# *Generation Interconnection*
# *Feasibility Study Report*

# *For*

# *PJM Generation Interconnection Request*
# *Queue Position AC1-164*

# *Chickahominy 500kV*
# *220.8 MW Capacity / 320 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 Charles City County, VA. The installed facilities will have a total capability of 320 MW with 220.8 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 10/1/2019. **This study does not imply an ITO commitment to this in-service date.**

## Point of Interconnection

AC1-164 will interconnect with the ITO transmission system at one of the following points of interconnection:

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

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

## Cost Summary

The AC1-164 project will be responsible for the following costs:

| Description | Total Cost |
|---|---|
| Attachment Facilities | $9,700,000 |
| Direct Connection Network Upgrades | $0 |
| Non Direct Connection Network Upgrades | $5,000,000 |
| **Total Costs** | **$14,700,000** |

In addition, the AC1-164 project may be responsible for a contribution to the following costs:

| Description | Total Cost |
|---|---|
| New System Upgrades | $0 |
| Previously Identified Upgrades | $273,150,000 |
| **Total Costs** | **$273,150,000** |

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 $700,000.

Transmission: Build approximately 3.0 miles of 500 kV Line. Estimated Cost $9,000,000

The estimated total cost of the Attachment Facilities is $9,700,000. It is estimated to take 30-32 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 two 500 kV Breakers to create another breaker row at the existing Chickahominy substation. Estimated Cost $3,000,000.

Transmission: Re-arrange existing lines to accommodate new 500 kV Line. Estimated Cost $2,000,000.

The estimated total cost of the Direct Connection Facilities is $5,000,000. It is estimated to take 14-20 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.

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: Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line # 209: wreck and rebuild the line to a rating of 1047 MVA. Estimated cost $28,200,000 and it is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.

Reinforcement: Lightfoot– Waller 230 kV line # 2113: wreck and rebuild the line to a rating of 1047 MVA. Estimated cost $15,200,000 and it is estimated to take 30-36 months to permit (VA CPCN required), engineer and construct.

Reinforcement: Carson - Midlothian 500 kV: replace wave trap at both Carson and Midlothian 500kV Substations. This will increase emergency rating by 31% to 3224 MVA. Estimated cost $500,000 and it is estimated to 12-16 months to engineer and construct.

Reinforcement: Chickahominy second 500 – 230 kV Transformer: Add a second 500-230 kV transformer into breaker bay created in attachment facilities. Estimated cost $17,500,000 and it is estimated to 24-30 months to engineer and construct.

Reinforcement: Elmont – Chickahominy 500 kV line #557 : replace wave trap at both Elmont and Chickahominy Substations. This will increase line rating by 22% to 3424 MVA. Estimated cost $500,000 and it is estimated to 14-16 months to engineer and construct.

Reinforcement: Brister - Chance 500kV: Wreck and rebuild the line since overload exceeds conductor rating of 2913 MVA by 3.1% to new line rating of 4300 MVA. It is estimated to cost $73,000,000 and it is estimate to take 36-48 months to engineer, permit and construct.

Reinforcement: Elmont – Ladysmith 500kV: Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated cost is $88,000,000 and it is estimated to take 36 – 48 months to engineer, permit and construct.

Reinforcement: Ladysmith – Chancellor 500kV line #581: Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. A Virginia CPCN is required. It is estimated to cost $50,000,000 and it is estimate to take 36-48 months to engineer, permit and construct.

Reinforcement: Midlothian – North Anna 500kV: Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated cost $250,000 and it is estimated to take 12-16 months to engineer and construct.

## Interconnection Customer Requirements

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

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

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

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

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

# Revenue Metering and SCADA Requirements

## PJM Requirements

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

# Option One

# Network Impacts

The Queue Project AC1-164 was evaluated as a 320.0 MW (Capacity 220.8 MW) injection at the Chickahonomy 500kV substation in the ITO area. Project AC1-164 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-164 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<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2)<br>OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 1 /*NORTH ANNA 500-230 (TX#5)<br>END |
| 557T574 | CONTINGENCY '557T574' /* ELMONT<br>OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)<br>OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)<br>OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)<br>END |
| 563T576 | CONTINGENCY '563T576' /*MIDLOTHIAN<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*MIDLOTHIAN TO CARSON (LINE 563)<br>END |
| G2T567 | CONTINGENCY 'G2T567' /*SURRY<br>OPEN BRANCH FROM BUS 314903 TO BUS 314924 CKT 1 /*CHICKAHOMINY TO SURRY (LINE 567)<br>REMOVE MACHINE 2 FROM BUS 315233 /*SURRY UNIT #2<br>END |

