

***Generation Interconnection  
System Impact Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AD1-022 /AD1-023***

***Cashie – Trowbridge 230kV  
77.7 MW Capacity / 120.0 MW Energy***

**December / 2019**

## **Introduction**

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, Section 205, as well as the System Impact Study Agreement between Sumac Solar LLC, 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 System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the IC. As a requirement for interconnection, the IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an IC may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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 Transmission Owners, the costs may be included in the study.

## **General**

The IC has proposed two solar generating facilities located in Bertie County, North Carolina. Queue project AD1-022 will have a total installed capability of 80 MW (51.8 MW Capacity) and AD1-023 will have a total installed capability of 40 MW (25.9 MW Capacity).

The AD1-022 and AD1-023 projects are behind the same point of interconnection and were evaluated as a single combined project in this System Impact Study. The installed AD1-022/AD1-023 facilities will have a total capability of 120 MW, with 77.7 MW of this output being recognized by PJM as capacity. The proposed in-service date for the combined project is June 1, 2019. This study does not imply an ITO commitment to this in-service date.

## **Point of Interconnection**

Queue project AD1-022/AD1-023 will interconnect with the ITO transmission system via a new three breaker ring bus that connects the Cashie – Trowbridge 230kV line.

## **Cost Summary**

The AD1-022/AD1-023 project will be responsible for the following costs:

<b>Description</b>	<b>Total Cost</b>
Attachment Facilities	\$ 1,800,000
Direct Connection Network Upgrades	\$ 6,300,000
Non Direct Connection Network Upgrades	\$ 1,000,000
Allocation for New System Upgrades	\$ 30,849,275
Contribution for Previously Identified Upgrades	\$ 3,568,565
<b>Total Costs</b>	<b>\$ 43,517,840</b>

## **Attachment Facilities**

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

Transmission: Construct approximately one span of 230 kV Attachment line between the generation substation and a new AD1-022/AD1-023 Switching Station. The estimated cost for this work is \$1,200,000.

The estimated total cost of the Attachment Facilities is \$1,800,000. It is estimated to take 18-24 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). 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. See Attachment 1.

## **Direct Connection Cost Estimate**

Substation: Establish the new 230 kV AD1-022/AD1-023 Switching Substation (interconnection substation). The arrangement in the substation will be as shown below on Dominion Attachment 1: One-Line Diagram. The estimated cost of this work scope is \$6,300,000. It is estimated to take 24-36 months to complete this work upon execution of an Interconnection Construction Service Agreement.

## **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 \$1,000,000 and is estimated to take 24-30 months to complete. See Attachment 1.

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.

## **New System Reinforcements**

PJM OATT 217.3 outlines cost responsibility for Network Upgrades and as the minimum amount of Network Upgrades required to resolve a single reliability criteria violation will not meet or exceed \$5,000,000 such costs shall be allocated to those Interconnection Requests in the New Services Queue that contribute to the need for such upgrades. Such allocations shall be made in proportion to each Interconnection Request's megawatt contribution to the need for these upgrades subject to the rules for minimum cost allocation thresholds in the PJM Manuals. For the purpose of applying the \$5,000,000 threshold, each reliability criteria violation shall be considered separately.

<b>Violation #</b>	<b>Ruling Violation #</b>	<b>Loading</b>	<b>Upgrade Description</b>	<b>Upgrade Cost</b>	<b>Allocated Cost</b>
# 2	2	From 99.49% To 103.65%	Rebuild the 20.5 miles of Dominion 230 kV Line #218 Everetts - Greenville	\$30,750,000	<b>\$30,750,000</b>
# 3, 4	3	From 46.36% To 58.16%	Replace relays at Everetts substation on the Poplar Chapel – Everetts 115 kV line # 25	\$500,000	<b>\$99,275</b>
# 1, 5	5	From 97.58% To 98.53%	Replace wave trap at Chickahominy substation on the Chickahominy – Elmont 500 kV line # 557	\$500,000	<b>\$0</b>
# 6	6	From 119.8% To 122.32%	Rebuild the 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway	\$13,000,000	<b>\$0</b>
# 7	7	From 104.77% To 105.05%	Replace the Elmont 500/230 kV transformer #1	\$22,000,000	<b>\$3,568,565</b>
# 8	8	From 103.05% To 104.2%	Reconductor 0.14 miles of the Chesterfield to Basin 230kV line.	\$250,000	<b>\$0</b>
# 9	9	From 228.05% To 231.78%	Battleboro – Rocky Mt. 115 kV line (Dominion – Duke Energy/Progress tie line)	\$0	<b>\$0</b>
# 10, 11	10	From 111.7% To 112.57%	Replace wave traps at both Ladysmith and Elmont substations for the Ladysmith – Elmont 500kV line #574.	\$700,000	<b>\$0</b>
# 10, 11	10	From 111.7% To 112.57%	Rebuild 26.2 miles of the Ladysmith to Elmont 500kV line #574	\$65,500,000	<b>\$0</b>
<b>Total Estimate Allocated Cost of Network Upgrades</b>					<b>\$ 34,417,840</b>

## **Interconnection Customer Requirements**

ITO's Facility Interconnection 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.

**Meteorological Data Reporting Requirement** - The solar generation facility shall, at a minimum, be required to provide the Transmission Provider with site-specific meteorological data including:

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

## **Revenue Metering and SCADA Requirements**

### **PJM Requirements**

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

### **Interconnected Transmission Owner Requirements**

Metering and SCADA/Communication equipment must meet the requirements outlined in section 3.1.6 Metering and Telecommunications of ITO's Facility Connection Requirement NERC Standard FAC-001 which is publically available at [www.dom.com](http://www.dom.com).

## Network Impacts

The Queue Projects AD1-022 and AD1-023 were evaluated as a 120.0 MW (Capacity 77.7 MW) injection into a new substation on the Cashie-Trowbridge 230kV transmission line in the Dominion zone. Projects AD1-022 and AD1-023 were evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Projects AD1-022 and AD1-023 were studied with a commercial probability of 100%. Potential network impacts were as follows:

### Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
DVP_P1-2: LN 2020	CONTINGENCY 'DVP_P1-2: LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 /* 6ECITYDP2 230.00 - 6ELIZ CT 230.00 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 /* 6ECITYDP2 230.00 - 6TANGLEW 230.00 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 /* 6TANGLEW 230.00 - 6WINFALL 230.00 OPEN BUS 313851 /* ISLAND OPEN BUS 314639 /* ISLAND OPEN BUS 913391 /* ISLAND OPEN BUS 913392 /* ISLAND END
DVP_P1-2: LN 2034-B	CONTINGENCY 'DVP_P1-2: LN 2034-B' OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 6EARLEYS 230.00 - 6CASHIE 230.00 OPEN BRANCH FROM BUS 933990 TO BUS 314620 CKT 1 /* AD1-023 TAP 230.00 - 6CASHIE 230.00 OPEN BUS 314620 /* ISLAND END
DVP_P1-2: LN 2058	CONTINGENCY 'DVP_P1-2: LN 2058' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6MORNSTR 230.00 END
DVP_P1-2: LN 2131A	CONTINGENCY 'DVP_P1-2: LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END

DVP_P1-2: LN 2181	<p>CONTINGENCY 'DVP_P1-2: LN 2181'</p> <p>OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00</p> <p>OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA- RMOUNT#4230.00 - 6NASH 230.00</p> <p>OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00</p> <p>OPEN BUS 314591 /* ISLAND: 6NASH 230.00</p> <p>END</p>
DVP_P1-2: LN 246	<p>CONTINGENCY 'DVP_P1-2: LN 246'</p> <p>OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00</p> <p>OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00</p> <p>OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00</p> <p>OPEN BUS 314575 /* ISLAND</p> <p>OPEN BUS 314590 /* ISLAND</p> <p>END</p>
DVP_P1-2: LN 247	<p>CONTINGENCY 'DVP_P1-2: LN 247'</p> <p>OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00</p> <p>OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00</p> <p>OPEN BUS 314648 /* ISLAND</p> <p>END</p>
DVP_P1-2: LN 557	<p>CONTINGENCY 'DVP_P1-2: LN 557'</p> <p>OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00</p> <p>OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00</p> <p>END</p>
DVP_P1-2: LN 563	<p>CONTINGENCY 'DVP_P1-2: LN 563'</p> <p>OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00</p> <p>END</p>
DVP_P1-2: LN 568	<p>CONTINGENCY 'DVP_P1-2: LN 568'</p> <p>OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1 /* 8LDYSMTH 500.00 - 8POSSUM 500.00</p> <p>END</p>
DVP_P1-2: LN 574	<p>CONTINGENCY 'DVP_P1-2: LN 574'</p> <p>OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00</p> <p>END</p>



DVP_P1-2: LN 576	CONTINGENCY 'DVP_P1-2: LN 576' OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
DVP_P4-2: 2014T2034	CONTINGENCY 'DVP_P4-2: 2014T2034' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 933990 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314569 TO BUS 314574 CKT 1 /* 2014 END
DVP_P4-2: 246T2034	CONTINGENCY 'DVP_P4-2: 246T2034' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 314537 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 246 - NUCOR OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 933990 CKT 1 /* 2034 END
DVP_P4-2: 562T563	CONTINGENCY 'DVP_P4-2: 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
DVP_P4-2: 563T576	CONTINGENCY 'DVP_P4-2: 563T576' /* MIDLOTHIAN 500 500 KV OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
DVP_P4-2: 57602	CONTINGENCY 'DVP_P4-2: 57602' /* NORTH ANNA 500 KV OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 OPEN BRANCH FROM BUS 314232 TO BUS 314918 CKT 1 /* 6NO ANNA 230.00 - 8NO ANNA 500.00 END
DVP_P4-2: H2T557	CONTINGENCY 'DVP_P4-2: 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

DVP_P4-2: WT576	<p>CONTINGENCY 'DVP_P4-2: WT576' /* NORTH ANNA 500 KV</p> <p>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00</p> <p>OPEN BRANCH FROM BUS 314232 TO BUS 314918 CKT 2 /* 6NO ANNA 230.00 - 8NO ANNA 500.00</p> <p>END</p>
DVP_P7-1: LN 2058-2181	<p>CONTINGENCY 'DVP_P7-1: LN 2058-2181'</p> <p>OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00</p> <p>OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00</p> <p>OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00</p> <p>OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00</p> <p>OPEN BUS 314591 /* ISLAND: 6NASH 230.00</p> <p>END</p>
DVP_P7-1: LN 81-2056	<p>CONTINGENCY 'DVP_P7-1: LN 81-2056'</p> <p>OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1 /* 3CAROLNA 115.00 - 3HORNRTN 115.00</p> <p>OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1 /* 3HORNRTN 115.00 - 3ROAN DP 115.00</p> <p>OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1 /* 3ROAN DP 115.00 - 3DARLINGT DP115.00</p> <p>OPEN BUS 314578 /* ISLAND: 3HORNRTN 115.00</p> <p>OPEN BUS 314598 /* ISLAND: 3ROAN DP 115.00</p> <p>OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00</p> <p>OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6MORNSTR 230.00 - 6NASH 230.00</p> <p>OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1 /* 6PA-RMOUNT#4230.00 - 6ROCKYMT230T</p> <p>OPEN BUS 304226 /* ISLAND</p> <p>OPEN BUS 314591 /* ISLAND: 6NASH 230.00</p> <p>END</p>

