Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AD1-056/AD1-057

Hornertown - Hathaway 230kV 61.3 MW Capacity / 94 MW Energy

Revision 3 / March 2022

Revision 2 / March 2022

Revision 1 / December 2021

December / 2019

Introduction

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, Section 205, as well as the System Impact Study Agreement between Sweetleaf Solar LLC, the Interconnection Customer (IC) and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the IC. As a requirement for interconnection, the IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

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

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

Summary Revision 1 - December 2021

This revision is being issued due to a re-tool performed.

Summary Revision 2 - March 2022

This revision is being issued to account for incorrect line ratings for the 3CHESTNUT-3WITAKRS 115 kV line and 3WITAKRS-3BTLEBRO 115 kV line flowgates. Therefore, AD1-056/57 will no longer require the upgrades previously identified for those flowgates. This report also corrects for n6220/n6223. n6220 does not solve all identified overloaded flowgates in previous reports. n6223 is needed to resolve flowgates and is first to cause by this project.

Summary Revision 3 – March 2022

Adding previously missing Appendix 3. Also replaced n6052 with b3691. N6052 was a previous upgrade to re-build Lakeview-Carolina 230kV Line #2141. The PJM board approved b3691 in February 2022 which will instead drive rebuild of the Lakeview-Carolina 230kV Line #2141. Report updated to remove n6052 and replace it with b3691.

General

The IC has proposed a solar generating facility located in Halifax County, North Carolina. The installed AD1-056/AD1-057 facilities will have a total capability of 94 MW with 61.3 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is June 1, 2020. This study does not imply an ITO commitment to this in-service date.

Point of Interconnection

AD1-056/AD1-057 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects the Hornertown – Hathaway 230kV line.

Cost Summary

The AD1-056/AD1-057 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 1,800,000
Direct Connection Network Upgrades	$ 6,300,000
Non Direct Connection Network Upgrades	$ 1,000,000
Total Costs	**$ 9,100,000**

In addition, the AD2-056/057 project may be responsible for a contribution to the following costs:

These costs are for PJM network upgrades:

Description	Total Cost
Allocation for New System Upgrades	$ 19,200,000
Contribution for Previously Identified Upgrades	$ 19,349,689
Total Costs	**$ 38,549,689**

These costs are for Duke Energy Progress upgrades to be confirmed as part of the affected systems study and constructed via a separate agreement between the customer and Duke:

Description	Total Cost
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 0**

Please note, although Queue Project AD1-056/AD1-057 may not have cost responsibility for Duke Energy Progress upgrades mentioned in this report, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study. As other projects leave the queue,

AD1-056/AD1-057 may receive cost allocation for Duke Energy Progress upgrades mentioned in this report.

Attachment Facilities

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

Transmission: Construct approximately one span of 230kV Attachment line between the generation substation and a new AD1-056/AD1-057 Switching Station. The estimated cost for this work is $1,200,000.

The estimated total cost of the Attachment Facilities is $1,800,000. It is estimated to take 18-24 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase.

Direct Connection Cost Estimate

Substation: Establish the new 230 kV AD1-056/AD1-057 Switching Substation (interconnection substation). The arrangement in the substation will be as shown in Attachment 1. The estimated cost of this work scope is $6,300,000. It is estimated to take 24-36 months to complete this work upon execution of an Interconnection Construction Service Agreement.

Non-Direct Network Upgrades:

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. Estimated cost is $1,000,000 and is estimated to take 24-30 months to complete.

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

New System Reinforcements

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

New System Reinforcements:

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-056/057 Allocation
#1	6CHESTF B-6BASIN 230 kV line	AD1-056/057 is the driver for the overload of this flowgate, and also a contributor to a previously identified overload for the same monitored facility. See item #7 below for the reinforcement and cost allocation, if any.	-	-	-
#2,4	AB2-100 TAP-6CLUBHSE 230 kV line	Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA. Rating: 1047/1047/1204 MVA Schedule: 12/31/2024 in-service date Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	b3121	$27,000,000	**$0**
#3	AD1-057 TAP-6MORNSTR 230 kV line	Rebuild 12.8 miles of 230 kV Line 2056 from AD1-057 Tap to Hathaway with 2-636 ACSR. Rating: 1047/1047/1204 MVA Schedule: 30-36 months Estimate; $19,200,000 AD1-057 is the driver for the overload of this facility for this contingency.	n6223	$19,200,000	**$19,200,000**
				Total New Network Upgrades	**$ 19,200,000**

Contribution to Previously Identified System Reinforcements:

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-056/057 Allocation
#5	3CHESTNUT-3WITAKRS 115 kV line	Incorrect rating. The correct rating of the line is 176/176/202 MVA. This is not overloaded.	-	-	-
#6	6MORNSTR-6ROCKYMT230 T 230 kV line	Description: Rebuild 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway Rating: 1047/1047/1204 MVA Schedule: 12/31/2024 in-service date Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	b3122	$13,000,000	**$0**
#7	6CHESTF B-6BASIN 230 kV line	Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor which will increase the line rating to approximately 706 MVA. Note: Project is in-service as of 4/27/2018	b2990	$350,000	**$0**
#8,9	3BTLEBRO-3ROCKYMT115 T 115 kV line	**Dominion Portion:** Replace Battleboro substation terminal equipment. Upgrading the breaker leads at Battleboro will bring the rating to 398 MVA for the DVP terminal. The Duke end of the line is still limiting. New Ratings of the line: 239/239/239 MVA (until Duke terminal is upgraded) Note 1: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	n6118	$100,000	**$0**

<table>
<tr>
<td></td>
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<td>Dominion Portion:
Split the 115 kV Bus at Hathaway into two separate buses with a 115 kV Line on each bus. Rebuild Line #55 (Tarboro – Anaconda) and close the tie switch between Line 55 & 80. Line #1001 is opened at Battleboro thus making Line #1001 radial from Chestnut Substation.