| Contingency Name | Description |
|---|---|
| H1T574 | CONTINGENCY 'H1T574' /* ELMONT<br>OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)<br>OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 1 /*ELMONT 500-230 (TX#1)<br>END |
| H2T557 | CONTINGENCY 'H2T557' /* ELMONT<br>OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)<br>OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)<br>OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2)<br>END |
| LN 557 | CONTINGENCY 'LN 557'<br>OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00<br>OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00<br>END |
| LN 563 | CONTINGENCY 'LN 563'<br>OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00<br>END |
| LN 567 | CONTINGENCY 'LN 567'<br>OPEN BRANCH FROM BUS 314903 TO BUS 314924 CKT 1 /* 8CHCKAHM 500.00 - 8SURRY 500.00<br>END |
| LN 573 | CONTINGENCY 'LN 573'<br>OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00<br>END |
| LN 574 | CONTINGENCY 'LN 574'<br>OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00<br>END |
| LN 576 | CONTINGENCY 'LN 576'<br>OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00<br>END |
| LN 594 | CONTINGENCY 'LN 594'<br>OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00<br>END |

| Contingency Name | Description |
|---|---|
| SPOTSH1T9033 | CONTINGENCY 'SPOTSH1T9033' /*SPOTSYLVANIA<br>OPEN BRANCH FROM BUS 314934 TO BUS 314916 CKT 1<br>/*SPOTSYLVANIA TO MORRISVILLE (LINE 9033)<br>OPEN BRANCH FROM BUS 314934 TO BUS 314755 CKT 1<br>/*SPOTSYLVANIA 500/115 (TX#1)<br>END |
| WT576 | CONTINGENCY 'WT576' /*NORTH ANNA<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1<br>/*MIDLOTHIAN TO NORTH ANNA (LINE 576)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1<br>/*MIDLOTHIAN 500-230 (TX#2)<br>OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 2 /*NORTH ANNA 500-230 (TX#6)<br>END |

# Summer Peak Analysis - 2020

## Generator Deliverability

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

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N-1 | LN 574 | DVP - DVP | 8CHCKAHM 500/230 kV transformer | 314903 | 314214 | 1 | DC | 97.83 | 103.71 | ER | 829 | 48.7 |

## Multiple Facility Contingency

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

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | LFFB | G2T567 | DVP - DVP | 8CHCKAHM 500/230 kV transformer | 314903 | 314214 | 1 | DC | 96.74 | 106.78 | LD | 945 | 94.86 |
| 3 | LFFB | H1T574 | DVP - DVP | 8CHCKAHM 500/230 kV transformer | 314903 | 314214 | 1 | DC | 95.37 | 103.32 | LD | 945 | 75.09 |

## 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 | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Cir. | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 4 | N-1 | LN 557 | DVP - DVP | 6SKIFF CREEK-6KINGS M 230 kV line | 314209 | 314386 | 1 | DC | 153.61 | 158.49 | ER | 442 | 21.55 | 1 |
| 5 | N-1 | LN 557 | DVP - DVP | 6PENNIMAN-6WALR209 230 kV line | 314296 | 314415 | 1 | DC | 141.3 | 146.18 | ER | 442 | 21.55 | 2 |
| 6 | N-1 | LN 557 | DVP - DVP | 6KINGS M-6PENNIMAN 230 kV line | 314386 | 314296 | 1 | DC | 145.17 | 150.05 | ER | 442 | 21.55 | 3 |
| 7 | N-1 | LN 557 | DVP - DVP | 6WALR209-6LIGH209 230 kV line | 314415 | 314391 | 1 | DC | 125.52 | 130.4 | ER | 442 | 21.55 | 4 |
| 8 | N-1 | LN 557 | DVP - DVP | 8CARSON-8MDLTHAN 500 kV line | 314902 | 314914 | 1 | DC | 121.11 | 123.79 | ER | 2442 | 65.4 | 5 |
| 9 | LFFB | 557T574 | DVP - DVP | 8CARSON-8MDLTHAN 500 kV line | 314902 | 314914 | 1 | DC | 115.2 | 118.27 | LD | 3144 | 100.24 | |
| 10 | LFFB | H2T557 | DVP - DVP | 8CARSON-8MDLTHAN 500 kV line | 314902 | 314914 | 1 | DC | 106.83 | 109.8 | LD | 3144 | 97.13 | |
| 11 | N-1 | LN 567 | DVP - DVP | 8CHCKAHM 500/230 kV transformer | 314903 | 314214 | 1 | DC | 103.07 | 110.96 | ER | 829 | 65.45 | 6 |
| 12 | N-1 | LN 576 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 126.23 | 131.51 | ER | 2442 | 128.96 | 7 |
| 13 | N-1 | LN 563 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 121.43 | 126.61 | ER | 2442 | 126.54 | |
| 14 | LFFB | 563T576 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 110.55 | 116.34 | LD | 3144 | 186.91 | |

