP	7.29
925171	AB2-174 C OP	9.79
925221	AB2-176 C	1.89
925281	AB2-186 C	0.95

925291	<i>AB2-188 C OP</i>	3.66
925331	<i>AB2-190 C</i>	23.28
925361	<i>AC1-007 C OP</i>	0.97
925521	<i>AC1-027 C</i>	3.24
925591	<i>AC1-034 C OP</i>	9.53
925691	<i>AC1-045 C</i>	2.63
925701	<i>AC1-046 C</i>	2.83
925711	<i>AC1-047 C</i>	3.76
925781	<i>AC1-054 C OP</i>	9.45
926071	<i>AC1-086 C</i>	29.39
926201	<i>AC1-098 C</i>	8.82
926211	<i>AC1-099 C</i>	2.95
926271	<i>AC1-105 C OP</i>	8.5
926281	<i>AC1-106</i>	3.03
926661	<i>AC1-147 C</i>	3.63
926741	<i>AC1-159 C</i>	219.81
926751	<i>AC1-161 C OP</i>	40.09
926771	<i>AC1-163 C</i>	3.13
927021	<i>AC1-189 C</i>	12.42
927051	<i>AC1-193 C</i>	5.35
927141	<i>AC1-208 C</i>	12.58
927211	<i>AC1-215 C</i>	12.6
927221	<i>AC1-216 C OP</i>	16.24
927251	<i>AC1-221 C</i>	3.99
927261	<i>AC1-222 C</i>	5.96

Appendix 7

(DVP - DVP) The 6SKIFF CREEK-6KINGS M 230 kV line (from bus 314209 to bus 314386 ckt 1) loads from 115.94% to 117.16% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 5.35 MW to the thermal violation.

CONTINGENCY 'LN 557'

OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM
230.00 - 8CHCKAHM 500.00

OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM
500.00 - 8ELMONT 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315099	1CHESPKB	0.53
315108	1ELIZAR1	1.56
315109	1ELIZAR2	1.53
315110	1ELIZAR3	1.58
315233	1SURRY 2	16.08
315091	1YORKTN2	23.96
315092	1YORKTN3	22.11
314421	6WINCHST	0.12
916191	Z1-068 C	0.02
921092	AA1-049 C	0.99
921532	AA1-132 C	3.05
921542	AA1-133 C	4.09
921552	AA1-134 C	3.87
921572	AA1-138 C	3.66
921582	AA1-139 C	6.14
921772	AA2-059 C	0.87
921982	AA2-088 C	1.9
922532	AA2-178 C	3.34
922602	AB1-013 C	1.01
923801	AB2-015 C OP	2.77
923831	AB2-022 C	0.92
924071	AB2-051 C OP	56.77
924241	AB2-068 OP	103.46
924941	AB2-149 C OP	1.01
925121	AB2-169 C OP	1.97
925141	AB2-171 C OP	1.52
925281	AB2-186 C	0.22

925291	AB2-188 C OP	0.82
925361	AC1-007 C OP	0.33
925521	AC1-027 C	0.83
925691	AC1-045 C	0.75
925701	AC1-046 C	0.72
925711	AC1-047 C	0.95
926661	AC1-147 C	0.93
926741	AC1-159 C	56.33
926751	AC1-161 C OP	10.79
927051	AC1-193 C	1.12
927221	AC1-216 C OP	5.35

Appendix 8

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 105.22% to 105.92% (**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 16.21 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	4.87
315068	1DARBY 2	4.87
315069	1DARBY 3	4.93
315070	1DARBY 4	4.93
315043	1FRIVERA	6.55
315044	1FRIVERB	5.07
315045	1FRIVERC	6.55
315046	1FRIVERD	5.07
315047	1FRIVERE	5.07
315048	1FRIVERF	6.55
315073	1STONECA	9.14
314784	1WEYRHSB	1.71
315091	1YORKTN2	31.74
314539	3UNCAMP	2.15
314541	3WATKINS	0.6
314229	6MT R221	1.42
314236	6NRTHEST	0.36
314189	6PAPERMILL	8.79
314251	6S PUMP	1.65
315074	CIR_AB2-152	11.02
315075	CIR_AB2-152	10.88
292791	U1-032 E	4.76
297087	V2-040	0.27
900672	V4-068 E	0.25
901082	W1-029E	41.21

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

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

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

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

Appendix 9

(DVP - DVP) The 6PENNIMAN-6WALR209 230 kV line (from bus 314296 to bus 314415 ckt 1) loads from 103.63% to 104.84% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 5.35 MW to the thermal violation.