Time Estimate: 20 months

<table>
<tr><th>Queue Project</th><th>MW Impact</th><th>Cost</th></tr>
<tr><td>AD1-023</td><td>7.27</td><td>$2,065,171</td></tr>
<tr><td>AD1-057</td><td>17.02</td><td>$4,834,829</td></tr>
</table>
</td>
<td>n6618</td>
<td>$6,900,000</td>
<td>$4,834,829</td>
</tr>
<tr>
<td></td>
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<td>Duke Energy/Progress Portion:
Reconductor 8.5 miles with single 795 ACSS-TW per phase, upgrade disconnect switches and CT ratios.

New Ratings: 313/313/313 MVA

Note 1: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.

Note 2: The Duke/Progress Energy portion of this line is studied under Duke’s FERC tariff process. Reference the applicable affected system study for the AD1 cluster.</td>
<td>dep0001</td>
<td>$31,300,000</td>
<td>$0</td>
</tr>
<tr>
<td>#10</td>
<td>6EVERETS-6GREENVILE T 230 kV line</td>
<td>Dominion Portion:
Rebuild 20.32 miles of 230 kV Line 218 from Everetts to Greenville with 2-636 ACSR

Rating: 1047/1047/1204 MVA
Schedule: 30-36 months</td>
<td>n6144</td>
<td>$30,750,000</td>
<td>$14,514,860</td>
</tr>
</table>

		<table><tr><th>Queue Project</th><th>MW Impact</th><th>Cost</th></tr><tr><td>AD1-022/023</td><td>15.10</td><td>$16,235,140</td></tr><tr><td>AD1-056/057</td><td>13.5</td><td>$14,514,860</td></tr></table>			
		Duke Energy/Progress Portion: Reconductor 2 miles with double 795 ACSS-TW per phase, upgrade disconnect switches and CT ratios Rating: 1195/1195/1195 MVA Schedule: 30-36 months Note: The Duke/Progress Energy portion of this line is studied under Duke's FERC tariff process. Reference the applicable affected system study for the AD1 cluster.	dep0003	$10,000,000	**$0**
#11	6LAKEVEW-6CAROLNA 230 kV line	Uprate/rebuild approximately 1.28 miles of the Lakeview – Carolina 230 kV Line # 2141 to increase the line rating 1047 MVA (normal), 1047 MVA (emergency), and 1047 MVA (load dump). Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	b3691	$1,185,000	**$0**
#12	3WITAKRS-3BTLEBRO 115 kV line	Incorrect rating. The correct rating of the line is 176/176/202 MVA. This is not overloaded.	-	-	-
#13	AD1-057 TAP-6MORNSTR 230 kV line	Install a second, back-to-back breaker between existing line positions #254 and #2141 at the Lakeview substation. Project Type: CON Schedule: 14-24 months Note 1: As changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project	n6220	$1,955,282	**$0**

		AD1-056/AD1-057 could become the driver and could be responsible for the upgrade Note 2: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, Queue Project AD1-056/AD1-057 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, Queue Project AD1-056/AD1-057 will need an interim study			
Total Cost Allocation Previously Identified Network Upgrades					**$ 19,349,689**

Interconnection Customer Requirements

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

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

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

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

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

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

Revenue Metering and SCADA Requirements

PJM Requirements

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

Interconnected Transmission Owner Requirements

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

Network Impacts

The Queue Project AD1-056/AD1-057 was evaluated as a 94.0 MW (Capacity 61.3 MW) injection into Hornertown-Hathaway 230kV substation. Project AD1-056/AD1-057 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-056/AD1-057 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
DVP_P1-2: LN 130-A	CONTINGENCY 'DVP_P1-2: LN 130-A' OPEN BRANCH FROM BUS 314562 TO BUS 314570 CKT 1 /* 3CLUBHSE 115.00 - 3METCATP 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314572 CKT 1 /* 3METCATP 115.00 - 3EMPORIA 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314588 CKT 1 /* 3METCATP 115.00 - 3METCALF 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 925170 CKT 1 /* 3EMPORIA 115.00 - AB2-174 TAP 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 314863 CKT 1 /* 3EMPORIA 115.00 - 3EMPOR_1 115.00 OPEN BUS 314570 /* ISLAND OPEN BUS 314572 /* ISLAND OPEN BUS 314588 /* ISLAND END
DVP_P1-2: LN 2020	CONTINGENCY 'DVP_P1-2: LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 /* 6ECITYDP2 230.00 - 6ELIZ CT 230.00 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 /* 6ECITYDP2 230.00 - 6TANGLEW 230.00 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 /* 6TANGLEW 230.00 - 6WINFALL 230.00 OPEN BUS 313851 /* ISLAND OPEN BUS 314639 /* ISLAND OPEN BUS 913391 /* ISLAND

	OPEN BUS 913392 /* ISLAND END
DVP_P1-2: LN 2056-A	CONTINGENCY 'DVP_P1-2: LN 2056-A' OPEN BRANCH FROM BUS 313845 TO BUS 934330 CKT 1 /* 6HATHAWAY 230.00 - AD1-057 TAP 230.00 END
DVP_P1-2: LN 2058	CONTINGENCY 'DVP_P1-2: LN 2058' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6MORNSTR 230.00 END
DVP_P1-2: LN 2141	CONTINGENCY 'DVP_P1-2: LN 2141' OPEN BRANCH FROM BUS 314561 TO BUS 314583 CKT 1 /* 6CAROLNA 230.00 - 6LAKEVEW 230.00 END
DVP_P1-2: LN 246	CONTINGENCY 'DVP_P1-2: LN 246' OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND OPEN BUS 314590 /* ISLAND