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Cir. | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | LFFB | WT576 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 110.55 | 116.34 | LD | 3144 | 186.89 | |
| 16 | LFFB | 57602 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 110.55 | 116.34 | LD | 3144 | 186.89 | |
| 17 | N-1 | LN 594 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 117.7 | 119.49 | ER | 2442 | 44.99 | 8 |
| 18 | N-1 | LN 573 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 112.38 | 114.13 | ER | 2442 | 44.21 | |
| 19 | N-1 | LN 576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 144.02 | 147.57 | ER | 2442 | 86.8 | 9 |
| 20 | N-1 | LN 563 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 135.52 | 138.78 | ER | 2442 | 79.56 | |
| 21 | LFFB | 57602 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 119.41 | 123.17 | LD | 3351 | 125.72 | |
| 22 | LFFB | WT576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 119.41 | 123.16 | LD | 3351 | 125.72 | |
| 23 | LFFB | 563T576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 119.34 | 123.09 | LD | 3351 | 125.8 | |
| 24 | N-1 | LN 573 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 108.56 | 110.23 | ER | 2738 | 45.81 | 10 |
| 25 | N-1 | LN 594 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 105.81 | 107.4 | ER | 2738 | 44.47 | |
| 26 | LFFB | SPOTSH1T 9033 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 100.96 | 102.93 | LD | 3351 | 66.12 | |

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Cir. | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | LFFB | 557T574 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 118.9 | 122 | LD | 3144 | 101.28 | 11 |
| 28 | N-1 | LN 557 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 109.5 | 112.05 | ER | 2442 | 62.14 | |
| 29 | N-1 | LN 574 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 109.83 | 110.75 | ER | 2442 | 50.09 | |
| 30 | LFFB | H2T557 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 102.02 | 104.96 | LD | 3144 | 95.87 | |

## Steady-State Voltage Requirements

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

To be determined during Impact Study

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

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

To be determined during Impact Study

## New System Reinforcements

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

| Violation # | Overloaded Facility | Upgrade Description | Network Upgrade Number | Upgrade Cost |
|---|---|---|---|---|
| # 1 -3 | 8CHCKAHM 500/230 kV transformer | Add a second Chickahominy 500-230 kV transformer into a new breaker bay. Estimated time 24 – 30 months. | Pending | **$17,500,000** |
| | | | **Total New Network Upgrades** | **$17,500,000** |

## Contribution to Previously Identified System Reinforcements

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

| Violation # | Overloaded Facility | Upgrade Description | Network Upgrade Number | Upgrade Cost |
|---|---|---|---|---|
| # 4 | 6SKIFF CREEK-6KINGS M 230 kV line | Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months. | Pending | **$28,200,000** |
| # 5 | 6PENNIMAN-6WALR209 230 kV line | Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months. | | |
| # 6 | 6KINGS M-6PENNIMAN 230 kV line | Wreck and rebuild the Skiffes Creek – Kingsmill – Pennimann – Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimated time 30 – 36 months. | | |
| # 7 | 6WALR209-6LIGH209 230 kV line | Wreck and rebuild the Lightfoot– Waller 230 kV line to a rating of 1047 MVA. (VA CPCN Required). Estimate time 30 – 36 months. | Pending | **$15,200,000** |
| # 8 – 10 | 8CARSON-8MDLTHAN 500 kV line | Replace wave trap at both Carson and Midlothian 500kV Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time: 12 – 16 months. | Pending | **$500,000** |
| # 11 | 8CHCKAHM 500/230 kV transformer | Add a second Chickahominy 500-230 kV transformer into a new breaker bay. Estimated time 24 – 30 months. | Pending | **$17,500,000** |
| # 12 – 16 | 8CHCKAHM-8ELMONT 500 kV line | Replace wave trap at both Elmont and Chickahominy Substations. This will increase line rating by 22% to 3424 MVA. Estimated time: 14 – 16 months. | Pending | **$500,000** |
| # 17 – 18 | 8CHANCE-8BRISTER 500 kV line | Rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months. | Pending | **$73,000,000** |
| # 19 - 23 | 8ELMONT-8LDYSMTH 500 kV line | Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months. | Pending | **$88,000,000** |
| # 24 - 26 | 8LDYSMTH-8CHANCE 500 kV line | Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months. | Pending | **$50,000,000** |

| Violation # | Overloaded Facility | Upgrade Description | Network Upgrade Number | Upgrade Cost |
|---|---|---|---|---|
| # 27 - 30 | 8MDLTHAN-8NO ANNA 500 kV line | Replace wave trap at both North Anna Substations. This will increase emergency rating by 31% to 3424 MVA. Estimated time 12 – 16 months. | Pending | **$250,000** |
| | | | **Total New Network Upgrades** | **$273,150,000** |