# Summer Peak Analysis – 2021

## Generator Deliverability

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

#	Contingency			Bus				Loading %		Rating		MW Contr	Flowgate Appendix	
	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type			MVA
1	N-1	DVP_P1-2: LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	AC	99.48	100.19	ER	2442	19.92	

## Multiple Facility Contingency

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

#	Contingency			Bus				Loading %		Rating		MW Contr	Flowgate Appendix	
	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type			MVA
2	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	99.49	103.65	ER	478	20.8	2
3	LFFB	DVP_P4-2: 2014T2034	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	46.36	58.16		239	29.29	4
4	LFFB	DVP_P4-2: 246T2034	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	39.46	51.88		239	30.62	
5	LFFB	DVP_P4-2: 563T576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	AC	97.58	98.53		3144	32.39	6

## 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			Facility Description	Bus			Power Flow	Loading %		Rating		MW Contr	Flowgate Appendix
	Type	Name	Affected Area		From	To	Ckt		Initial	Final	Type	MVA		
6	DCTL	DVP_P7-1: LN 81-2056	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	119.8	122.32	ER	374	11.2	7
7	LFFB	DVP_P4-2: H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	AC	104.77	105.05		1051	17.27	8
8	LFFB	DVP_P4-2: 562T563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	103.05	104.2		549	7.34	9
9	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	AC	228.05	231.78	ER	164	7.27	10
10	LFFB	DVP_P4-2: 57602	DVP - DVP	8ELMONT-8LADYSMITH 500 kV line	314908	314911	1	AC	111.7	112.57		3351	33.88	11
11	LFFB	DVP_P4-2: WT576	DVP - DVP	8ELMONT-8LADYSMITH 500 kV line	314908	314911	1	AC	111.7	112.57		3351	33.88	

### **Steady-State Voltage Requirements**

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

None

### **Stability and Reactive Power Requirement for Low Voltage Ride Through**

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

No mitigations were found to be required.

### **New System Reinforcements**

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-022 / AD1-023 Allocation									
#2	6EVERETS-6GREENVILE T 230 kV line	<p><b>Dominion Portion:</b>            Description: Rebuild the 20.5 miles of Dominion 230 kV Line #218 Everetts - Greenville            Rating: 1047/1047/1204            Schedule: 30-36 months</p> <table border="1" data-bbox="606 521 1329 662"> <thead> <tr> <th data-bbox="606 521 774 602">Queue</th> <th data-bbox="774 521 974 602">MW contribution</th> <th data-bbox="974 521 1329 602">Cost</th> </tr> </thead> <tbody> <tr> <td data-bbox="606 602 774 662"></td> <td data-bbox="774 602 974 662"></td> <td data-bbox="974 602 1329 662">\$30,750,000</td> </tr> <tr> <td data-bbox="606 662 774 711"><b>AD1-023</b></td> <td data-bbox="774 662 974 711">18.24</td> <td data-bbox="974 662 1329 711">\$30,750,000</td> </tr> </tbody> </table> <p><b>Duke Energy/Progress Portion:</b>            A potential constraint was identified by PJM on the Duke Energy/Progress (DEP) portion of the Everetts - Greenville 230 kV line. There are no mitigations currently planned for the DEP portion of this overload. The Queue Project AD1-022/AD1-023 may be subject to operational restriction if real-time system reliability issues occur. Additionally, if a baseline Network Upgrade project is identified on the Everetts - Greenville 230 kV line prior to the execution of the Queue Project's final agreements, the Queue Project may require this upgrade to be in-service to be deliverable to the PJM system. If Queue Project AD1-022/AD1-023 comes into service prior to completion of the baseline Network Upgrade, Queue Project AD1-022/AD1-023 will need an interim deliverability study.</p>	Queue	MW contribution	Cost			\$30,750,000	<b>AD1-023</b>	18.24	\$30,750,000	n6144	\$30,750,000	<b>\$30,750,000</b>
Queue	MW contribution	Cost												
		\$30,750,000												
<b>AD1-023</b>	18.24	\$30,750,000												

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-022 / AD1-023 Allocation									
#3, 4	3POPLR C-3EVERETS 115 kV line	<p>Description: Replace relays at Everetts substation on the Poplar Chapel – Everetts 115 kV line # 25 Rating: 300/300/345 Schedule: 14 – 16 months</p> <table border="1"> <thead> <tr> <th>Queue</th> <th>MW contribution</th> <th>Cost</th> </tr> </thead> <tbody> <tr> <td>AD1-023</td> <td>29.29</td> <td>\$99,275</td> </tr> <tr> <td>AD1-076</td> <td>118.23</td> <td>\$400,725</td> </tr> </tbody> </table>	Queue	MW contribution	Cost	AD1-023	29.29	\$99,275	AD1-076	118.23	\$400,725	n6141	\$500,000	\$99,275
Queue	MW contribution	Cost												
AD1-023	29.29	\$99,275												
AD1-076	118.23	\$400,725												
# 1, 5	8CHCKAHM-8ELMONT 500 kV line	<p>Description: Replace wave trap at Chickahominy substation on the Chickahominy – Elmont 500 kV line # 557 Rating: 3937/3937/4527 Schedule: 12 – 16 months</p> <p>Note 1: As changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AD1-022 / AD1-023 could become the driver and could be responsible for the upgrade</p> <p>Note 2: Although Queue Project AD1-022 / AD1-023 may not have cost responsibility for this upgrade, Queue Project AD1-022 / AD1-023 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-022 / AD1-023 comes into service prior to completion of the upgrade, Queue Project AD1-022 / AD1-023 will need an interim study.</p>	n5464	\$500,000	\$0									
<b>Total New Network Upgrades</b>					<b>\$ 30,849,275</b>									

## Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which is calculated and reported for in the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-022 / AD1-023 Allocation																					
# 6	6MORNSTR-6ROCKYMT230T 230 kV line	<p>Description: Rebuild the 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway                      Rating: 1047/1047/1204                      Schedule: 12/31/2024 in-service date</p> <p>Note: Although Queue Project AD1-022 / AD1-023 may not have cost responsibility for this upgrade, Queue Project AD1-022 / AD1-023 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-022 / AD1-023 comes into service prior to completion of the upgrade, Queue Project AD1-022 / AD1-023 will need an interim study.</p>	b3122	\$13,000,000	\$0																					
# 7	8ELMONT 500/230 kV transformer	<p>Description: Replace the Elmont 500/230 kV transformer #1                      Rating: 1134 MVA (normal), 1203 MVA (emergency), and 1365 MVA (load dump).                      Time Estimate: 24 - 30 Months                      Cost: \$22,000,000</p> <table border="1" data-bbox="661 1079 1270 1299"> <thead> <tr> <th>Queue</th> <th>MW contribution</th> <th>Cost</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>\$22,000,000</td> </tr> <tr> <td>AC2-012</td> <td>24.79</td> <td>\$5,084,180</td> </tr> <tr> <td>AC2-078</td> <td>12.13</td> <td>\$2,487,741</td> </tr> <tr> <td>AC2-079</td> <td>14.89</td> <td>\$3,053,790</td> </tr> <tr> <td>AC2-141</td> <td>38.06</td> <td>\$7,805,724</td> </tr> <tr> <td>AD1-023</td> <td>17.4</td> <td>\$3,568,565</td> </tr> </tbody> </table>	Queue	MW contribution	Cost			\$22,000,000	AC2-012	24.79	\$5,084,180	AC2-078	12.13	\$2,487,741	AC2-079	14.89	\$3,053,790	AC2-141	38.06	\$7,805,724	AD1-023	17.4	\$3,568,565	n6127	\$22,000,000	\$3,568,565
Queue	MW contribution	Cost																								
		\$22,000,000																								
AC2-012	24.79	\$5,084,180																								
AC2-078	12.13	\$2,487,741																								
AC2-079	14.89	\$3,053,790																								
AC2-141	38.06	\$7,805,724																								
AD1-023	17.4	\$3,568,565																								

<b>Violation #</b>	<b>Overloaded Facility</b>	<b>Upgrade Description</b>	<b>Network Upgrade Number</b>	<b>Upgrade Cost</b>	<b>AD1-022 / AD1-023 Allocation</b>
# 8	6CHSTF B-6BASIN 230 kV line	Description: Reconductor 0.14 miles of the Chesterfield to Basin 230kV line.  This project is in-service.	b2990	\$250,000	\$0
# 9	3BTLEBRO- 3ROCKYMT115T 115 kV line	A potential constraint was identified by PJM on the Battleboro – Rocky Mt. 115 kV line (Dominion – Duke Energy/Progress (DEP) tie line). There are no mitigations currently planned for the DEP portion of this overload. The Queue Project AD1-022/AD1-023 may be subject to operational restriction if real-time system reliability issues occur. Additionally, if a baseline Network Upgrade project is identified on the Battleboro – Rocky Mt. 115 kV line prior to the execution of the Queue Project’s final agreements, the Queue Project may require this upgrade to be in-service to be deliverable to the PJM system. If Queue Project AD1-022/AD1-023 comes into service prior to completion of the baseline Network Upgrade, Queue Project AD1-022/AD1-023 will need an interim deliverability study.			\$0



Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-022 / AD1-023 Allocation
# 10, 11	8ELMONT-8LADYSMITH 500 kV line	<p>Description: Replace wave traps at both Ladysmith and Elmont substations for the Ladysmith – Elmont 500kV line #574. Schedule: 12 – 16 months</p> <p>Note 1: As changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AD1-022 / AD1-023 could become the driver and could be responsible for the upgrade</p> <p>Note 2: Although Queue Project AD1-022 / AD1-023 may not have cost responsibility for this upgrade, Queue Project AD1-022 / AD1-023 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-022 / AD1-023 comes into service prior to completion of the upgrade, Queue Project AD1-022 / AD1-023 will need an interim study.</p>	n5483	\$700,000	\$0
		<p>Description: Rebuild 26.2 miles of the Ladysmith to Elmont 500kV line #574 Schedule:12/31/2025</p> <p>Note: Although Queue Project AD1-022 / AD1-023 may not have cost responsibility for this upgrade, Queue Project AD1-022 / AD1-023 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-022 / AD1-023 comes into service prior to completion of the upgrade, Queue Project AD1-022 / AD1-023 will need an interim study.</p>	b3020	\$65,500,000	\$0
<b>Total Previously Identified Upgrades</b>					<b>\$ 3,568,565</b>

## 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 interconnection request by addressing 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				Bus				Loading %		Rating		MW Contribution
	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type	MVA	
12	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	119.09	121.61	ER	374	11.17
13	N-1	DVP_P1-2: LN 2058	DVP - DVP	6MORNSTR-6NASH 230 kV line	313845	314591	1	AC	105.99	108.12	ER	449	11.39
14	N-1	DVP_P1-2: LN 557	DVP - DVP	6SKIFF CREEK-6KINGS M 230 kV line	314209	314386	1	AC	122.64	124.12	ER	442	6.66
15	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	120.25	121.66	ER	449	7.44
16	N-1	DVP_P1-2: LN 557	DVP - DVP	6PENNIMAN-6WALR209 230 kV line	314296	314415	1	AC	111.83	113.3	ER	442	6.66
17	N-1	DVP_P1-2: LN 557	DVP - DVP	6KINGS M-6PENNIMAN 230 kV line	314386	314296	1	AC	115.24	116.71	ER	442	6.66
18	N-1	DVP_P1-2: LN 557	DVP - DVP	6WALR209-6LIGH209 230 kV line	314415	314391	1	AC	98.09	99.56	ER	442	6.66
19	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6SAPONY-6CARSON 230 kV line	314435	314282	1	AC	83.23	86	ER	679	18.72
20	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	95.89	99.03	ER	599	18.72
21	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	AC	98.14	105.51	ER	572	42.97
22	N-1	DVP_P1-2: LN 2131A	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	80.51	85.5	ER	478	25.13
23	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6NUCO TP-6SUFFOLK 230 kV line	314575	314537	1	AC	91.93	99.3	ER	572	42.97
24	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	104.28	108.97	ER	375	17.89
25	Non	Non	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	83.6	86.27	NR	375	11.73
26	N-1	DVP_P1-2: LN 2058	DVP - CPLE	6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	AC	96.39	98.43	ER	470	11.39