	END
DVP_P1-2: LN 563	CONTINGENCY 'DVP_P1-2: LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
DVP_P4-2: 246T247	CONTINGENCY 'DVP_P4-2: 246T247' /* SUFFOLK 230 KV OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND: 6NUCO TP 230.00 OPEN BUS 314590 /* ISLAND: 6NUCOR 230.00 OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND: 6SUNBURY 230.00 END
DVP_P4-2: 254T2141	CONTINGENCY 'DVP_P4-2: 254T2141' /* LAKEVIEW OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1 /* 2141 OPEN BRANCH FROM BUS 314583 TO BUS 924510 CKT 1 /* 254 END

DVP_P4-2: 562T563	CONTINGENCY 'DVP_P4-2: 562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
DVP_P7-1: LN 2058-2181	CONTINGENCY 'DVP_P7-1: LN 2058-2181' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 END
DVP_P7-1: LN 81-2056	CONTINGENCY 'DVP_P7-1: LN 81-2056' OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1 /* 3CAROLNA 115.00 - 3HORNRTN 115.00 OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1 /* 3HORNRTN 115.00 - 3ROAN DP 115.00 OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1 /* 3ROAN DP 115.00 - 3DARLINGT DP115.00 OPEN BUS 314578 /* ISLAND: 3HORNRTN 115.00 OPEN BUS 314598 /* ISLAND: 3ROAN DP 115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6MORNSTR 230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1 /* 6PA-RMOUNT#4230.00 - 6ROCKYMT230T OPEN BUS 304226 /* ISLAND OPEN BUS 314591 /* ISLAND: 6NASH 230.00

	END

Summer Peak Analysis – 2021

Generator Deliverability

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

	Contingency				Bus				Loading %		Rating		MW	Flowgate
#	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type	MVA	Contribution	Appendix
1	N-1	DVP_P1-2: LN 563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	99.52	100.3	ER	449	4.09	
2	N-1	DVP_P1-2: LN 2141	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	96.35	101.92	ER	375	21.63	
3	N-1	DVP_P1-2: LN 2141	DVP - DVP	AD1-057 TAP-6MORNSTR 230 kV line	934330	313845	1	AC	91.86	100.44	ER	442	39.55	

Multiple Facility Contingency

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

	Contingency				Bus				Loading %		Rating		MW	Flowgate
#	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type	MVA	Contribution	Appendix
4	LFFB	DVP_P4-2: 246T247	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	99.83	105.13	LD	459	24.63	4

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				Bus				Loading %		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type	MVA	MW Contribution	Flowgate Appendix
5	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	3CHESTNUT-3WITAKRS 115 kV line	313719	314623	1	AC	116.7	119.2	ER	134	3.56	5
6	DCTL	DVP_P7-1: LN 81-2056	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	120.9	128.97	ER	374	30.34	6
7	LFFB	DVP_P4-2: 562T563	DVP - DVP	6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	104	105.04	LD	549	6.52	7
8	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	AC	229.1	239.31	ER	164	17.02	8
9	DCTL	DVP_P7-1: LN 81-2056	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	AC	112.1	115	ER	164	5.74	
10	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	103	105.73	ER	478	13.5	10
11	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	AC	117.3	126.47	ER	375	34.82	11
12	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	3WITAKRS-3BTLEBRO 115 kV line	314623	314554	1	AC	117.6	120.09	ER	134	3.56	12
13	LFFB	DVP_P4-2: 254T2141	DVP - DVP	AD1-057 TAP-6MORNSTR 230 kV line	934330	313845	1	AC	120.4	137.25	LD	541	93.81	14

Steady-State Voltage Requirements

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

None

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

No mitigations were found to be required.

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-056 / AD1-057 Allocation
#1	6CHESTF B-6BASIN 230 kV line	AD1-056/057 is the driver for the overload of this flowgate, and also a contributor to a previously identified overload for the same monitored facility. See item #7 below for the reinforcement and cost allocation, if any.	-	-	-
#2,4	AB2-100 TAP-6CLUBHSE 230 kV line	Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA. Rating: 1047/1047/1204 MVA Schedule: 12/31/2024 in-service date Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	b3121	$27,000,000	**$0**
#3	AD1-057 TAP-6MORNSTR 230 kV line	Rebuild 12.8 miles of 230 kV Line 2056 from AD1-057 Tap to Hathaway with 2-636 ACSR. Rating: 1047/1047/1204 MVA Schedule: 30-36 months Estimate; $19,200,000 AD1-057 is the driver for the overload of this facility for this contingency.	n6223	$19,200,000	**$19,200,000**
				Total New Network Upgrades	**$ 19,200,000**

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 is calculated and reported for in the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AD1-056/057 Allocation
#5	3CHESTNUT-3WITAKRS 115 kV line	Incorrect rating. The correct rating of the line is 176/176/202 MVA. This is not overloaded.	-	-	-
#6	6MORNSTR-6ROCKYMT230 T 230 kV line	Description: Rebuild 4.3 miles of Dominion 230 kV Line #2058 Rocky Mt. – Hathaway Rating: 1047/1047/1204 MVA Schedule: 12/31/2024 in-service date Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.	b3122	$13,000,000	**$0**
#7	6CHESTF B-6BASIN 230 kV line	Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor which will increase the line rating to approximately 706 MVA. Note: Project is in-service as of 4/27/2018	b2990	$350,000	**$0**
#8,9	3BTLEBRO-3ROCKYMT115 T 115 kV line	**Dominion Portion:** Replace Battleboro substation terminal equipment. Upgrading the breaker leads at Battleboro will bring the rating to 398 MVA for the DVP terminal. The Duke end of the line is still limiting. New Ratings of the line: 239/239/239 MVA (until Duke terminal is upgraded) Note 1: Although Queue Project AD1-056/AD1-057	n6118	$100,000	**$0**

<table>
<tr><td></td><td></td><td>may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Dominion Portion:
Split the 115 kV Bus at Hathaway into two separate buses with a 115 kV Line on each bus. Rebuild Line #55 (Tarboro – Anaconda) and close the tie switch between Line 55 & 80. Line #1001 is opened at Battleboro thus making Line #1001 radial from Chestnut Substation.