## 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 | | Bus | | | Power | Loading % | | Rating | | MW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution |
| 31 | N-1 | LN 557 | DVP - DVP | 6SKIFF CREEK-6KINGS M 230 kV line | 314209 | 314386 | 1 | DC | 129.4 | 132.59 | ER | 442 | 31.23 |
| 32 | N-1 | LN 557 | DVP - DVP | 6PENNIMAN-6WALR209 230 kV line | 314296 | 314415 | 1 | DC | 117.09 | 120.28 | ER | 442 | 31.23 |
| 33 | N-1 | LN 557 | DVP - DVP | 6KINGS M-6PENNIMAN 230 kV line | 314386 | 314296 | 1 | DC | 120.96 | 124.15 | ER | 442 | 31.23 |
| 34 | N-1 | LN 557 | DVP - DVP | 6WALR209-6LIGH209 230 kV line | 314415 | 314391 | 1 | DC | 101.32 | 104.5 | ER | 442 | 31.23 |
| 35 | N-1 | LN 557 | DVP - DVP | 8CARSON-8MDLTHAN 500 kV line | 314902 | 314914 | 1 | DC | 135.84 | 139.58 | ER | 2442 | 94.78 |

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | N-1 | LN 567 | DVP - DVP | 8CHCKAHM 500/230 kV transformer | 314903 | 314214 | 1 | DC | 100.67 | 112.12 | ER | 829 | 94.86 |
| 37 | N-1 | LN 576 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 142.3 | 149.76 | ER | 2442 | 186.91 |
| 38 | N-1 | LN 594 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 132.13 | 134.8 | ER | 2442 | 65.2 |
| 39 | N-1 | LN 576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 163.73 | 168.88 | ER | 2442 | 125.8 |
| 40 | N-1 | LN 573 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 119.26 | 121.68 | ER | 2738 | 66.39 |

## 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 #AC1-164 interconnection of a 320 MW Energy (220.8 MW Capacity) injection into the ITO's Transmission System at Chickahominy Substation at 500 kV, 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 AC1-164 was evaluated as a 320.0 MW (Capacity 220.8 MW) injection at the Chickahominy 230kV substation in the ITO area. Project AC1-164 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-164 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<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2)<br>OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 1 /*NORTH ANNA 500-230 (TX#5)<br>END |
| 557T574 | CONTINGENCY '557T574' /* ELMONT<br>OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)<br>OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)<br>OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)<br>END |
| 563T576 | CONTINGENCY '563T576' /*MIDLOTHIAN<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2)<br>OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*MIDLOTHIAN TO CARSON (LINE 563)<br>END |
| H2T557 | CONTINGENCY 'H2T557' /* ELMONT<br>OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)<br>OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)<br>OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2)<br>END |

| Contingency Name | Description |
|---|---|
| LN 552 | CONTINGENCY 'LN 552'<br>OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 1 /* 3CHANCE 115.00 - 8CHANCE 500.00<br>OPEN BRANCH FROM BUS 314900 TO BUS 314905 CKT 1 /* 8BRISTER 500.00 - 8CHANCE 500.00<br>END |
| LN 557 | CONTINGENCY 'LN 557'<br>OPEN BRANCH FROM BUS 314214 TO BUS 314903 CKT 1 /* 6CHCKAHM 230.00 - 8CHCKAHM 500.00<br>OPEN BRANCH FROM BUS 314903 TO BUS 314908 CKT 1 /* 8CHCKAHM 500.00 - 8ELMONT 500.00<br>END |
| LN 563 | CONTINGENCY 'LN 563'<br>OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00<br>END |
| LN 573 | CONTINGENCY 'LN 573'<br>OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00<br>END |
| LN 574 | CONTINGENCY 'LN 574'<br>OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00<br>END |
| LN 576 | CONTINGENCY 'LN 576'<br>OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00<br>OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00<br>END |
| LN 581 | CONTINGENCY 'LN 581'<br>OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 2 /* 3CHANCE 115.00 - 8CHANCE 500.00<br>OPEN BRANCH FROM BUS 314905 TO BUS 314911 CKT 1 /* 8CHANCE 500.00 - 8LDYSMTH 500.00<br>END |
| LN 594 | CONTINGENCY 'LN 594'<br>OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00<br>END |

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

# Summer Peak Analysis - 2020

## Generator Deliverability

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

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N-1 | LN 563 | DVP - DVP | 6CHSTF A-6IRON208 230 kV line | 314286 | 314309 | 1 | DC | 99.04 | 101.76 | ER | 664 | 18.04 |

## Multiple Facility Contingency

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

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Cir. | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | LFFB | H2T557 | DVP - DVP | 8ELMONT 500/230 kV transformer | 314218 | 314908 | 1 | DC | 98.13 | 101.75 | LD | 1051 | 84.48 | 12 |