27	N-1	DVP_P1-2: LN 2034-B	DVP - DVP	3POPLR C-3EVERETS 115 kV line	314596	314573	1	AC	40.9	54.24	ER	225	30.86
28	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6CASHIE-6EARLEYS 230 kV line	314620	314569	1	AC	52.41	67.96	ER	572	94.89
29	N-1	DVP_P1-2: LN 247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	AC	81.26	87.51	ER	572	35.47
30	N-1	DVP_P1-2: LN 2020	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	AC	97.51	104.82	ER	449	32.92
31	N-1	DVP_P1-2: LN 2020	DVP - DVP	6WINFALL-W1-029 230 kV line	314651	901080	1	AC	58.89	66.22	ER	449	32.95
32	N-1	DVP_P1-2: LN 246	DVP - DVP	6S HERTFORD-6WINFALL 230 kV line	314662	314651	1	AC	75.19	81.96	ER	733	49.31
33	N-1	DVP_P1-2: LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	AC	120.42	121.59	ER	2442	30.77
34	N-1	DVP_P1-2: LN 576	DVP - DVP	8ELMONT-8LADYSMITH 500 kV line	314908	314911	1	AC	153.16	154.35	ER	2442	33.89
35	N-1	DVP_P1-2: LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	AC	122.01	123.13	ER	2442	31.24
36	N-1	DVP_P1-2: LN 568	DVP - DVP	8SPOTSYL-8MORRSVL 500 kV line	314934	314916	1	AC	99.46	100.17	ER	3219	20.86
37	N-1	DVP_P1-2: LN 2020	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	AC	98.9	106.21	ER	449	32.92
38	N-1	DVP_P1-2: LN 246	DVP - DVP	Z1-036 TAP-6S HERTFORD 230 kV line	916040	314662	1	AC	77.35	84.13	ER	733	49.31
39	N-1	DVP_P1-2: LN 2131A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	118.73	123.35	ER	375	17.89
40	Non	Non	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	98.6	101.25	NR	375	11.73
41	N-1	DVP_P1-2: LN 2131A	DVP - DVP	AD1-023 TAP-6CASHIE 230 kV line	933990	314620	1	AC	54.17	69.7	ER	572	94.89

## **Light Load Analysis in 2021**

Not required

## **Affected System Analysis & Mitigation**

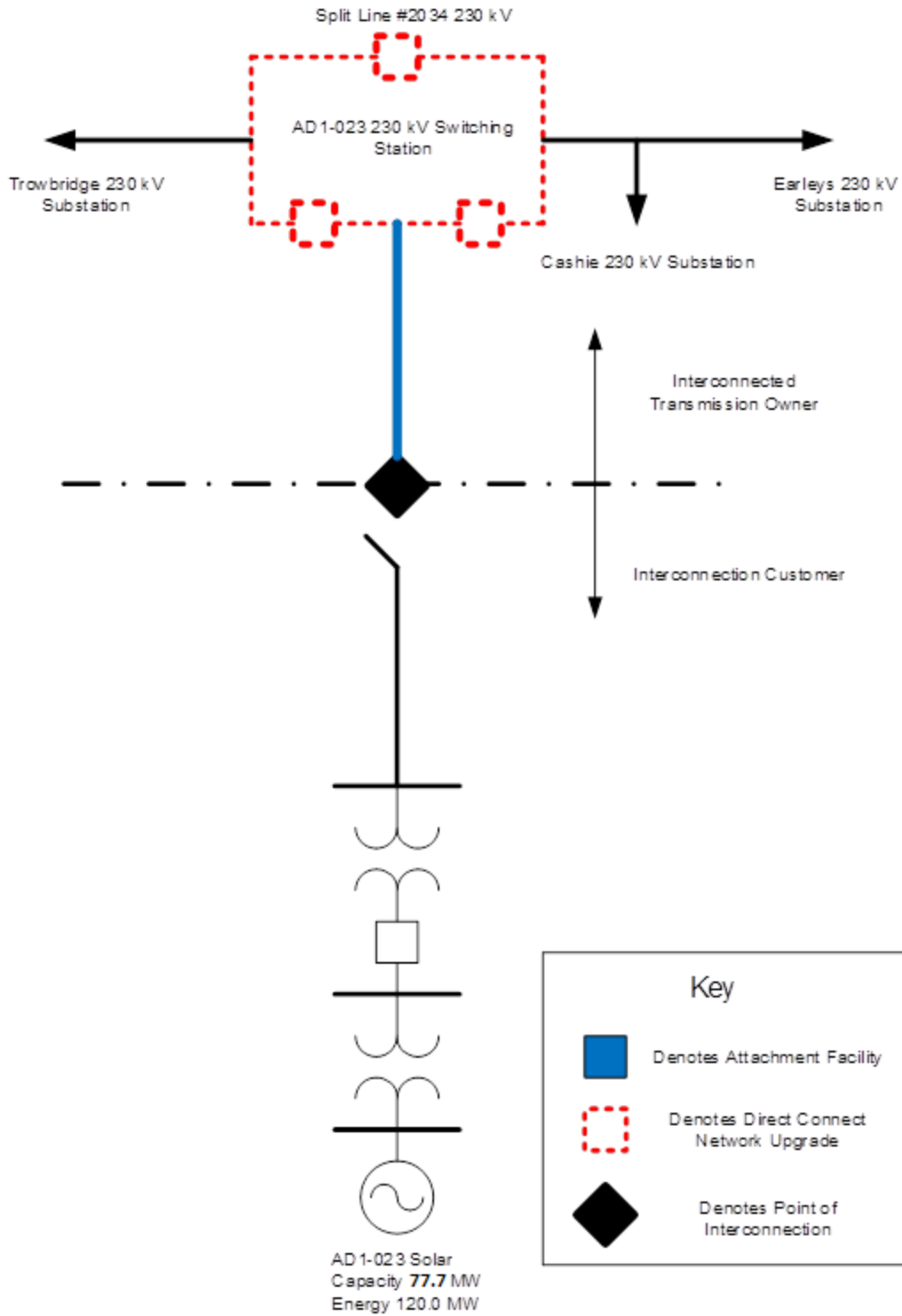
### **Duke Energy/Progress:**

Potential constraints were identified by PJM on the following Dominion – Duke Energy/Progress (DEP) tie lines. There are no mitigations currently planned for the DEP portions of these overloads. The Queue Project AD1-022/AD1-023 may be subject to operational restriction if real-time system reliability issues occur. The following facilities were identified in this report:

- Battleboro – Rocky Mt. 115 kV line
- Everetts - Greenville 230 kV line
- Rocky Mt. – Hathaway 230 kV line

# Attachment 1.

## System Configuration



## **Appendices**

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

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 2

(DVP - CPLE) The 6EVERETS-6GREENVILE T 230 kV line (from bus 314574 to bus 304451 ckt 1) loads from 99.49% to 103.65% (AC power flow) of its emergency rating (478 MVA) for the tower line contingency outage of 'DVP\_P7-1: LN 2058-2181'. This project contributes approximately 20.8 MW to the thermal violation.

CONTINGENCY 'DVP\_P7-1: LN 2058-2181'

OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /\*  
 6ROCKYMT230T230.00 - 6HATHAWAY 230.00  
 OPEN BUS 304226 /\* ISLAND: 6PA-RMOUNT#4115.00  
 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /\* 6PA-  
 RMOUNT#4230.00 - 6NASH 230.00  
 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /\* 6HATHAWAY  
 230.00 - 6NASH 230.00  
 OPEN BUS 314591 /\* ISLAND: 6NASH 230.00  
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315294	1DOMTR10	2.99
315292	1DOMTR78	2.02
315293	1DOMTR9	1.65
315131	1EDGECEMA	9.28
315132	1EDGECEMB	9.28
315136	1ROSEMG1	1.9
315138	1ROSEMG2	0.89
315137	1ROSEMS1	1.18
314557	3BETHEL C	1.14
314554	3BTLEBRO	0.43
314566	3CRESWEL	2.04
314572	3EMPORIA	0.21
314578	3HORNRTN	2.04
314582	3KELFORD	0.72
314603	3SCOT NK	2.51

314617	3TUNIS	0.7
314539	3UNCAMP	1.18
314541	3WATKINS	0.36
314620	6CASHIE	0.88
314574	6EVERETS	5.39
314594	6PLYMOTH	0.83
314648	6SUNBURY	0.4
314651	6WINFALL	0.97
932631	AC2-084 C	6.17
932632	AC2-084 E	3.04
933991	AD1-023 C	13.47
933992	AD1-023 E	7.33
934201	AD1-047 C	4.29
934202	AD1-047 E	2.86
934331	AD1-057 C O1	8.81
934332	AD1-057 E O1	4.7
934521	AD1-076 C O1	54.75
934522	AD1-076 E O1	27.88
LTF	AMIL	0.49
LTF	BLUEG	2.5
LTF	CALDERWOOD	1.54
LTF	CANNELTON	0.48
LTF	CATAWBA	1.51
LTF	CBM-N	< 0.01
LTF	CELEVELAND	/* 35% REVERSE 4479079 4642907
LTF	CHEOAH	1.44



<i>LTF</i>	<i>CHILHOWEE</i>	<i>0.5</i>
<i>LTF</i>	<i>CLIFTY</i>	<i>9.05</i>
<i>LTF</i>	<i>COTTONWOOD</i>	<i>5.21</i>
<i>LTF</i>	<i>EDWARDS</i>	<i>0.78</i>
<i>LTF</i>	<i>ELMERSMITH</i>	<i>1.42</i>
<i>LTF</i>	<i>FARMERCITY</i>	<i>0.62</i>
<i>LTF</i>	<i>G-007A</i>	<i>1.03</i>
<i>LTF</i>	<i>GIBSON</i>	<i>0.88</i>
<i>LTF</i>	<i>HAMLET</i>	<i>3.22</i>
<i>LTF</i>	<i>MORGAN</i>	<i>4.57</i>
<i>LTF</i>	<i>NEWTON</i>	<i>2.15</i>
<i>LTF</i>	<i>NYISO</i>	<i>0.08</i>
<i>LTF</i>	<i>O-066A</i>	<i>0.47</i>
<i>LTF</i>	<i>PRAIRIE</i>	<i>4.69</i>
<i>LTF</i>	<i>SANTEETLA</i>	<i>0.43</i>
<i>LTF</i>	<i>SMITHLAND</i>	<i>0.42</i>
<i>LTF</i>	<i>TATANKA</i>	<i>1.05</i>
<i>LTF</i>	<i>TILTON</i>	<i>0.92</i>
<i>LTF</i>	<i>TRIMBLE</i>	<i>0.47</i>
<i>LTF</i>	<i>TVA</i>	<i>1.92</i>
<i>LTF</i>	<i>UNIONPOWER</i>	<i>2.56</i>
<i>900672</i>	<i>V4-068 E</i>	<i>0.21</i>
<i>LTF</i>	<i>VFT</i>	<i>2.74</i>
<i>901082</i>	<i>W1-029E</i>	<i>23.38</i>
<i>907092</i>	<i>X1-038 E</i>	<i>2.96</i>
<i>913392</i>	<i>Y1-086 E</i>	<i>1.05</i>