Time Estimate: 20 months

<table>
<tr><th>Queue Project</th><th>MW Impact</th><th>Cost</th></tr>
<tr><td>AD1-023</td><td>7.27</td><td>$2,065,171</td></tr>
<tr><td>AD1-057</td><td>17.02</td><td>$4,834,829</td></tr>
</table>
</td><td>n6618</td><td>$6,900,000</td><td>$4,834,829</td></tr>
<tr><td></td><td></td><td>Duke Energy/Progress Portion:
Reconductor 8.5 miles with single 795 ACSS-TW per phase, upgrade disconnect switches and CT ratios.

New Ratings: 313/313/313 MVA

Note 1: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.

Note 2: The Duke/Progress Energy portion of this line is studied under Duke’s FERC tariff process.</td><td>dep0001</td><td>$31,300,000</td><td>$0</td></tr>
</table>

<table>
<tr><td></td><td></td><td>Reference the applicable affected system study for the AD1 cluster.</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">#10</td><td rowspan="2">6EVERETS-6GREENVILE T 230 kV line</td><td>Dominion Portion:
Rebuild 20.32 miles of 230 kV Line 218 from Everetts to Greenville with 2-636 ACSR

Rating: 1047/1047/1204 MVA
Schedule: 30-36 months

<table>
<tr><th>Queue Project</th><th>MW Impact</th><th>Cost</th></tr>
<tr><td>AD1-022/023</td><td>15.10</td><td>$16,235,140</td></tr>
<tr><td>AD1-056/057</td><td>13.5</td><td>$14,514,860</td></tr>
</table></td><td>n6144</td><td>$30,750,000</td><td>$14,514,860</td></tr>
<tr><td>Duke Energy/Progress Portion:
Reconductor 2 miles with double 795 ACSS-TW per phase, upgrade disconnect switches and CT ratios

Rating: 1195/1195/1195 MVA
Schedule: 30-36 months

Note: The Duke/Progress Energy portion of this line is studied under Duke’s FERC tariff process. Reference the applicable affected system study for the AD1 cluster.</td><td>dep0003</td><td>$10,000,000</td><td>$0</td></tr>
<tr><td>#11</td><td>6LAKEVEW-6CAROLNA 230 kV line</td><td>Uprate/rebuild approximately 1.28 miles of the Lakeview – Carolina 230 kV
Line # 2141 to increase the line rating 1047 MVA (normal), 1047 MVA
(emergency), and 1047 MVA (load dump).

Note: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, it may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, it will need an interim study.</td><td>b3691</td><td>$1,185,000</td><td>$0</td></tr>
</table>

#12	3WITAKRS-3BTLEBRO 115 kV line	Incorrect rating. The correct rating of the line is 176/176/202 MVA. This is not overloaded.	-	-	-
#13	AD1-057 TAP-6MORNSTR 230 kV line	Install a second, back-to-back breaker between existing line positions #254 and #2141 at the Lakeview substation. Project Type: CON Schedule: 14-24 months Note 1: As changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AD1-056/AD1-057 could become the driver and could be responsible for the upgrade Note 2: Although Queue Project AD1-056/AD1-057 may not have cost responsibility for this upgrade, Queue Project AD1-056/AD1-057 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AD1-056/AD1-057 comes into service prior to completion of the upgrade, Queue Project AD1-056/AD1-057 will need an interim study	n6220	$1,955,282	**$0**
				Total Cost Allocation Previously Identified Network Upgrades	**$ 19,349,689**

Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The IC can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this interconnection request by addressing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

	Contingency				Bus				Loading %		Rating		
#	Type	Name	Affected Area	Facility Description	From	To	Ckt	Power Flow	Initial	Final	Type	MVA	MW Contribution
1	N-1	DVP_P1-2: LN 2181	DVP - CPLE	The 6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	AC	120.28	128.41	ER	374	30.27
2	N-1	DVP_P1-2: LN 2058	DVP - DVP	The 6MORNSTR-6NASH 230 kV line	313845	314591	1	AC	106.97	113.85	ER	449	30.88
3	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	The 3SO JUSTICE-3COX DP 115 kV line	313858	314577	1	AC	102.4	105.19	ER	165	5.46
4	N-1	DVP_P1-2: LN 563	DVP - DVP	The 6CHESTF B-6BASIN 230 kV line	314287	314276	1	AC	121.34	122.53	ER	449	6.27
5	N-1	DVP_P1-2: LN 2181	DVP - CPLE	The 3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	AC	101.7	104.48	ER	164	5.5
6	N-1	DVP_P1-2: LN 254-A	DVP - DVP	The 6CLUBHSE 230/115 kV transformer	314562	314563	1	AC	96.89	100.24	ER	183	5.89
7	N-1	DVP_P1-2: LN 2131A	DVP - DVP	The 6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	96.22	99.93	ER	599	22.28
8	N-1	DVP_P1-2: LN 2131A	DVP - DVP	The 6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	AC	102.83	105.51	ER	572	15.62
9	N-1	DVP_P1-2: LN 2131A	DVP - CPLE	The 6EVERETS-6GREENVILE T 230 kV line	314574	304451	1	AC	86.24	87.25	ER	478	5.97
10	N-1	DVP_P1-2: LN 2131A	DVP - DVP	The 6NUCO TP-6SUFFOLK 230 kV line	314575	314537	1	AC	96.62	99.3	ER	572	15.62
11	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	The 3COX DP-3CHESTNUT 115 kV line	314577	313719	1	AC	118.56	121.98	ER	134	5.46
12	N-1	DVP_P1-2: LN 2056-A	DVP - DVP	The 6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	AC	134.2	148.8	ER	375	53.39
13	N-1	DVP_P1-2: LN 2131A	DVP - DVP	The 6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	99.47	105.42	ER	375	22.77
14	N-1	DVP_P1-2: LN 2058	DVP - CPLE	The 6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	AC	97.33	103.9	ER	470	30.88
15	N-1	DVP_P1-2: LN 2020	DVP - DVP	The 6WINFALL-W1-029 230 kV line	314651	901080	1	AC	65.78	66.78	ER	449	5.29
16	N-1	DVP_P1-2: LN 246	DVP - DVP	The 6S HERTFORD-6WINFALL 230 kV line	314662	314651	1	AC	80.51	81.99	ER	733	10.77
17	N-1	DVP_P1-2: LN 246	DVP - DVP	The Z1-036 TAP-6S HERTFORD 230 kV line	916040	314662	1	AC	82.68	84.16	ER	733	10.77
18	N-1	DVP_P1-2: LN 130-A	DVP - DVP	The AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	120.44	126.39	ER	375	22.54
19	N/A	N/A	DVP - DVP	The AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	95.86	101.65	NR	375	21.75
20	N/A	N/A	DVP - DVP	The AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	95.86	101.65	NR	375	21.75
21	N-1	DVP_P1-2: LN 2141	DVP - DVP	The AD1-057 TAP-6MORNSTR 230 kV line	934330	313845	1	AC	104.82	117.99	ER	442	60.65