## 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 | | Bus | | | Power | Loading % | | Rating | | MW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Cir. | Flow | Initial | Final | Type | MVA | Contribution | Ref |
| 3 | N-1 | LN 574 | DVP - DVP | 6FRRIVER-6STJOHN 230 kV line | 314212 | 314150 | 1 | DC | 103.71 | 105.11 | ER | 749 | 23.2 | 13 |
| 4 | N-1 | LN 557 | DVP - DVP | 6CHSTF A-6IRON208 230 kV line | 314286 | 314309 | 1 | DC | 104.07 | 107.92 | ER | 664 | 25.58 | 14 |
| 5 | N-1 | LN 594 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 116.29 | 118.01 | ER | 2442 | 43.41 | 15 |
| 6 | N-1 | LN 573 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 110.91 | 112.6 | ER | 2442 | 42.64 | |
| 7 | N-1 | LN 576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 138.63 | 141.72 | ER | 2442 | 75.56 | 16 |
| 8 | N-1 | LN 563 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 128.07 | 130.7 | ER | 2442 | 64.24 | |
| 9 | LFFB | WT576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 115.46 | 118.73 | LD | 3351 | 109.45 | |
| 10 | LFFB | 57602 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 115.46 | 118.73 | LD | 3351 | 109.45 | |
| 11 | LFFB | 563T576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 115.39 | 118.66 | LD | 3351 | 109.51 | |
| 12 | N-1 | LN 573 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 107.22 | 108.83 | ER | 2738 | 44.17 | 17 |
| 13 | N-1 | LN 594 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 104.49 | 106.02 | ER | 2738 | 42.78 | |

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Cir. | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution | Ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | N-1 | LN 594 | DVP - DVP | 8LDYSMTH-8POSSUM 500 kV line | 314911 | 314922 | 1 | DC | 106.93 | 108.46 | ER | 2442 | 37.46 | 18 |
| 15 | N-1 | LN 581 | DVP - DVP | 8LDYSMTH-8POSSUM 500 kV line | 314911 | 314922 | 1 | DC | 105.57 | 107.16 | ER | 2442 | 39.44 | |
| 16 | LFFB | 557T574 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 111.05 | 112.17 | LD | 3144 | 77.82 | 19 |
| 17 | N-1 | LN 574 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 107.59 | 108.54 | ER | 2442 | 51.49 | |

## 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)*

None

## Potential Congestion due to Local Energy Deliverability

*PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The 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 | | Bus | | | Power | Loading % | | Rating | | MW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Type | Name | Area | Facility Description | From | To | Circuit | Flow | Initial | Final | Type | MVA | Contribution |
| 18 | N-1 | LN 574 | DVP - DVP | 6FRRIVER-6STJOHN 230 kV line | 314212 | 314150 | 1 | DC | 103.13 | 105.15 | ER | 749 | 33.62 |
| 19 | N-1 | LN 557 | DVP - DVP | 6NRTHEST-6ELMONT 230 kV line | 314236 | 314218 | 1 | DC | 99.74 | 105.36 | ER | 679 | 38.13 |
| 20 | N-1 | LN 576 | DVP - DVP | 8CHCKAHM-8ELMONT 500 kV line | 314903 | 314908 | 1 | DC | 117.28 | 119.1 | ER | 2442 | 98.67 |
| 21 | N-1 | LN 594 | DVP - DVP | 8CHANCE-8BRISTER 500 kV line | 314905 | 314900 | 1 | DC | 123.66 | 124.82 | ER | 2442 | 62.92 |
| 22 | N-1 | LN 576 | DVP - DVP | 8ELMONT-8LDYSMTH 500 kV line | 314908 | 314911 | 1 | DC | 158.32 | 162.8 | ER | 2442 | 109.51 |
| 23 | N-1 | LN 573 | DVP - DVP | 8LDYSMTH-8CHANCE 500 kV line | 314911 | 314905 | 1 | DC | 111.48 | 112.53 | ER | 2738 | 64.02 |
| 24 | N-1 | LN 594 | DVP - DVP | 8LDYSMTH-8POSSUM 500 kV line | 314911 | 314922 | 1 | DC | 110.83 | 111.83 | ER | 2442 | 54.29 |
| 25 | N-1 | LN 574 | DVP - DVP | 8MDLTHAN-8NO ANNA 500 kV line | 314914 | 314918 | 1 | DC | 130.91 | 132.28 | ER | 2442 | 74.62 |

| # | Contingency Type | Contingency Name | Affected Area | Facility Description | Bus From | Bus To | Circuit | Power Flow | Loading % Initial | Loading % Final | Rating Type | Rating MVA | MW Contribution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | N-1 | LN 581 | DVP - DVP | 8NO ANNA-8SPOTSYL 500 kV line | 314918 | 314934 | 1 | DC | 105.05 | 105.96 | ER | 3219 | 65.2 |
| 27 | N-1 | LN 552 | DVP - DVP | 8SPOTSYL-8MORRSVL 500 kV line | 314934 | 314916 | 1 | DC | 109.26 | 110.16 | ER | 3219 | 64.46 |

## 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 #AC1-164 interconnection of a 320 MW Energy (220.8 MW Capacity) injection into the ITO's Transmission System at Chickahominy Substation at 230 kV, 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.