<i>LTF</i>	<i>Y3-032</i>	<i>&lt; 0.01</i>
<i>916042</i>	<i>Z1-036 E</i>	<i>29.13</i>
<i>917122</i>	<i>Z2-027 E</i>	<i>0.51</i>
<i>917331</i>	<i>Z2-043 C</i>	<i>0.38</i>
<i>917332</i>	<i>Z2-043 E</i>	<i>0.86</i>
<i>917342</i>	<i>Z2-044 E</i>	<i>0.33</i>
<i>917511</i>	<i>Z2-088 C OPI</i>	<i>1.46</i>
<i>917512</i>	<i>Z2-088 E OPI</i>	<i>6.13</i>
<i>918411</i>	<i>AA1-050</i>	<i>1.23</i>
<i>918492</i>	<i>AA1-063AE OP</i>	<i>2.44</i>
<i>918511</i>	<i>AA1-065 C OP</i>	<i>1.85</i>
<i>918512</i>	<i>AA1-065 E OP</i>	<i>4.84</i>
<i>918531</i>	<i>AA1-067 C</i>	<i>0.71</i>
<i>918532</i>	<i>AA1-067 E</i>	<i>1.62</i>
<i>918561</i>	<i>AA1-072 C</i>	<i>0.06</i>
<i>918562</i>	<i>AA1-072 E</i>	<i>0.14</i>
<i>919692</i>	<i>AA2-053 E</i>	<i>2.58</i>
<i>919701</i>	<i>AA2-057 C</i>	<i>4.25</i>
<i>919702</i>	<i>AA2-057 E</i>	<i>2.12</i>
<i>920042</i>	<i>AA2-088 E</i>	<i>6.25</i>
<i>920592</i>	<i>AA2-165 E</i>	<i>0.28</i>
<i>920672</i>	<i>AA2-174 E</i>	<i>0.3</i>
<i>920691</i>	<i>AA2-178 C</i>	<i>1.53</i>
<i>920692</i>	<i>AA2-178 E</i>	<i>3.5</i>
<i>930402</i>	<i>AB1-081 E</i>	<i>2.42</i>
<i>930861</i>	<i>AB1-132 C</i>	<i>10.36</i>

930862	<i>AB1-132 E</i>	4.44
931231	<i>AB1-173 C</i>	1.21
931232	<i>AB1-173 E</i>	0.56
931241	<i>AB1-173AC</i>	1.21
931242	<i>AB1-173AE</i>	0.56
923801	<i>AB2-015 C O1</i>	4.4
923802	<i>AB2-015 E O1</i>	3.61
923831	<i>AB2-022 C</i>	1.02
923832	<i>AB2-022 E</i>	0.55
923911	<i>AB2-031 C O1</i>	1.2
923912	<i>AB2-031 E O1</i>	0.59
923991	<i>AB2-040 C O1</i>	3.93
923992	<i>AB2-040 E O1</i>	3.22
924151	<i>AB2-059 C O1</i>	6.64
924152	<i>AB2-059 E O1</i>	3.42
924491	<i>AB2-098 C</i>	1.26
924492	<i>AB2-098 E</i>	0.54
924501	<i>AB2-099 C</i>	0.53
924502	<i>AB2-099 E</i>	0.23
924511	<i>AB2-100 C</i>	5.85
924512	<i>AB2-100 E</i>	2.88
925121	<i>AB2-169 C</i>	10.02
925122	<i>AB2-169 E</i>	8.99
925171	<i>AB2-174 C O1</i>	3.64
925172	<i>AB2-174 E O1</i>	3.29
925591	<i>AC1-034 C</i>	4.3

925592	<i>ACI-034 E</i>	3.25
926071	<i>ACI-086 C</i>	15.26
926072	<i>ACI-086 E</i>	6.94
926201	<i>ACI-098 C</i>	4.33
926202	<i>ACI-098 E</i>	2.58
926211	<i>ACI-099 C</i>	1.45
926212	<i>ACI-099 E</i>	0.85
<i>LTF</i>	<i>ACI-131</i>	5.64
927021	<i>ACI-189 C</i>	15.45
927022	<i>ACI-189 E</i>	7.7
927141	<i>ACI-208 C</i>	5.74
927142	<i>ACI-208 E</i>	2.55

## Appendix 4

(DVP - DVP) The 3POPLR C-3EVERETS 115 kV line (from bus 314596 to bus 314573 ckt 1) loads from 46.36% to 58.16% (AC power flow) of its load dump rating (239 MVA) for the line fault with failed breaker contingency outage of 'DVP\_P4-2: 2014T2034'. This project contributes approximately 29.29 MW to the thermal violation.

CONTINGENCY 'DVP\_P4-2: 2014T2034' /\* EARLEYS  
 OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /\* 2034  
 OPEN BRANCH FROM BUS 314620 TO BUS 933990 CKT 1 /\* 2034  
 OPEN BRANCH FROM BUS 314569 TO BUS 314574 CKT 1 /\* 2014  
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315294	1DOMTR10	4.8
315292	1DOMTR78	3.24
315293	1DOMTR9	2.65
314566	3CRESWEL	2.76
314594	6PLYMOTH	1.18
314648	6SUNBURY	0.34
314651	6WINFALL	1.05
933991	AD1-023 C	18.97
933992	AD1-023 E	10.33
934521	AD1-076 C O1	78.28
934522	AD1-076 E O1	39.86
LTF	AMIL	0.17
LTF	BLUEG	0.89
LTF	CALDERWOOD	0.54
LTF	CANNELTON	0.17
LTF	CATAWBA	0.52
LTF	CBM-N	< 0.01

<i>LTF</i>	<i>CHEOAH</i>	<i>0.5</i>
<i>LTF</i>	<i>CHILHOWEE</i>	<i>0.17</i>
<i>LTF</i>	<i>CLIFTY</i>	<i>3.23</i>
<i>LTF</i>	<i>COTTONWOOD</i>	<i>1.81</i>
<i>LTF</i>	<i>EDWARDS</i>	<i>0.28</i>
<i>LTF</i>	<i>ELMERSMITH</i>	<i>0.5</i>
<i>LTF</i>	<i>FARMERCITY</i>	<i>0.22</i>
<i>LTF</i>	<i>G-007A</i>	<i>0.37</i>
<i>LTF</i>	<i>GIBSON</i>	<i>0.31</i>
<i>LTF</i>	<i>HAMLET</i>	<i>1.09</i>
<i>LTF</i>	<i>MORGAN</i>	<i>1.58</i>
<i>LTF</i>	<i>NEWTON</i>	<i>0.76</i>
<i>LTF</i>	<i>NYISO</i>	<i>0.03</i>
<i>LTF</i>	<i>O-066A</i>	<i>0.17</i>
<i>LTF</i>	<i>PRAIRIE</i>	<i>1.64</i>
<i>LTF</i>	<i>SANTEETLA</i>	<i>0.15</i>
<i>LTF</i>	<i>SMITHLAND</i>	<i>0.15</i>
<i>LTF</i>	<i>TATANKA</i>	<i>0.37</i>
<i>LTF</i>	<i>TILTON</i>	<i>0.32</i>
<i>LTF</i>	<i>TRIMBLE</i>	<i>0.17</i>
<i>LTF</i>	<i>TVA</i>	<i>0.67</i>
<i>LTF</i>	<i>UNIONPOWER</i>	<i>0.89</i>
<i>LTF</i>	<i>VFT</i>	<i>0.99</i>
<i>901082</i>	<i>W1-029E</i>	<i>23.46</i>
<i>913392</i>	<i>Y1-086 E</i>	<i>1.07</i>
<i>916041</i>	<i>Z1-036 C</i>	<i>0.98</i>

<i>916042</i>	<i>Z1-036 E</i>	<i>34.82</i>
<i>917122</i>	<i>Z2-027 E</i>	<i>0.52</i>
<i>920691</i>	<i>AA2-178 C</i>	<i>2.08</i>
<i>920692</i>	<i>AA2-178 E</i>	<i>4.73</i>
<i>923831</i>	<i>AB2-022 C</i>	<i>0.99</i>
<i>923832</i>	<i>AB2-022 E</i>	<i>0.53</i>
<i>925121</i>	<i>AB2-169 C</i>	<i>4.79</i>
<i>925122</i>	<i>AB2-169 E</i>	<i>4.3</i>

## Appendix 6

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 97.58% to 98.53% (AC power flow) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of 'DVP\_P4-2: 563T576'. This project contributes approximately 32.39 MW to the thermal violation.

CONTINGENCY 'DVP\_P4-2: 563T576' /\* MIDLOTHIAN 500 500 KV  
 OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /\* 8CARSON  
 500.00 - 8MDLTHAN 500.00  
 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /\* 8MDLTHAN  
 500.00 - 8NO ANNA 500.00  
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	11.85
315132	1EDGECEMB	11.85
315074	1HOPCGN1	10.64
315075	1HOPCGN2	10.5
315073	1STONECA	8.82
315233	1SURRY 2	60.39
315090	1YORKTN1	53.6
315091	1YORKTN2	55.63
315092	1YORKTN3	50.12
314557	3BETHEL C	1.06
314554	3BTLEBRO	1.02
314566	3CRESWEL	3.98
314572	3EMPORIA	0.56
314578	3HORNRTN	4.52
314582	3KELFORD	1.21
314315	3LOCKS E	1.44
314603	3SCOT NK	4.64



<i>314617</i>	<i>3TUNIS</i>	<i>1.27</i>
<i>314539</i>	<i>3UNCAMP</i>	<i>3.91</i>
<i>314541</i>	<i>3WATKINS</i>	<i>1.09</i>
<i>314620</i>	<i>6CASHIE</i>	<i>1.33</i>
<i>314574</i>	<i>6EVERETS</i>	<i>3.39</i>
<i>314189</i>	<i>6PAPERMILL</i>	<i>10.97</i>
<i>314594</i>	<i>6PLYMOTH</i>	<i>1.37</i>
<i>314648</i>	<i>6SUNBURY</i>	<i>1.56</i>
<i>314651</i>	<i>6WINFALL</i>	<i>3.05</i>
<i>932041</i>	<i>AC2-012 C</i>	<i>18.6</i>
<i>932042</i>	<i>AC2-012 E</i>	<i>30.35</i>
<i>932531</i>	<i>AC2-073 C</i>	<i>3.89</i>
<i>932532</i>	<i>AC2-073 E</i>	<i>1.96</i>
<i>932581</i>	<i>AC2-078 C</i>	<i>5.53</i>
<i>932582</i>	<i>AC2-078 E</i>	<i>9.03</i>
<i>932591</i>	<i>AC2-079 C</i>	<i>9.32</i>
<i>932592</i>	<i>AC2-079 E</i>	<i>15.21</i>
<i>932631</i>	<i>AC2-084 C</i>	<i>12.14</i>
<i>932632</i>	<i>AC2-084 E</i>	<i>5.98</i>
<i>932831</i>	<i>AC2-110 C</i>	<i>2.15</i>
<i>932832</i>	<i>AC2-110 E</i>	<i>3.5</i>
<i>933061</i>	<i>AC2-130</i>	<i>3.12</i>
<i>933262</i>	<i>AC2-137 E</i>	<i>1.87</i>
<i>933272</i>	<i>AC2-138 E</i>	<i>1.18</i>
<i>933291</i>	<i>AC2-141 C</i>	<i>59.6</i>
<i>933292</i>	<i>AC2-141 E</i>	<i>25.44</i>