Light Load Analysis in 2021

Not required

Affected System Analysis & Mitigation

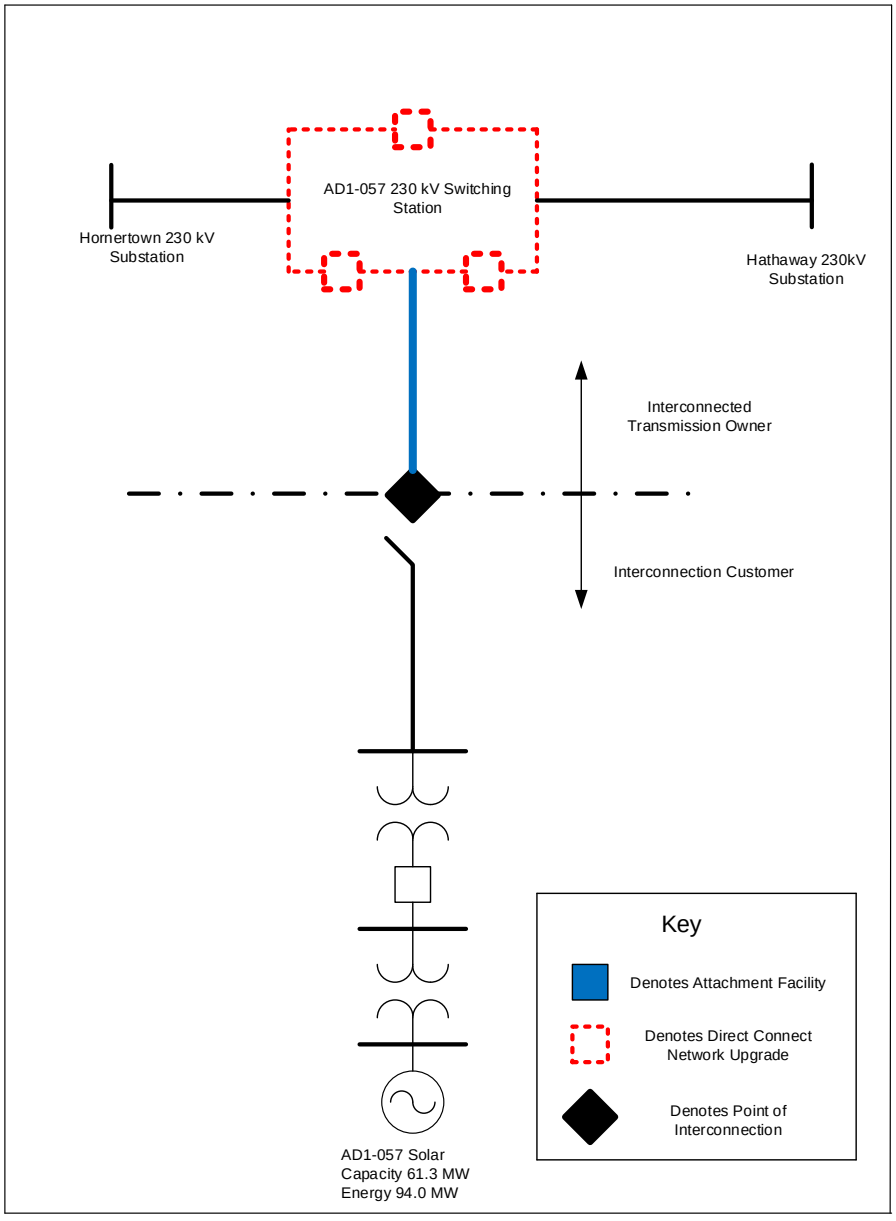
Duke Energy/Progress:

Potential constraints were identified by PJM on the following Dominion – Duke Energy/Progress (DEP) tie lines. There are no mitigations currently planned for the DEP portions of these overloads. The Queue Project AD1-056/AD1-057 may be subject to operational restriction if real-time system reliability issues occur. The following facilities were identified in this report:

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

Attachment 1.