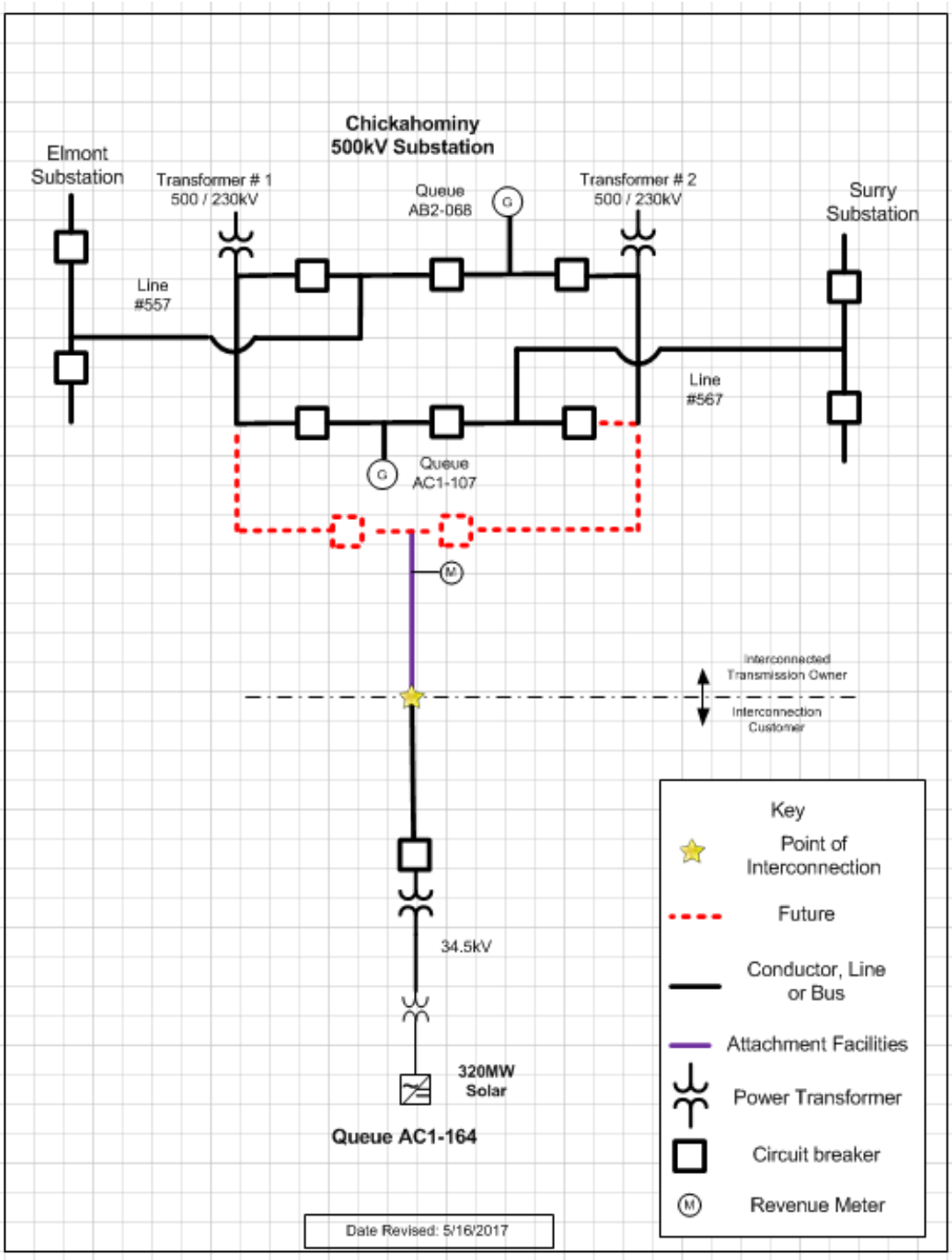
## Affected System Analysis & Mitigation

### Duke, Progress & TVA Impacts:

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

# Attachment 1.

## *System Configuration*



# Appendices

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

***It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.***

# Appendix 1

(DVP - DVP) The 6SKIFF CREEK-6KINGS M 230 kV line (from bus 314209 to bus 314386 ckt 1) loads from 153.61% to 158.49% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 21.55 MW to the thermal violation.

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

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

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

# Appendix 2

(DVP - DVP) The 6PENNIMAN-6WALR209 230 kV line (from bus 314296 to bus 314415 ckt 1) loads from 141.3% to 146.18% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 21.55 MW to the thermal violation.