933732	<i>AC2-196 E</i>	2.18
933991	<i>AD1-023 C</i>	20.97
933992	<i>AD1-023 E</i>	11.42
934011	<i>AD1-025 C OI</i>	24.76
934012	<i>AD1-025 E OI</i>	14.66
934061	<i>AD1-033 C OI</i>	13.73
934062	<i>AD1-033 E OI</i>	9.15
934141	<i>AD1-041 C OI</i>	8.49
934142	<i>AD1-041 E OI</i>	5.66
934201	<i>AD1-047 C</i>	10.77
934202	<i>AD1-047 E</i>	7.18
934211	<i>AD1-048 C</i>	2.73
934212	<i>AD1-048 E</i>	1.37
934231	<i>AD1-050 C</i>	5.58
934232	<i>AD1-050 E</i>	3.05
934331	<i>AD1-057 C OI</i>	13.19
934332	<i>AD1-057 E OI</i>	7.04
934391	<i>AD1-063 C</i>	2.63
934392	<i>AD1-063 E</i>	1.76
934521	<i>AD1-076 C OI</i>	87.6
934522	<i>AD1-076 E OI</i>	44.6
934571	<i>AD1-082 C OI</i>	11.71
934572	<i>AD1-082 E OI</i>	6.68
934611	<i>AD1-087 C OI</i>	9.65
934612	<i>AD1-087 E OI</i>	4.53
935111	<i>AD1-144 C</i>	3.07

935112	AD1-144 E	1.68
935161	AD1-151 C OI	23.65
935162	AD1-151 E OI	15.77
935171	AD1-152 C OI	9.59
935172	AD1-152 E OI	6.39
935211	AD1-156 C	2.59
935212	AD1-156 E	1.73
LTF	CARR	1.01
LTF	CBM-S1	12.87
LTF	CBM-S2	30.4
LTF	CBM-W1	20.39
LTF	CBM-W2	65.9
LTF	CIN	4.7
LTF	CPLE	9.86
LTF	G-007	4.23
LTF	IPL	2.98
LTF	LGEE	1.04
LTF	MEC	12.11
LTF	MECS	2.92
LTF	O-066	14.15
LTF	RENSSELAER	0.8
292791	U1-032 E	4.6
900672	V4-068 E	0.45
901082	W1-029E	80.28
LTF	WEC	1.3
907092	X1-038 E	9.77

913392	<i>Y1-086 E</i>	3.85
916042	<i>Z1-036 E</i>	78.06
916192	<i>Z1-068 E</i>	3.43
916302	<i>Z1-086 E</i>	13.66
917122	<i>Z2-027 E</i>	1.86
917332	<i>Z2-043 E</i>	1.45
917342	<i>Z2-044 E</i>	0.75
917512	<i>Z2-088 E OP1</i>	5.15
918492	<i>AA1-063AE OP</i>	5.75
918512	<i>AA1-065 E OP</i>	6.8
918532	<i>AA1-067 E</i>	1.02
918562	<i>AA1-072 E</i>	0.24
919152	<i>AA1-139 E</i>	11.61
919692	<i>AA2-053 E</i>	5.23
919701	<i>AA2-057 C</i>	9.41
919702	<i>AA2-057 E</i>	4.71
<i>LTF</i>	<i>AA2-074</i>	6.71
920042	<i>AA2-088 E</i>	16.1
920592	<i>AA2-165 E</i>	0.62
920672	<i>AA2-174 E</i>	0.6
920692	<i>AA2-178 E</i>	6.81
930402	<i>ABI-081 E</i>	4.91
930861	<i>ABI-132 C</i>	19.25
930862	<i>ABI-132 E</i>	8.25
931231	<i>ABI-173 C</i>	3.03
931232	<i>ABI-173 E</i>	1.41

931241	ABI-173AC	3.03
931242	ABI-173AE	1.41
923801	AB2-015 C OI	13.75
923802	AB2-015 E OI	11.27
923831	AB2-022 C	4.08
923832	AB2-022 E	2.2
923842	AB2-024 E	1.84
923852	AB2-025 E	1.45
923911	AB2-031 C OI	3.01
923912	AB2-031 E OI	1.48
923991	AB2-040 C OI	9.87
923992	AB2-040 E OI	8.08
924151	AB2-059 C OI	13.49
924152	AB2-059 E OI	6.95
924241	AB2-068 OI	619.7
924401	AB2-089 C	2.53
924402	AB2-089 E	1.3
924491	AB2-098 C	0.79
924492	AB2-098 E	0.34
924501	AB2-099 C	0.88
924502	AB2-099 E	0.38
924511	AB2-100 C	15.41
924512	AB2-100 E	7.59
924811	AB2-134 C OI	18.87
924812	AB2-134 E OI	18.55
925051	AB2-160 C OI	6.26

925052	AB2-160 E OI	10.22
925061	AB2-161 C OI	5.14
925062	AB2-161 E OI	8.38
925121	AB2-169 C	9.82
925122	AB2-169 E	8.81
925171	AB2-174 C OI	9.4
925172	AB2-174 E OI	8.5
925331	AB2-190 C	29.43
925332	AB2-190 E	12.61
925522	AC1-027 E	2.09
925591	AC1-034 C	8.74
925592	AC1-034 E	6.59
925781	AC1-054 C	8.7
925782	AC1-054 E	4.01
925861	AC1-065 C	5.37
925862	AC1-065 E	8.76
926071	AC1-086 C	28.35
926072	AC1-086 E	12.9
926201	AC1-098 C	8.51
926202	AC1-098 E	5.07
926211	AC1-099 C	2.85
926212	AC1-099 E	1.68
926291	AC1-107	935.39
926662	AC1-147 E	2.42
926751	AC1-161 C	59.6
926752	AC1-161 E	25.44

<i>926781</i>	<i>ACI-164 C</i>	<i>68.11</i>
<i>926782</i>	<i>ACI-164 E</i>	<i>30.6</i>
<i>927021</i>	<i>ACI-189 C</i>	<i>11.67</i>
<i>927022</i>	<i>ACI-189 E</i>	<i>5.81</i>
<i>927141</i>	<i>ACI-208 C</i>	<i>12.32</i>
<i>927142</i>	<i>ACI-208 E</i>	<i>5.47</i>
<i>927221</i>	<i>ACI-216 C OI</i>	<i>14.4</i>
<i>927222</i>	<i>ACI-216 E OI</i>	<i>11.33</i>

## Appendix 7

(DVP - CPLE) The 6MORNSTR-6ROCKYMT230T 230 kV line (from bus 313845 to bus 304222 ckt 1) loads from 119.8% to 122.32% (AC power flow) of its emergency rating (374 MVA) for the tower line contingency outage of 'DVP\_P7-1: LN 81-2056'. This project contributes approximately 11.2 MW to the thermal violation.

CONTINGENCY 'DVP\_P7-1: LN 81-2056'

OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1 /\* 3CAROLNA  
115.00 - 3HORNRTN 115.00  
OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1 /\* 3HORNRTN  
115.00 - 3ROAN DP 115.00  
OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1 /\* 3ROAN DP  
115.00 - 3DARLINGT DP115.00  
OPEN BUS 314578 /\* ISLAND: 3HORNRTN 115.00  
OPEN BUS 314598 /\* ISLAND: 3ROAN DP 115.00  
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /\* 6PA-  
RMOUNT#4230.00 - 6NASH 230.00  
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /\* 6MORNSTR  
230.00 - 6NASH 230.00  
OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1 /\* 6PA-  
RMOUNT#4230.00 - 6ROCKYMT230T  
OPEN BUS 304226 /\* ISLAND  
OPEN BUS 314591 /\* ISLAND: 6NASH 230.00  
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	24.8
315132	1EDGECEMB	24.8
315139	1GASTONA	3.84
315141	1GASTONB	3.84
315126	1ROARAP2	1.17
315128	1ROARAP4	1.13
315136	1ROSEMG1	3.22
315138	1ROSEMG2	1.51
315137	1ROSEMS1	2.



<i>314557</i>	<i>3BETHEL C</i>	<i>1.61</i>
<i>314554</i>	<i>3BTLEBRO</i>	<i>1.08</i>
<i>314566</i>	<i>3CRESWEL</i>	<i>1.09</i>
<i>314572</i>	<i>3EMPORIA</i>	<i>0.27</i>
<i>314582</i>	<i>3KELFORD</i>	<i>0.7</i>
<i>314603</i>	<i>3SCOT NK</i>	<i>3.23</i>
<i>314617</i>	<i>3TUNIS</i>	<i>0.55</i>
<i>314539</i>	<i>3UNCAMP</i>	<i>1.04</i>
<i>314541</i>	<i>3WATKINS</i>	<i>0.33</i>
<i>314620</i>	<i>6CASHIE</i>	<i>0.49</i>
<i>314574</i>	<i>6EVERETS</i>	<i>1.81</i>
<i>314594</i>	<i>6PLYMOTH</i>	<i>0.44</i>
<i>932631</i>	<i>AC2-084 C</i>	<i>9.38</i>
<i>932632</i>	<i>AC2-084 E</i>	<i>4.62</i>
<i>933991</i>	<i>AD1-023 C</i>	<i>7.25</i>
<i>933992</i>	<i>AD1-023 E</i>	<i>3.95</i>
<i>934201</i>	<i>AD1-047 C</i>	<i>5.53</i>
<i>934202</i>	<i>AD1-047 E</i>	<i>3.69</i>
<i>934331</i>	<i>AD1-057 C O1</i>	<i>19.79</i>
<i>934332</i>	<i>AD1-057 E O1</i>	<i>10.55</i>
<i>934521</i>	<i>AD1-076 C O1</i>	<i>28.51</i>
<i>934522</i>	<i>AD1-076 E O1</i>	<i>14.52</i>
<i>LTF</i>	<i>AMIL</i>	<i>0.38</i>
<i>LTF</i>	<i>BLUEG</i>	<i>1.99</i>
<i>LTF</i>	<i>CALDERWOOD</i>	<i>1.17</i>
<i>LTF</i>	<i>CANNELTON</i>	<i>0.38</i>

<i>LTF</i>	<i>CARR</i>	<i>&lt; 0.01</i>
<i>LTF</i>	<i>CATAWBA</i>	<i>1.14</i>
<i>LTF</i>	<i>CELEVELAND</i> /* 35% REVERSE 4479079 <i>4642907</i>	<i>&lt; 0.01</i>
<i>LTF</i>	<i>CHEOAH</i>	<i>1.09</i>
<i>LTF</i>	<i>CHILHOWEE</i>	<i>0.38</i>
<i>LTF</i>	<i>CLIFTY</i>	<i>7.33</i>
<i>LTF</i>	<i>COTTONWOOD</i>	<i>3.91</i>
<i>LTF</i>	<i>EDWARDS</i>	<i>0.61</i>
<i>LTF</i>	<i>ELMERSMITH</i>	<i>1.11</i>
<i>LTF</i>	<i>FARMERCITY</i>	<i>0.48</i>
<i>LTF</i>	<i>G-007A</i>	<i>0.76</i>
<i>LTF</i>	<i>GIBSON</i>	<i>0.7</i>
<i>LTF</i>	<i>HAMLET</i>	<i>2.25</i>
<i>LTF</i>	<i>MORGAN</i>	<i>3.43</i>
<i>LTF</i>	<i>NEWTON</i>	<i>1.68</i>
<i>LTF</i>	<i>O-066A</i>	<i>0.35</i>
<i>LTF</i>	<i>PRAIRIE</i>	<i>3.62</i>
<i>LTF</i>	<i>RENSSELAER</i>	<i>&lt; 0.01</i>
<i>LTF</i>	<i>SANTEETLA</i>	<i>0.32</i>
<i>LTF</i>	<i>SMITHLAND</i>	<i>0.32</i>
<i>LTF</i>	<i>TATANKA</i>	<i>0.82</i>
<i>LTF</i>	<i>TILTON</i>	<i>0.73</i>
<i>LTF</i>	<i>TRIMBLE</i>	<i>0.38</i>
<i>LTF</i>	<i>TVA</i>	<i>1.45</i>
<i>LTF</i>	<i>UNIONPOWER</i>	<i>1.94</i>
<i>900671</i>	<i>V4-068 C</i>	<i>0.06</i>