System Configuration



Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 3

(DVP - DVP) The AD1-057 TAP-6MORNSTR 230 kV line (from bus 934330 to bus 313845 ckt 1) loads from 91.86% to 100.44% (AC power flow) of its emergency rating (442 MVA) for the single line contingency outage of 'DVP_P1-2: LN 2141'. This project contributes approximately 39.55 MW to the thermal violation.

```
CONTINGENCY 'DVP_P1-2: LN 2141'
  OPEN BRANCH FROM BUS 314561 TO BUS 314583 CKT 1              /* 6CAROLNA
230.00 - 6LAKEVEW 230.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*9.0252*
315141	*1GASTONB*	*9.0252*
315136	*1ROSEMG1*	*7.1271*
315138	*1ROSEMG2*	*3.338*
315137	*1ROSEMS1*	*4.4206*
314704	*3LAWRENC*	*0.2521*
919701	*AA2-057 C*	*-4.3418*
930861	*AB1-132 C*	*37.6253*
931231	*AB1-173 C*	*1.1857*
931241	*AB1-173AC*	*1.1857*
923851	*AB2-025 C*	*0.3544*
923911	*AB2-031 C O1*	*1.1769*
923991	*AB2-040 C O1*	*3.8645*
924151	*AB2-059 C O1*	*-9.6369*
924511	*AB2-100 C*	*17.8521*
925171	*AB2-174 C O1*	*4.4591*
925591	*AC1-034 C*	*-6.2421*
926071	*AC1-086 C*	*55.4077*
934331	*AD1-057 C O1*	*39.5508*
LTF	*AMIL*	*0.3193*
LTF	*BLUEG*	*1.6676*
LTF	*CALDERWOOD*	*0.9997*
LTF	*CANNELTON*	*0.3176*
LTF	*CATAWBA*	*0.9779*
LTF	*CBM-N*	*0.0033*
LTF	*CHEOAH*	*0.9329*
LTF	*CLIFTY*	*6.0836*
LTF	*COTTONWOOD*	*3.3537*
LTF	*EDWARDS*	*0.5156*

LTF	*ELMERSMITH*	*0.9354*
LTF	*FARMERCITY*	*0.4074*
LTF	*G-007A*	*0.6881*
LTF	*GIBSON*	*0.5826*
LTF	*HAMLET*	*1.9889*
LTF	*MORGAN*	*2.9435*
LTF	*NEWTON*	*1.4172*
LTF	*NYISO*	*0.0429*
LTF	*O-066A*	*0.3158*
LTF	*PRAIRIE*	*3.0686*
LTF	*SMITHLAND*	*0.2722*
LTF	*TATANKA*	*0.6892*
LTF	*TILTON*	*0.6086*
LTF	*TRIMBLE*	*0.3162*
LTF	*TVA*	*1.2385*
LTF	*UNIONPOWER*	*1.6586*
LTF	*VFT*	*1.8318*
LTF	*Y3-032*	*0*

Appendix 4

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 99.83% to 105.13% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 24.63 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-2: 246T247'                          /* SUFFOLK 230 KV
  OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1        /* 6SUFFOLK
230.00 - 6NUCO TP 230.00
  OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1        /* 6EARLEYS
230.00 - 6NUCO TP 230.00
  OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1        /* 6NUCO TP
230.00 - 6NUCOR 230.00
  OPEN BUS 314575                                  /* ISLAND: 6NUCO TP 230.00
  OPEN BUS 314590                                  /* ISLAND: 6NUCOR 230.00
  OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1        /* 6SUFFOLK
230.00 - 6SUNBURY 230.00
  OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1        /* 6SUNBURY
230.00 - W1-029 230.00
  OPEN BUS 314648                                  /* ISLAND: 6SUNBURY 230.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*1.98*
315131	*1EDGECMA*	*9.02*
315132	*1EDGECMB*	*9.02*
315139	*1GASTONA*	*7.4*
315141	*1GASTONB*	*7.4*
315126	*1ROARAP2*	*1.52*
315128	*1ROARAP4*	*1.46*
315136	*1ROSEMG1*	*4.97*
315138	*1ROSEMG2*	*2.33*
315137	*1ROSEMS1*	*3.08*
314557	*3BETHELC*	*0.87*
314554	*3BTLEBRO*	*0.84*

314566	*3CRESWEL*	*1.63*
314578	*3HORNRTN*	*3.35*
314582	*3KELFORD*	*0.91*
314603	*3SCOT NK*	*3.54*
314617	*3TUNIS*	*0.81*
314541	*3WATKINS*	*0.32*
314620	*6CASHIE*	*0.83*
314574	*6EVERETS*	*2.43*
314594	*6PLYMOTH*	*0.69*
932631	*AC2-084 C*	*6.99*
932632	*AC2-084 E*	*3.44*
933991	*AD1-023 C*	*11.93*
933992	*AD1-023 E*	*6.49*
934331	*AD1-057 C O1*	*16.06*
934332	*AD1-057 E O1*	*8.57*
934521	*AD1-076 C O1*	*45.21*
934522	*AD1-076 E O1*	*23.02*
LTF	*CARR*	*0.09*
LTF	*CBM-S1*	*4.49*
LTF	*CBM-S2*	*9.26*
LTF	*CBM-W1*	*9.8*
LTF	*CBM-W2*	*24.09*
LTF	*CIN*	*2.19*
LTF	*CPLE*	*3.18*
LTF	*G-007*	*0.61*
LTF	*IPL*	*1.4*

LTF	*LGEE*	*0.47*
LTF	*MEC*	*4.97*
LTF	*MECS*	*2.19*
LTF	*O-066*	*3.86*