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

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

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

# Appendix 3

(DVP - DVP) The 6KINGS M-6PENNIMAN 230 kV line (from bus 314386 to bus 314296 ckt 1) loads from 145.17% to 150.05% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 21.55 MW to the thermal violation.

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

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

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

# Appendix 4

(DVP - DVP) The 6WALR209-6LIGH209 230 kV line (from bus 314415 to bus 314391 ckt 1) loads from 125.52% to 130.4% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 21.55 MW to the thermal violation.

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

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

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

# Appendix 5

(DVP - DVP) The 8CARSON-8MDLTHAN 500 kV line (from bus 314902 to bus 314914 ckt 1) loads from 121.11% to 123.79% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 65.4 MW to the thermal violation.

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

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

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

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

# Appendix 6

(DVP - DVP) The 8CHCKAHM 500/230 kV transformer (from bus 314903 to bus 314214 ckt 1) loads from 103.07% to 110.96% (**DC power flow**) of its emergency rating (829 MVA) for the single line contingency outage of 'LN 567'. This project contributes approximately 65.45 MW to the thermal violation.

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

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

# Appendix 7

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 126.23% to 131.51% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 128.96 MW to the thermal violation.

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

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

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

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

# Appendix 8

(DVP - DVP) The 8CHANCE-8BRISTER 500 kV line (from bus 314905 to bus 314900 ckt 1) loads from 117.7% to 119.49% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 44.99 MW to the thermal violation.

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

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

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

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

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

# Appendix 9

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 144.02% to 147.57% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 86.8 MW to the thermal violation.

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

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

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

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

# Appendix 10

(DVP - DVP) The 8LDYSMTH-8CHANCE 500 kV line (from bus 314911 to bus 314905 ckt 1) loads from 108.56% to 110.23% (**DC power flow**) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 573'. This project contributes approximately 45.81 MW to the thermal violation.

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

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

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

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

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

# Appendix 11

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 118.9% to 122.0% (**DC power flow**) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of '557T574'. This project contributes approximately 101.28 MW to the thermal violation.

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

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

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

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

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

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

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

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

# Appendix 12

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 98.13% to 101.75% (**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 84.48 MW to the thermal violation.

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

| *Bus Number* | *Bus Name* | *Full Contribution* |
|---|---|---|
| *315067* | *1DARBY 1* | *4.87* |
| *315068* | *1DARBY 2* | *4.87* |
| *315069* | *1DARBY 3* | *4.93* |
| *315070* | *1DARBY 4* | *4.93* |
| *315043* | *1FRIVERA* | *6.55* |
| *315044* | *1FRIVERB* | *5.07* |
| *315045* | *1FRIVERC* | *6.55* |
| *315046* | *1FRIVERD* | *5.07* |
| *315047* | *1FRIVERE* | *5.07* |
| *315048* | *1FRIVERF* | *6.55* |
| *315073* | *1STONECA* | *9.14* |
| *314784* | *1WEYRHSB* | *1.71* |
| *315091* | *1YORKTN2* | *31.74* |
| *314539* | *3UNCAMP* | *2.15* |
| *314541* | *3WATKINS* | *0.6* |
| *314229* | *6MT R221* | *1.42* |
| *314236* | *6NRTHEST* | *0.36* |
| *314189* | *6PAPERMILL* | *8.79* |
| *314251* | *6S PUMP* | *1.65* |
| *315074* | *CIR_AB2-152* | *11.02* |
| *315075* | *CIR_AB2-152* | *10.88* |
| *292791* | *U1-032 E* | *4.76* |
| *297087* | *V2-040* | *0.27* |
| *900672* | *V4-068 E* | *0.25* |
| *901082* | *W1-029E* | *41.21* |
| *907092* | *X1-038 E* | *5.37* |
| *913392* | *Y1-086 E* | *1.96* |