900672	V4-068 E	0.18
LTF	VFT	2.01
907092	X1-038 E	2.6
LTF	Y3-032	< 0.01
917331	Z2-043 C	0.37
917332	Z2-043 E	0.84
917341	Z2-044 C	0.33
917342	Z2-044 E	0.75
917511	Z2-088 C OPI	1.6
917512	Z2-088 E OPI	6.74
918411	AA1-050	1.35
918491	AA1-063AC OP	1.09
918492	AA1-063AE OP	2.74
918511	AA1-065 C OP	1.11
918512	AA1-065 E OP	2.92
918531	AA1-067 C	0.24
918532	AA1-067 E	0.54
918561	AA1-072 C	0.06
918562	AA1-072 E	0.14
919691	AA2-053 C	1.22
919692	AA2-053 E	2.79
919701	AA2-057 C	8.78
919702	AA2-057 E	4.39
920042	AA2-088 E	5.93
920591	AA2-165 C	0.23
920592	AA2-165 E	0.58

920671	AA2-174 C	0.06
920672	AA2-174 E	0.32
920692	AA2-178 E	1.86
930401	AB1-081 C	2.74
930402	AB1-081 E	6.24
930861	AB1-132 C	15.62
930862	AB1-132 E	6.7
931231	AB1-173 C	1.56
931232	AB1-173 E	0.73
931241	AB1-173AC	1.56
931242	AB1-173AE	0.73
923801	AB2-015 C O1	3.94
923802	AB2-015 E O1	3.23
923852	AB2-025 E	0.45
923911	AB2-031 C O1	1.55
923912	AB2-031 E O1	0.76
923991	AB2-040 C O1	5.07
923992	AB2-040 E O1	4.15
924151	AB2-059 C O1	17.15
924152	AB2-059 E O1	8.83
924491	AB2-098 C	0.42
924492	AB2-098 E	0.18
924501	AB2-099 C	0.4
924502	AB2-099 E	0.17
924511	AB2-100 C	8.3
924512	AB2-100 E	4.09

925121	<i>AB2-169 C</i>	4.03
925122	<i>AB2-169 E</i>	3.62
925171	<i>AB2-174 C O1</i>	4.75
925172	<i>AB2-174 E O1</i>	4.3
925591	<i>AC1-034 C</i>	11.11
925592	<i>AC1-034 E</i>	8.38
926071	<i>AC1-086 C</i>	23.01
926072	<i>AC1-086 E</i>	10.47
926201	<i>AC1-098 C</i>	6.58
926202	<i>AC1-098 E</i>	3.92
926211	<i>AC1-099 C</i>	2.21
926212	<i>AC1-099 E</i>	1.3
927021	<i>AC1-189 C</i>	12.21
927022	<i>AC1-189 E</i>	6.08
927141	<i>AC1-208 C</i>	10.44
927142	<i>AC1-208 E</i>	4.64

## Appendix 8

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 104.77% to 105.05% (AC power flow) of its load dump rating (1051 MVA) for the line fault with failed breaker contingency outage of 'DVP\_P4-2: H2T557'. This project contributes approximately 17.27 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-2: 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	4.77
315068	1DARBY 2	4.78
315069	1DARBY 3	4.8
315070	1DARBY 4	4.8
315043	1FOUR RIVERA	6.38
315044	1FOUR RIVERB	4.93
315045	1FOUR RIVERC	6.38
315046	1FOUR RIVERD	4.93
315047	1FOUR RIVERE	4.93
315048	1FOUR RIVERF	6.38
315074	1HOPCGN1	11.17
315075	1HOPCGN2	11.02
315083	1SPRUNCA	14.88
315084	1SPRUNCB	14.88
315085	1SPRUNCC	11.03

<i>315086</i>	<i>1SPRUNCD</i>	<i>11.03</i>
<i>315073</i>	<i>1STONECA</i>	<i>9.26</i>
<i>315090</i>	<i>1YORKTN1</i>	<i>30.76</i>
<i>315091</i>	<i>1YORKTN2</i>	<i>31.92</i>
<i>314566</i>	<i>3CRESWEL</i>	<i>2.09</i>
<i>314315</i>	<i>3LOCKS E</i>	<i>1.63</i>
<i>314539</i>	<i>3UNCAMP</i>	<i>2.17</i>
<i>314541</i>	<i>3WATKINS</i>	<i>0.61</i>
<i>314229</i>	<i>6MT RD221</i>	<i>1.41</i>
<i>314236</i>	<i>6NRTHEST</i>	<i>0.35</i>
<i>314189</i>	<i>6PAPERMILL</i>	<i>8.8</i>
<i>314594</i>	<i>6PLYMOTH</i>	<i>0.73</i>
<i>314250</i>	<i>6ROCKVILLE</i>	<i>0.38</i>
<i>314256</i>	<i>6ROCKVILLE E</i>	<i>1.16</i>
<i>314648</i>	<i>6SUNBURY</i>	<i>0.8</i>
<i>314651</i>	<i>6WINFALL</i>	<i>1.58</i>
<i>932041</i>	<i>AC2-012 C</i>	<i>9.55</i>
<i>932042</i>	<i>AC2-012 E</i>	<i>15.57</i>
<i>932501</i>	<i>AC2-070 C</i>	<i>2.91</i>
<i>932502</i>	<i>AC2-070 E</i>	<i>1.2</i>
<i>932531</i>	<i>AC2-073 C</i>	<i>3.09</i>
<i>932532</i>	<i>AC2-073 E</i>	<i>1.56</i>
<i>932581</i>	<i>AC2-078 C</i>	<i>4.69</i>
<i>932582</i>	<i>AC2-078 E</i>	<i>7.66</i>
<i>932591</i>	<i>AC2-079 C</i>	<i>5.74</i>
<i>932592</i>	<i>AC2-079 E</i>	<i>9.36</i>

932831	AC2-110 C	1.74
932832	AC2-110 E	2.84
933061	AC2-130	3.47
933261	AC2-137 C	0.59
933262	AC2-137 E	2.05
933272	AC2-138 E	1.08
933291	AC2-141 C	26.96
933292	AC2-141 E	11.51
933732	AC2-196 E	1.1
933991	AD1-023 C	11.18
933992	AD1-023 E	6.09
934011	AD1-025 C O1	20.62
934012	AD1-025 E O1	12.22
934061	AD1-033 C O1	6.91
934062	AD1-033 E O1	4.6
934141	AD1-041 C O1	6.72
934142	AD1-041 E O1	4.48
934211	AD1-048 C	3.82
934212	AD1-048 E	1.93
934391	AD1-063 C	2.09
934392	AD1-063 E	1.4
934521	AD1-076 C O1	46.47
934522	AD1-076 E O1	23.66
934571	AD1-082 C O1	8.18
934572	AD1-082 E O1	4.67
934781	AD1-105 C	8.13



934782	AD1-105 E	5.65
935111	AD1-144 C	1.67
935112	AD1-144 E	0.91
935161	AD1-151 C O1	19.7
935162	AD1-151 E O1	13.14
935211	AD1-156 C	2.52
935212	AD1-156 E	1.68
LTF	CARR	0.67
LTF	CBM-S1	3.79
LTF	CBM-S2	13.69
LTF	CBM-W1	0.11
LTF	CBM-W2	17.24
LTF	CIN	0.09
LTF	CLIFTY	1.71
LTF	CPLE	4.71
LTF	G-007	2.3
LTF	IPL	0.04
LTF	LGEE	0.04
LTF	MEC	1.91
LTF	O-066	7.7
LTF	RENSSELAER	0.53
LTF	TRIMBLE	< 0.01
292791	U1-032 E	4.82
297087	V2-040	0.27
901082	W1-029E	41.48
LTF	WEC	0.05

907092	<i>XI-038 E</i>	5.43
913392	<i>YI-086 E</i>	1.98
916042	<i>ZI-036 E</i>	40.5
916192	<i>ZI-068 E</i>	1.74
917122	<i>Z2-027 E</i>	0.96
918691	<i>AA1-083</i>	1.12
919152	<i>AA1-139 E</i>	5.87
919211	<i>AA1-145</i>	19.04
<i>LTF</i>	<i>AA2-074</i>	3.21
920042	<i>AA2-088 E</i>	9.07
920692	<i>AA2-178 E</i>	3.58
930121	<i>AB1-027 C</i>	0.83
930122	<i>AB1-027 E</i>	1.9
923801	<i>AB2-015 C O1</i>	7.66
923802	<i>AB2-015 E O1</i>	6.28
923831	<i>AB2-022 C</i>	2.08
923832	<i>AB2-022 E</i>	1.12
923842	<i>AB2-024 E</i>	1.48
923852	<i>AB2-025 E</i>	1.08
924061	<i>AB2-050</i>	1.12
924241	<i>AB2-068 O1</i>	176.73
924511	<i>AB2-100 C</i>	10.36
924512	<i>AB2-100 E</i>	5.1
924811	<i>AB2-134 C O1</i>	15.72
924812	<i>AB2-134 E O1</i>	15.46
925051	<i>AB2-160 C O1</i>	7.1

925052	<i>AB2-160 E OI</i>	<i>11.58</i>
925061	<i>AB2-161 C OI</i>	<i>3.59</i>
925062	<i>AB2-161 E OI</i>	<i>5.85</i>
925331	<i>AB2-190 C</i>	<i>24.52</i>
925332	<i>AB2-190 E</i>	<i>10.51</i>
925522	<i>AC1-027 E</i>	<i>1.06</i>
925861	<i>AC1-065 C</i>	<i>4.35</i>
925862	<i>AC1-065 E</i>	<i>7.1</i>
926291	<i>AC1-107</i>	<i>266.77</i>
926411	<i>AC1-112 C</i>	<i>0.65</i>
926412	<i>AC1-112 E</i>	<i>1.93</i>
926472	<i>AC1-118 E</i>	<i>1.07</i>
926551	<i>AC1-134</i>	<i>14.9</i>
926662	<i>AC1-147 E</i>	<i>1.24</i>
926751	<i>AC1-161 C</i>	<i>26.96</i>
926752	<i>AC1-161 E</i>	<i>11.51</i>
926781	<i>AC1-164 C</i>	<i>58.34</i>
926782	<i>AC1-164 E</i>	<i>26.21</i>
927041	<i>AC1-191 C</i>	<i>17.54</i>
927042	<i>AC1-191 E</i>	<i>8.74</i>
927221	<i>AC1-216 C OI</i>	<i>12.</i>
927222	<i>AC1-216 E OI</i>	<i>9.44</i>