CONTINGENCY 'LN 557'

OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM
230.00 - 8CHCKAHM 500.00

OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM
500.00 - 8ELMONT 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315099	1CHESPKB	0.53
315108	1ELIZAR1	1.56
315109	1ELIZAR2	1.53
315110	1ELIZAR3	1.58
315233	1SURRY 2	16.08
315091	1YORKTN2	23.96
315092	1YORKTN3	22.11
314421	6WINCHST	0.12
916191	Z1-068 C	0.02
921092	AA1-049 C	0.99
921532	AA1-132 C	3.05
921542	AA1-133 C	4.09
921552	AA1-134 C	3.87
921572	AA1-138 C	3.66
921582	AA1-139 C	6.14
921772	AA2-059 C	0.87
921982	AA2-088 C	1.9
922532	AA2-178 C	3.34
922602	AB1-013 C	1.01
923801	AB2-015 C OP	2.77
923831	AB2-022 C	0.92
924071	AB2-051 C OP	56.77
924241	AB2-068 OP	103.46
924941	AB2-149 C OP	1.01
925121	AB2-169 C OP	1.97
925141	AB2-171 C OP	1.52
925281	AB2-186 C	0.22

925291	AB2-188 C OP	0.82
925361	AC1-007 C OP	0.33
925521	AC1-027 C	0.83
925691	AC1-045 C	0.75
925701	AC1-046 C	0.72
925711	AC1-047 C	0.95
926661	AC1-147 C	0.93
926741	AC1-159 C	56.33
926751	AC1-161 C OP	10.79
927051	AC1-193 C	1.12
927221	AC1-216 C OP	5.35

Appendix 10

(DVP - DVP) The 6KINGS M-6PENNIMAN 230 kV line (from bus 314386 to bus 314296 ckt 1) loads from 107.5% to 108.71% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 5.35 MW to the thermal violation.

CONTINGENCY 'LN 557'

OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM
230.00 - 8CHCKAHM 500.00

OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM
500.00 - 8ELMONT 500.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315099	1CHESPKB	0.53
315108	1ELIZAR1	1.56
315109	1ELIZAR2	1.53
315110	1ELIZAR3	1.58
315233	1SURRY 2	16.08
315091	1YORKTN2	23.96
315092	1YORKTN3	22.11
314421	6WINCHST	0.12
916191	Z1-068 C	0.02
921092	AA1-049 C	0.99
921532	AA1-132 C	3.05
921542	AA1-133 C	4.09
921552	AA1-134 C	3.87
921572	AA1-138 C	3.66
921582	AA1-139 C	6.14
921772	AA2-059 C	0.87
921982	AA2-088 C	1.9
922532	AA2-178 C	3.34
922602	AB1-013 C	1.01
923801	AB2-015 C OP	2.77
923831	AB2-022 C	0.92
924071	AB2-051 C OP	56.77
924241	AB2-068 OP	103.46
924941	AB2-149 C OP	1.01
925121	AB2-169 C OP	1.97
925141	AB2-171 C OP	1.52
925281	AB2-186 C	0.22

925291	AB2-188 C OP	0.82
925361	AC1-007 C OP	0.33
925521	AC1-027 C	0.83
925691	AC1-045 C	0.75
925701	AC1-046 C	0.72
925711	AC1-047 C	0.95
926661	AC1-147 C	0.93
926741	AC1-159 C	56.33
926751	AC1-161 C OP	10.79
927051	AC1-193 C	1.12
927221	AC1-216 C OP	5.35