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|---|---|---|
| *916042* | *Z1-036 E* | *40.01* |
| *916192* | *Z1-068 E* | *1.73* |
| *917122* | *Z2-027 E* | *0.95* |
| *917592* | *Z2-099 E* | *0.37* |
| *921092* | *AA1-049 C* | *2.19* |
| *921093* | *AA1-049 E* | *1.03* |
| *921162* | *AA1-063AC* | *6.94* |
| *921163* | *AA1-063AE* | *3.27* |
| *918512* | *AA1-065 E OP* | *3.65* |
| *921292* | *AA1-083* | *6.* |
| *921532* | *AA1-132 C* | *6.77* |
| *921533* | *AA1-132 E* | *2.9* |
| *921542* | *AA1-133 C* | *9.06* |
| *921543* | *AA1-133 E* | *3.88* |
| *921552* | *AA1-134 C* | *8.84* |
| *921553* | *AA1-134 E* | *3.79* |
| *921572* | *AA1-138 C* | *8.66* |
| *921573* | *AA1-138 E* | *3.71* |
| *921582* | *AA1-139 C* | *13.6* |
| *921583* | *AA1-139 E* | *5.83* |
| *921622* | *AA1-145* | *102.06* |
| *921772* | *AA2-059 C* | *2.07* |
| *921773* | *AA2-059 E* | *0.95* |
| *920022* | *AA2-086 E* | *0.2* |
| *921982* | *AA2-088 C* | *5.49* |
| *921983* | *AA2-088 E* | *8.96* |
| *922522* | *AA2-177 C* | *12.12* |
| *922523* | *AA2-177 E* | *5.19* |
| *922532* | *AA2-178 C* | *8.21* |
| *922533* | *AA2-178 E* | *3.52* |
| *922602* | *AB1-013 C* | *2.48* |
| *922603* | *AB1-013 E* | *16.58* |
| *922672* | *AB1-026 C* | *2.22* |
| *922673* | *AB1-026 E* | *0.95* |
| *922682* | *AB1-027 C* | *4.44* |
| *922683* | *AB1-027 E* | *1.9* |
| *922722* | *AB1-053 C* | *0.85* |
| *922723* | *AB1-053 E* | *0.48* |
| *922732* | *AB1-054 C* | *5.79* |
| *922733* | *AB1-054 E* | *2.85* |
| *923262* | *AB1-132 C OP* | *11.47* |
| *923263* | *AB1-132 E OP* | *4.92* |
| *923272* | *AB1-135 C OP* | *3.7* |
| *923273* | *AB1-135 E OP* | *1.58* |
| *923572* | *AB1-173 C OP* | *1.85* |

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|---|---|---|
| *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* |

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|---|---|---|
| *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 13

(DVP - DVP) The 6FRRIVER-6STJOHN 230 kV line (from bus 314212 to bus 314150 ckt 1) loads from 103.71% to 105.11% (**DC power flow**) of its emergency rating (749 MVA) for the single line contingency outage of 'LN 574'. This project contributes approximately 23.2 MW to the thermal violation.

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

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

| | | |
|---|---|---|
| *922522* | *AA2-177 C* | *5.21* |
| *922682* | *AB1-027 C* | *1.82* |
| *923272* | *AB1-135 C OP* | *1.47* |
| *923841* | *AB2-024 C* | *1.23* |
| *923981* | *AB2-039 C OP* | *3.9* |
| *924061* | *AB2-050* | *6.06* |
| *924241* | *AB2-068 OP* | *107.62* |
| *924811* | *AB2-134 C OP* | *6.68* |
| *924961* | *AB2-152* | *1.5* |
| *925051* | *AB2-160 C OP* | *2.95* |
| *925061* | *AB2-161 C OP* | *1.58* |
| *925331* | *AB2-190 C* | *11.92* |
| *925811* | *AC1-060* | *1.33* |
| *925821* | *AC1-061* | *0.02* |
| *926291* | *AC1-107 OP* | *168.1* |
| *926411* | *AC1-112 C* | *1.42* |
| *926551* | *AC1-134* | *15.16* |
| *926751* | *AC1-161 C OP* | *14.19* |
| *926781* | *AC1-164 C OP* | *23.2* |
| *927041* | *AC1-191 C* | *6.75* |
| *927221* | *AC1-216 C OP* | *5.* |

# Appendix 14

(DVP - DVP) The 6CHSTF A-6IRON208 230 kV line (from bus 314286 to bus 314309 ckt 1) loads from 104.07% to 107.92% (**DC power flow**) of its emergency rating (664 MVA) for the single line contingency outage of 'LN 557'. This project contributes approximately 25.58 MW to the thermal violation.

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

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

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

# Appendix 15

(DVP - DVP) The 8CHANCE-8BRISTER 500 kV line (from bus 314905 to bus 314900 ckt 1) loads from 116.29% to 118.01% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 43.41 MW to the thermal violation.

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

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

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

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

# Appendix 16

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 138.63% to 141.72% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 75.56 MW to the thermal violation.

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

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

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

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

# Appendix 17

(DVP - DVP) The 8LDYSMTH-8CHANCE 500 kV line (from bus 314911 to bus 314905 ckt 1) loads from 107.22% to 108.83% (**DC power flow**) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 573'. This project contributes approximately 44.17 MW to the thermal violation.

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

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

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

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

# Appendix 18

(DVP - DVP) The 8LDYSMTH-8POSSUM 500 kV line (from bus 314911 to bus 314922 ckt 1) loads from 106.93% to 108.46% (**DC power flow**) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 37.46 MW to the thermal violation.

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

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

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

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

# Appendix 19

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 111.05% to 112.17% (**DC power flow**) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of '557T574'. This project contributes approximately 77.82 MW to the thermal violation.

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

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

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

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

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

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

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