## Appendix 9

(DVP - DVP) The 6CHESTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 103.05% to 104.2% (AC power flow) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of 'DVP\_P4-2: 562T563'. This project contributes approximately 7.34 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-2: 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
```

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.69
315131	1EDGECEMA	3.54
315132	1EDGECEMB	3.54
315074	1HOPCGN1	5.88
315075	1HOPCGN2	5.81
315077	1HOPHCF1	1.78
315078	1HOPHCF2	1.78
315079	1HOPHCF3	1.78
315080	1HOPHCF4	2.7
315076	1HOPPOLC	1.27
315073	1STONECA	4.88
314557	3BETHEL	0.3
314554	3BTLEBRO	0.3
314572	3EMPORIA	0.22
314578	3HORNRTN	1.43
314582	3KELFORD	0.33
314314	3LOCKS	0.06

314315	3LOCKS E	0.83
314603	3SCOT NK	1.31
314617	3TUNIS	0.33
314539	3UNCAMP	0.94
314541	3WATKINS	0.27
314620	6CASHIE	0.31
314594	6PLYMOTH	0.3
932581	AC2-078 C	3.04
932582	AC2-078 E	4.95
932591	AC2-079 C	2.7
932592	AC2-079 E	4.41
932631	AC2-084 C	3.51
932632	AC2-084 E	1.73
933991	AD1-023 C	4.75
933992	AD1-023 E	2.59
934011	AD1-025 C O1	9.49
934012	AD1-025 E O1	5.62
934201	AD1-047 C	3.93
934202	AD1-047 E	2.62
934331	AD1-057 C O1	4.26
934332	AD1-057 E O1	2.27
934521	AD1-076 C O1	19.37
934522	AD1-076 E O1	9.86
934571	AD1-082 C O1	4.47
934572	AD1-082 E O1	2.55
935161	AD1-151 C O1	9.07

935162	AD1-151 E O1	6.04
935211	AD1-156 C	2.12
935212	AD1-156 E	1.41
LTF	CARR	0.23
LTF	CBM-S1	4.
LTF	CBM-S2	8.63
LTF	CBM-W1	7.44
LTF	CBM-W2	20.89
LTF	CIN	1.7
LTF	CPL	2.76
LTF	G-007	1.04
LTF	IPL	1.08
LTF	LGEE	0.37
LTF	MEC	4.07
LTF	MECS	1.38
LTF	O-066	3.48
LTF	RENSSELAER	0.18
292791	U1-032 E	2.54
900672	V4-068 E	0.12
LTF	WEC	0.47
907092	X1-038 E	2.35
914231	Y2-077	0.72
916302	Z1-086 E	3.71
917332	Z2-043 E	0.39
917342	Z2-044 E	0.22
917512	Z2-088 E OP1	1.45

918492	AA1-063AE OP	1.7
918512	AA1-065 E OP	1.69
918562	AA1-072 E	0.07
919692	AA2-053 E	1.6
919701	AA2-057 C	2.8
919702	AA2-057 E	1.4
LTF	AA2-074	1.88
920042	AA2-088 E	4.24
920592	AA2-165 E	0.18
920672	AA2-174 E	0.18
930402	AB1-081 E	1.46
930861	AB1-132 C	6.74
930862	AB1-132 E	2.89
931231	AB1-173 C	1.1
931232	AB1-173 E	0.52
931241	AB1-173AC	1.1
931242	AB1-173AE	0.52
923801	AB2-015 C O1	3.37
923802	AB2-015 E O1	2.76
923851	AB2-025 C	0.33
923852	AB2-025 E	0.78
923911	AB2-031 C O1	1.1
923912	AB2-031 E O1	0.54
923991	AB2-040 C O1	3.6
923992	AB2-040 E O1	2.94
924151	AB2-059 C O1	4.01

924152	AB2-059 E OI	2.06
924501	AB2-099 C	0.23
924502	AB2-099 E	0.1
924511	AB2-100 C	6.79
924512	AB2-100 E	3.35
924811	AB2-134 C OI	7.23
924812	AB2-134 E OI	7.11
925051	AB2-160 C OI	3.59
925052	AB2-160 E OI	5.86
925061	AB2-161 C OI	1.96
925062	AB2-161 E OI	3.2
925171	AB2-174 C OI	3.52
925172	AB2-174 E OI	3.18
925331	AB2-190 C	11.28
925332	AB2-190 E	4.84
925591	ACI-034 C	2.6
925592	ACI-034 E	1.96
925821	ACI-061	< 0.01
926071	ACI-086 C	9.93
926072	ACI-086 E	4.52
926201	ACI-098 C	2.47
926202	ACI-098 E	1.47
926211	ACI-099 C	0.83
926212	ACI-099 E	0.49
927141	ACI-208 C	3.74
927142	ACI-208 E	1.66



<i>927221</i>	<i>ACI-216 C OI</i>	<i>5.52</i>
<i>927222</i>	<i>ACI-216 E OI</i>	<i>4.34</i>

## Appendix 10

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 228.05% to 231.78% (AC power flow) of its emergency rating (164 MVA) for the tower line contingency outage of 'DVP\_P7-1: LN 2058-2181'. This project contributes approximately 7.27 MW to the thermal violation.

CONTINGENCY 'DVP\_P7-1: LN 2058-2181'

OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /\*

6ROCKYMT230T230.00 - 6HATHAWAY 230.00

OPEN BUS 304226 /\* ISLAND: 6PA-RMOUNT#4115.00

OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /\* 6PA-

RMOUNT#4230.00 - 6NASH 230.00

OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /\* 6HATHAWAY  
230.00 - 6NASH 230.00

OPEN BUS 314591 /\* ISLAND: 6NASH 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	13.41
315132	1EDGECEMB	13.41
315139	1GASTONA	2.39
315141	1GASTONB	2.39
315126	1ROARAP2	0.99
315128	1ROARAP4	0.96
315136	1ROSEMG1	1.94
315138	1ROSEMG2	0.91
315137	1ROSEMS1	1.2
314557	3BETHEL C	0.88
314554	3BTLEBRO	1.95
314572	3EMPORIA	0.2
314578	3HORNRTN	2.51
314582	3KELFORD	0.69

<i>314603</i>	<i>3SCOT NK</i>	<i>3.67</i>
<i>314617</i>	<i>3TUNIS</i>	<i>0.44</i>
<i>314541</i>	<i>3WATKINS</i>	<i>0.26</i>
<i>314620</i>	<i>6CASHIE</i>	<i>0.32</i>
<i>314574</i>	<i>6EVERETS</i>	<i>1.04</i>
<i>932631</i>	<i>AC2-084 C</i>	<i>11.33</i>
<i>932632</i>	<i>AC2-084 E</i>	<i>5.58</i>
<i>933991</i>	<i>AD1-023 C</i>	<i>4.71</i>
<i>933992</i>	<i>AD1-023 E</i>	<i>2.56</i>
<i>934201</i>	<i>AD1-047 C</i>	<i>4.29</i>
<i>934202</i>	<i>AD1-047 E</i>	<i>2.86</i>
<i>934331</i>	<i>AD1-057 C O1</i>	<i>11.1</i>
<i>934332</i>	<i>AD1-057 E O1</i>	<i>5.92</i>
<i>LTF</i>	<i>AMIL</i>	<i>0.26</i>
<i>LTF</i>	<i>BLUEG</i>	<i>1.35</i>
<i>LTF</i>	<i>CALDERWOOD</i>	<i>0.8</i>
<i>LTF</i>	<i>CANNELTON</i>	<i>0.26</i>
<i>LTF</i>	<i>CARR</i>	<i>&lt; 0.01</i>
<i>LTF</i>	<i>CATAWBA</i>	<i>0.78</i>
<i>LTF</i>	<i>CHEOAH</i>	<i>0.74</i>
<i>LTF</i>	<i>CHILHOWEE</i>	<i>0.26</i>
<i>LTF</i>	<i>CLIFTY</i>	<i>4.96</i>
<i>LTF</i>	<i>COTTONWOOD</i>	<i>2.67</i>
<i>LTF</i>	<i>EDWARDS</i>	<i>0.42</i>
<i>LTF</i>	<i>ELMERSMITH</i>	<i>0.76</i>
<i>LTF</i>	<i>FARMERCITY</i>	<i>0.33</i>

<i>LTF</i>	<i>G-007A</i>	<i>0.49</i>
<i>LTF</i>	<i>GIBSON</i>	<i>0.47</i>
<i>LTF</i>	<i>HAMLET</i>	<i>1.56</i>
<i>LTF</i>	<i>MORGAN</i>	<i>2.34</i>
<i>LTF</i>	<i>NEWTON</i>	<i>1.14</i>
<i>LTF</i>	<i>O-066A</i>	<i>0.22</i>
<i>LTF</i>	<i>PRAIRIE</i>	<i>2.47</i>
<i>LTF</i>	<i>RENSSELAER</i>	<i>&lt; 0.01</i>
<i>LTF</i>	<i>SANTEETLA</i>	<i>0.22</i>
<i>LTF</i>	<i>SMITHLAND</i>	<i>0.22</i>
<i>LTF</i>	<i>TATANKA</i>	<i>0.56</i>
<i>LTF</i>	<i>TILTON</i>	<i>0.49</i>
<i>LTF</i>	<i>TRIMBLE</i>	<i>0.26</i>
<i>LTF</i>	<i>TVA</i>	<i>0.99</i>
<i>LTF</i>	<i>UNIONPOWER</i>	<i>1.32</i>
<i>900672</i>	<i>V4-068 E</i>	<i>0.15</i>
<i>LTF</i>	<i>VFT</i>	<i>1.3</i>
<i>917331</i>	<i>Z2-043 C</i>	<i>0.36</i>
<i>917332</i>	<i>Z2-043 E</i>	<i>0.82</i>
<i>917341</i>	<i>Z2-044 C</i>	<i>0.55</i>
<i>917342</i>	<i>Z2-044 E</i>	<i>1.25</i>
<i>917511</i>	<i>Z2-088 C OPI</i>	<i>0.88</i>
<i>917512</i>	<i>Z2-088 E OPI</i>	<i>3.69</i>
<i>918411</i>	<i>AA1-050</i>	<i>0.74</i>
<i>918492</i>	<i>AA1-063AE OP</i>	<i>2.28</i>
<i>918512</i>	<i>AA1-065 E OP</i>	<i>1.94</i>

918532	AA1-067 E	0.31
918561	AA1-072 C	0.05
918562	AA1-072 E	0.14
919691	AA2-053 C	1.02
919692	AA2-053 E	2.32
919701	AA2-057 C	13.27
919702	AA2-057 E	6.64
920042	AA2-088 E	4.77
920591	AA2-165 C	0.34
920592	AA2-165 E	0.87
920671	AA2-174 C	0.05
920672	AA2-174 E	0.27
930401	AB1-081 C	3.77
930402	AB1-081 E	8.59
930861	AB1-132 C	9.71
930862	AB1-132 E	4.16
931231	AB1-173 C	1.21
931232	AB1-173 E	0.56
931241	AB1-173AC	1.21
931242	AB1-173AE	0.56
923801	AB2-015 C O1	3.09
923802	AB2-015 E O1	2.53
923911	AB2-031 C O1	1.2
923912	AB2-031 E O1	0.59