Appendix 11

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 119.63% to 120.69% (**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 35.44 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	21.45
315061	1CHESTG7	8.41
315063	1CHESTG8	8.34
315062	1CHESTS7	3.82
315064	1CHESTS8	4.27
315067	1DARBY 1	5.48
315068	1DARBY 2	5.49
315069	1DARBY 3	5.56
315070	1DARBY 4	5.56
315073	1STONECA	12.44
315233	1SURRY 2	54.51
314784	1WEYRHSB	3.43
315091	1YORKTN2	53.71
314539	3UNCAMP	4.08
314541	3WATKINS	1.15
314229	6MT R221	1.36
314236	6NRTHEST	0.4
314189	6PAPERMILL	11.77
315074	CIR_AB2-152	15.
315075	CIR_AB2-152	14.8
292791	U1-032 E	6.48
297087	V2-040	0.26
900672	V4-068 E	0.49
901082	W1-029E	79.38
907092	X1-038 E	10.21

913392	Y1-086 E	3.79
916042	Z1-036 E	77.7
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	28.8
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	13.05
921533	AA1-132 E	5.59
921542	AA1-133 C	17.46
921543	AA1-133 E	7.48
921552	AA1-134 C	17.03
921553	AA1-134 E	7.3
921562	AA1-135 C	14.69
921563	AA1-135 E	6.3
921572	AA1-138 C	16.69
921573	AA1-138 E	7.15
921582	AA1-139 C	26.19
921583	AA1-139 E	11.22
921752	AA2-053 C	13.81
921753	AA2-053 E	5.93
921772	AA2-059 C	4.03
921773	AA2-059 E	1.85
921862	AA2-068 C	3.45
921863	AA2-068 E	1.58
LTF	AA2-074	8.46
920022	AA2-086 E	0.39
921982	AA2-088 C	10.63
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	32.53
922682	AB1-027 C	4.79
922683	AB1-027 E	2.05
922722	AB1-053 C	1.67
922723	AB1-053 E	0.94
922732	AB1-054 C	11.22
922733	AB1-054 E	5.53
923262	AB1-132 C OP	22.25
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
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	11.65
923992	AB2-040 E OP	9.54
924071	AB2-051 C OP	241.5
924072	AB2-051 E OP	33.16
924241	AB2-068 OP	416.64
LTF	AB2-075	4.55
LTF	AB2-076	5.35
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	23.1
924812	AB2-134 E OP	30.89
924931	AB2-147 C	4.05
924932	AB2-147 E	6.61
924941	AB2-149 C OP	5.87
924942	AB2-149 E OP	9.58
924951	AB2-150 C OP	4.05
924952	AB2-150 E OP	6.61
924961	AB2-152	4.86
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	9.61
925121	AB2-169 C OP	10.47
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	10.1
925281	AB2-186 C	1.03
925282	AB2-186 E	0.44
925291	AB2-188 C OP	3.97
925292	AB2-188 E OP	1.78
925331	AB2-190 C	41.19
925332	AB2-190 E	10.3
925361	AC1-007 C OP	1.2
925362	AC1-007 E OP	1.96
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	4.44
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	32.77
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	547.25
926411	AC1-112 C	3.73
926412	AC1-112 E	2.09
926661	AC1-147 C	3.97
926662	AC1-147 E	2.33
926741	AC1-159 C	239.64
926751	AC1-161 C OP	53.64
926752	AC1-161 E OP	22.9
926771	AC1-163 C	3.44
926772	AC1-163 E	1.61
926781	AC1-164 C OP	75.52
926782	AC1-164 E OP	33.93
927041	AC1-191 C	16.45
927042	AC1-191 E	8.19
927051	AC1-193 C	5.97
927052	AC1-193 E	9.75
927111	AC1-206 C OP	18.18
927112	AC1-206 E OP	8.59
927221	AC1-216 C OP	19.84
927222	AC1-216 E OP	15.6