LTF	*RENSSELAER*	*0.08*
900672	*V4-068 E*	*0.24*
LTF	*WEC*	*0.6*
916041	*Z1-036 C*	*3.25*
916042	*Z1-036 E*	*21.75*
917331	*Z2-043 C*	*0.47*
917332	*Z2-043 E*	*1.09*
917341	*Z2-044 C*	*0.26*
917342	*Z2-044 E*	*0.61*
917511	*Z2-088 C OP1*	*0.95*
917512	*Z2-088 E OP1*	*4.11*
918411	*AA1-050*	*0.8*
918491	*AA1-063AC OP*	*1.36*
918492	*AA1-063AE OP*	*3.51*
918511	*AA1-065 C OP*	*1.98*
918512	*AA1-065 E OP*	*5.33*
918531	*AA1-067 C*	*0.31*
918532	*AA1-067 E*	*0.73*
918561	*AA1-072 C*	*0.07*
918562	*AA1-072 E*	*0.18*
919691	*AA2-053 C*	*1.64*
919692	*AA2-053 E*	*3.86*

919701	*AA2-057 C*	*7.45*
919702	*AA2-057 E*	*3.72*
LTF	*AA2-074*	*2.16*
920042	*AA2-088 E*	*6.93*
920591	*AA2-165 C*	*0.19*
920592	*AA2-165 E*	*0.49*
920671	*AA2-174 C*	*0.08*
920672	*AA2-174 E*	*0.45*
920692	*AA2-178 E*	*2.8*
930401	*AB1-081 C*	*1.74*
930402	*AB1-081 E*	*4.08*
930861	*AB1-132 C*	*30.87*
930862	*AB1-132 E*	*13.23*
924151	*AB2-059 C O1*	*11.21*
924152	*AB2-059 E O1*	*5.78*
924501	*AB2-099 C*	*0.61*
924502	*AB2-099 E*	*0.26*
924511	*AB2-100 C*	*42.66*
924512	*AB2-100 E*	*21.01*
925121	*AB2-169 C*	*5.87*
925122	*AB2-169 E*	*5.26*
925591	*AC1-034 C*	*7.26*
925592	*AC1-034 E*	*5.48*
925781	*AC1-054 C*	*3.7*
925782	*AC1-054 E*	*1.7*
926071	*AC1-086 C*	*45.46*

926072	*AC1-086 E*	*20.69*
926201	*AC1-098 C*	*6.54*
926202	*AC1-098 E*	*3.9*
926211	*AC1-099 C*	*2.19*
926212	*AC1-099 E*	*1.29*
927021	*AC1-189 C*	*8.99*
927022	*AC1-189 E*	*4.48*
927141	*AC1-208 C*	*9.4*
927142	*AC1-208 E*	*4.17*

Appendix 5

(DVP - DVP) The 3CHESTNUT-3WITAKRS 115 kV line (from bus 313719 to bus 314623 ckt 1) loads from 116.67% to 119.2% (AC power flow) of its emergency rating (134 MVA) for the single line contingency outage of 'DVP_P1-2: LN 2056-A'. This project contributes approximately 3.56 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 2056-A'
OPEN BRANCH FROM BUS 313845 TO BUS 934330 CKT 1 /* 6HATHAWAY 230.00 - AD1-057 TAP 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*1.17*
315141	*1GASTONB*	*1.17*
315126	*1ROARAP2*	*1.01*
315128	*1ROARAP4*	*0.97*
315136	*1ROSEMG1*	*0.84*
315138	*1ROSEMG2*	*0.39*
315137	*1ROSEMS1*	*0.52*
315115	*1S HAMPT1*	*0.58*
932631	*AC2-084 C*	*15.09*
934331	*AD1-057 C O1*	*3.56*
LTF	*AMIL*	*0.14*
LTF	*BLUEG*	*0.74*
LTF	*CALDERWOOD*	*0.45*
LTF	*CANNELTON*	*0.14*
LTF	*CATAWBA*	*0.44*
LTF	*CBM-N*	*< 0.01*
LTF	*CHEOAH*	*0.42*
LTF	*CLIFTY*	*2.7*

LTF	*COTTONWOOD*	*1.51*
LTF	*EDWARDS*	*0.23*
LTF	*ELMERSMITH*	*0.42*
LTF	*FARMERCITY*	*0.18*
LTF	*G-007A*	*0.29*
LTF	*GIBSON*	*0.26*
LTF	*HAMLET*	*0.91*
LTF	*MORGAN*	*1.32*
LTF	*NEWTON*	*0.63*
LTF	*NYISO*	*< 0.01*
LTF	*O-066A*	*0.14*
LTF	*PRAIRIE*	*1.37*
LTF	*SMITHLAND*	*0.12*
LTF	*TATANKA*	*0.31*
LTF	*TILTON*	*0.27*
LTF	*TRIMBLE*	*0.14*
LTF	*TVA*	*0.56*
LTF	*UNIONPOWER*	*0.75*
900671	*V4-068 C*	*0.05*
LTF	*VFT*	*0.79*
917331	*Z2-043 C*	*0.49*
918491	*AA1-063AC OP*	*0.89*
918561	*AA1-072 C*	*0.07*
919691	*AA2-053 C*	*1.*
919701	*AA2-057 C*	*26.37*
920041	*AA2-088 C*	*0.5*

920591	*AA2-165 C*	*0.66*
920671	*AA2-174 C*	*0.05*
930861	*AB1-132 C*	*4.88*
931231	*AB1-173 C*	*1.09*
931241	*AB1-173AC*	*1.09*
923801	*AB2-015 C O1*	*2.73*
923911	*AB2-031 C O1*	*1.08*
923991	*AB2-040 C O1*	*3.55*
924151	*AB2-059 C O1*	*-10.62*
924501	*AB2-099 C*	*0.28*
925171	*AB2-174 C O1*	*3.12*
925591	*AC1-034 C*	*-6.88*
925781	*AC1-054 C*	*2.48*
926071	*AC1-086 C*	*7.18*
926201	*AC1-098 C*	*14.12*
926211	*AC1-099 C*	*4.73*
927141	*AC1-208 C*	*19.61*

Appendix 6

(DVP - CPLE) The 6MORNSTR-6ROCKYMT230T 230 kV line (from bus 313845 to bus 304222 ckt 1) loads from 120.86% to 128.97% (AC power flow) of its emergency rating (374 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 81-2056'. This project contributes approximately 30.34 MW to the thermal violation.