923991	AB2-040 C O1	3.93
923992	AB2-040 E O1	3.22

924151	AB2-059 C OI	23.61
924152	AB2-059 E OI	12.16
924491	AB2-098 C	0.24
924492	AB2-098 E	0.1
924501	AB2-099 C	0.31
924502	AB2-099 E	0.13
924511	AB2-100 C	5.31
924512	AB2-100 E	2.62
925121	AB2-169 C	2.45
925122	AB2-169 E	2.19
925171	AB2-174 C OI	3.6
925172	AB2-174 E OI	3.26
925591	AC1-034 C	15.29
925592	AC1-034 E	11.54
926071	AC1-086 C	14.3
926072	AC1-086 E	6.51
926201	AC1-098 C	7.95
926202	AC1-098 E	4.74
926211	AC1-099 C	2.66
926212	AC1-099 E	1.56
927021	AC1-189 C	6.74
927022	AC1-189 E	3.36
927141	AC1-208 C	11.27
927142	AC1-208 E	5.

## Appendix 11

(DVP - DVP) The 8ELMONT-8LADYSMITH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 111.7% to 112.57% (AC power flow) of its load dump rating (3351 MVA) for the line fault with failed breaker contingency outage of 'DVP\_P4-2: 57602'. This project contributes approximately 33.88 MW to the thermal violation.

CONTINGENCY 'DVP\_P4-2: 57602' /\* NORTH ANNA 500 KV  
 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /\* 8MDLTHAN  
 500.00 - 8NO ANNA 500.00  
 OPEN BRANCH FROM BUS 314232 TO BUS 314918 CKT 1 /\* 6NO ANNA  
 230.00 - 8NO ANNA 500.00  
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315060	1CHESTF5	21.06
315061	1CHESTG7	8.25
315063	1CHESTG8	8.16
315062	1CHESTS7	3.75
315064	1CHESTS8	4.19
315067	1DARBY 1	5.37
315068	1DARBY 2	5.38
315069	1DARBY 3	5.4
315070	1DARBY 4	5.4
315074	1HOPCGN1	15.03
315075	1HOPCGN2	14.84
315083	1SPRUNCA	18.58
315084	1SPRUNCB	18.58
315085	1SPRUNCC	13.78
315086	1SPRUNCD	13.78
315073	1STONECA	12.47
315233	1SURRY 2	52.65

315090	<i>1YORKTNI</i>	<i>51.91</i>
315091	<i>1YORKTN2</i>	<i>53.87</i>
314566	<i>3CRESWEL</i>	<i>4.07</i>
314572	<i>3EMPORIA</i>	<i>0.67</i>
314578	<i>3HORNRTN</i>	<i>5.23</i>
314582	<i>3KELFORD</i>	<i>1.33</i>
314315	<i>3LOCKS E</i>	<i>2.22</i>
314603	<i>3SCOT NK</i>	<i>5.21</i>
314617	<i>3TUNIS</i>	<i>1.38</i>
314539	<i>3UNCAMP</i>	<i>4.1</i>
314541	<i>3WATKINS</i>	<i>1.16</i>
314620	<i>6CASHIE</i>	<i>1.4</i>
314229	<i>6MT RD221</i>	<i>1.36</i>
314236	<i>6NRTHEST</i>	<i>0.39</i>
314189	<i>6PAPERMILL</i>	<i>11.78</i>
314594	<i>6PLYMOTH</i>	<i>1.43</i>
314256	<i>6ROCKVILLE E</i>	<i>1.29</i>
314648	<i>6SUNBURY</i>	<i>1.54</i>
314651	<i>6WINFALL</i>	<i>3.03</i>
932041	<i>AC2-012 C</i>	<i>18.05</i>
932042	<i>AC2-012 E</i>	<i>29.45</i>
932501	<i>AC2-070 C</i>	<i>3.15</i>
932502	<i>AC2-070 E</i>	<i>1.3</i>
932531	<i>AC2-073 C</i>	<i>4.16</i>
932532	<i>AC2-073 E</i>	<i>2.1</i>
932581	<i>AC2-078 C</i>	<i>7.13</i>



932582	<i>AC2-078 E</i>	<i>11.64</i>
932591	<i>AC2-079 C</i>	<i>10.03</i>
932592	<i>AC2-079 E</i>	<i>16.36</i>
932631	<i>AC2-084 C</i>	<i>13.76</i>
932632	<i>AC2-084 E</i>	<i>6.78</i>
932831	<i>AC2-110 C</i>	<i>2.33</i>
932832	<i>AC2-110 E</i>	<i>3.81</i>
933061	<i>AC2-130</i>	<i>4.39</i>
933261	<i>AC2-137 C</i>	<i>0.73</i>
933262	<i>AC2-137 E</i>	<i>2.51</i>
933291	<i>AC2-141 C</i>	<i>54.22</i>
933292	<i>AC2-141 E</i>	<i>23.15</i>
933732	<i>AC2-196 E</i>	<i>2.1</i>
933991	<i>AD1-023 C</i>	<i>21.94</i>
933992	<i>AD1-023 E</i>	<i>11.94</i>
934011	<i>AD1-025 C O1</i>	<i>30.4</i>
934012	<i>AD1-025 E O1</i>	<i>18.01</i>
934061	<i>AD1-033 C O1</i>	<i>13.24</i>
934062	<i>AD1-033 E O1</i>	<i>8.83</i>
934141	<i>AD1-041 C O1</i>	<i>9.08</i>
934142	<i>AD1-041 E O1</i>	<i>6.05</i>
934201	<i>AD1-047 C</i>	<i>12.78</i>
934202	<i>AD1-047 E</i>	<i>8.52</i>
934211	<i>AD1-048 C</i>	<i>4.48</i>
934212	<i>AD1-048 E</i>	<i>2.26</i>
934391	<i>AD1-063 C</i>	<i>2.82</i>

934392	<i>AD1-063 E</i>	<i>1.88</i>
934521	<i>AD1-076 C OI</i>	<i>91.09</i>
934522	<i>AD1-076 E OI</i>	<i>46.39</i>
934571	<i>AD1-082 C OI</i>	<i>13.48</i>
934572	<i>AD1-082 E OI</i>	<i>7.69</i>
935111	<i>AD1-144 C</i>	<i>3.05</i>
935112	<i>AD1-144 E</i>	<i>1.67</i>
935161	<i>AD1-151 C OI</i>	<i>29.04</i>
935162	<i>AD1-151 E OI</i>	<i>19.36</i>
935211	<i>AD1-156 C</i>	<i>3.69</i>
935212	<i>AD1-156 E</i>	<i>2.46</i>
<i>LTF</i>	<i>CARR</i>	<i>1.66</i>
<i>LTF</i>	<i>CBM-S1</i>	<i>25.68</i>
<i>LTF</i>	<i>CBM-S2</i>	<i>42.1</i>
<i>LTF</i>	<i>CBM-W1</i>	<i>59.6</i>
<i>LTF</i>	<i>CBM-W2</i>	<i>137.92</i>
<i>LTF</i>	<i>CIN</i>	<i>13.85</i>
<i>LTF</i>	<i>CPL</i>	<i>12.5</i>
<i>LTF</i>	<i>G-007</i>	<i>8.94</i>
<i>LTF</i>	<i>IPL</i>	<i>8.85</i>
<i>LTF</i>	<i>LGEE</i>	<i>3.03</i>
<i>LTF</i>	<i>MEC</i>	<i>29.61</i>
<i>LTF</i>	<i>MECS</i>	<i>13.38</i>
<i>LTF</i>	<i>O-066</i>	<i>29.78</i>
<i>LTF</i>	<i>RENSSELAER</i>	<i>1.33</i>
<i>LTF</i>	<i>ROWAN</i> <i>/* 35% REVERSE 4479078</i>	<i>&lt; 0.01</i>

292791	<i>U1-032 E</i>	6.49
297087	<i>V2-040</i>	0.26
900672	<i>V4-068 E</i>	0.49
901082	<i>W1-029E</i>	79.56
<i>LTF</i>	<i>WEC</i>	3.71
907092	<i>X1-038 E</i>	10.26
913392	<i>Y1-086 E</i>	3.8
916042	<i>Z1-036 E</i>	78.21
<i>LTF</i>	<i>Z1-043</i>	14.61
916192	<i>Z1-068 E</i>	3.32
916302	<i>Z1-086 E</i>	14.34
917122	<i>Z2-027 E</i>	1.84
917332	<i>Z2-043 E</i>	1.6
918492	<i>AA1-063AE OP</i>	6.47
918512	<i>AA1-065 E OP</i>	7.28
918562	<i>AA1-072 E</i>	0.27
919152	<i>AA1-139 E</i>	11.26
919692	<i>AA2-053 E</i>	5.96
<i>LTF</i>	<i>AA2-074</i>	8.51
920042	<i>AA2-088 E</i>	17.44
920672	<i>AA2-174 E</i>	0.69
920692	<i>AA2-178 E</i>	6.97
930121	<i>ABI-027 C</i>	0.9
930122	<i>ABI-027 E</i>	2.05
930861	<i>ABI-132 C</i>	22.39
930862	<i>ABI-132 E</i>	9.59

931231	<i>AB1-173 C</i>	3.59
931232	<i>AB1-173 E</i>	1.68
931241	<i>AB1-173AC</i>	3.59
931242	<i>AB1-173AE</i>	1.68
<i>LTF</i>	<i>AB2-013</i>	< 0.01
923801	<i>AB2-015 C O1</i>	14.53
923802	<i>AB2-015 E O1</i>	11.91
923831	<i>AB2-022 C</i>	4.
923832	<i>AB2-022 E</i>	2.16
923842	<i>AB2-024 E</i>	1.98
923852	<i>AB2-025 E</i>	1.82
923911	<i>AB2-031 C O1</i>	3.57
923912	<i>AB2-031 E O1</i>	1.76
923991	<i>AB2-040 C O1</i>	11.72
923992	<i>AB2-040 E O1</i>	9.59
924241	<i>AB2-068 O1</i>	417.05
924501	<i>AB2-099 C</i>	0.96
924502	<i>AB2-099 E</i>	0.41
924511	<i>AB2-100 C</i>	18.66
924512	<i>AB2-100 E</i>	9.19
924811	<i>AB2-134 C O1</i>	23.17
924812	<i>AB2-134 E O1</i>	22.78
925051	<i>AB2-160 C O1</i>	9.63
925052	<i>AB2-160 E O1</i>	15.71
925061	<i>AB2-161 C O1</i>	5.92
925062	<i>AB2-161 E O1</i>	9.65

925121	AB2-169 C	10.51
925122	AB2-169 E	9.43
925171	AB2-174 C O1	11.22
925172	AB2-174 E O1	10.15
925331	AB2-190 C	36.14
925332	AB2-190 E	15.49
925522	AC1-027 E	2.02
925861	AC1-065 C	5.84
925862	AC1-065 E	9.52
926071	AC1-086 C	32.97
926072	AC1-086 E	15.
926201	AC1-098 C	9.65
926202	AC1-098 E	5.75
926211	AC1-099 C	3.24
926212	AC1-099 E	1.9
926291	AC1-107	629.5
926411	AC1-112 C	0.7
926412	AC1-112 E	2.09
926662	AC1-147 E	2.34
926751	AC1-161 C	54.22
926752	AC1-161 E	23.15
926781	AC1-164 C	75.58
926782	AC1-164 E	33.96
927041	AC1-191 C	16.49
927042	AC1-191 E	8.22
927141	AC1-208 C	14.16

<i>927142</i>	<i>ACI-208 E</i>	<i>6.29</i>
<i>927221</i>	<i>ACI-216 C OI</i>	<i>17.68</i>
<i>927222</i>	<i>ACI-216 E OI</i>	<i>13.91</i>