```
CONTINGENCY 'DVP_P7-1: LN 81-2056'
  OPEN BRANCH FROM BUS 314559 TO BUS 314578 CKT 1          /* 3CAROLNA
115.00 - 3HORNRTN 115.00
  OPEN BRANCH FROM BUS 314578 TO BUS 314598 CKT 1          /* 3HORNRTN
115.00 - 3ROAN DP 115.00
  OPEN BRANCH FROM BUS 314598 TO BUS 314628 CKT 1          /* 3ROAN DP
115.00 - 3DARLINGT DP115.00
  OPEN BUS 314578                                  /* ISLAND: 3HORNRTN 115.00
  OPEN BUS 314598                                  /* ISLAND: 3ROAN DP 115.00
  OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1          /* 6PA-
RMOUNT#4230.00 - 6NASH 230.00
  OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1          /* 6MORNSTR
230.00 - 6NASH 230.00
  OPEN BRANCH FROM BUS 304226 TO BUS 304222 CKT 1          /* 6PA-
RMOUNT#4230.00 - 6ROCKYMT230T
  OPEN BUS 304226                                  /* ISLAND
  OPEN BUS 314591                                  /* ISLAND: 6NASH 230.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*21.38*
315132	*1EDGECMB*	*21.38*
315139	*1GASTONA*	*3.75*
315141	*1GASTONB*	*3.75*
315126	*1ROARAP2*	*1.14*
315128	*1ROARAP4*	*1.1*
315136	*1ROSEMG1*	*3.14*
315138	*1ROSEMG2*	*1.47*
315137	*1ROSEMS1*	*1.95*

314557	*3BETHELC*	*1.61*
314554	*3BTLEBRO*	*1.08*
314566	*3CRESWEL*	*1.09*
314572	*3EMPORIA*	*0.27*
314582	*3KELFORD*	*0.7*
314603	*3SCOT NK*	*3.23*
314617	*3TUNIS*	*0.55*
314539	*3UNCAMP*	*1.04*
314541	*3WATKINS*	*0.33*
314620	*6CASHIE*	*0.49*
314574	*6EVERETS*	*1.81*
314594	*6PLYMOTH*	*0.44*
932631	*AC2-084 C*	*7.04*
932632	*AC2-084 E*	*3.47*
933991	*AD1-023 C*	*7.25*
933992	*AD1-023 E*	*3.95*
934331	*AD1-057 C O1*	*19.79*
934332	*AD1-057 E O1*	*10.56*
934521	*AD1-076 C O1*	*28.52*
934522	*AD1-076 E O1*	*14.52*
LTF	*AMIL*	*0.38*
LTF	*BLUEG*	*1.99*
LTF	*CALDERWOOD*	*1.17*
LTF	*CANNELTON*	*0.38*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*1.14*

LTF	*CELEVELAND /* 35% REVERSE 4479079 4642907*	*< 0.01*
LTF	*CHEOAH*	*1.09*
LTF	*CLIFTY*	*7.31*
LTF	*COTTONWOOD*	*3.91*
LTF	*EDWARDS*	*0.61*
LTF	*ELMERSMITH*	*1.11*
LTF	*FARMERCITY*	*0.48*
LTF	*G-007A*	*0.76*
LTF	*GIBSON*	*0.69*
LTF	*HAMLET*	*2.25*
LTF	*MORGAN*	*3.43*
LTF	*NEWTON*	*1.68*
LTF	*O-066A*	*0.35*
LTF	*PRAIRIE*	*3.62*
LTF	*SMITHLAND*	*0.32*
LTF	*TATANKA*	*0.82*
LTF	*TILTON*	*0.72*
LTF	*TRIMBLE*	*0.38*
LTF	*TVA*	*1.45*
LTF	*UNIONPOWER*	*1.94*
900671	*V4-068 C*	*0.06*
900672	*V4-068 E*	*0.18*
LTF	*VFT*	*2.03*
907092	*X1-038 E*	*2.6*
LTF	*Y3-032*	*< 0.01*
917331	*Z2-043 C*	*0.36*

917332	*Z2-043 E*	*0.84*
917341	*Z2-044 C*	*0.32*
917342	*Z2-044 E*	*0.75*
917511	*Z2-088 C OP1*	*1.56*
917512	*Z2-088 E OP1*	*6.74*
918411	*AA1-050*	*1.32*
918491	*AA1-063AC OP*	*1.07*
918492	*AA1-063AE OP*	*2.74*
918511	*AA1-065 C OP*	*1.09*
918512	*AA1-065 E OP*	*2.92*
918531	*AA1-067 C*	*0.23*
918532	*AA1-067 E*	*0.54*
918561	*AA1-072 C*	*0.05*
918562	*AA1-072 E*	*0.14*
919691	*AA2-053 C*	*1.19*
919692	*AA2-053 E*	*2.79*
919701	*AA2-057 C*	*8.78*
919702	*AA2-057 E*	*4.39*
920042	*AA2-088 E*	*5.93*
920591	*AA2-165 C*	*0.22*
920592	*AA2-165 E*	*0.58*
920671	*AA2-174 C*	*0.05*
920672	*AA2-174 E*	*0.32*
920692	*AA2-178 E*	*1.86*
930401	*AB1-081 C*	*2.67*
930402	*AB1-081 E*	*6.24*

930861	*AB1-132 C*	*15.62*
930862	*AB1-132 E*	*6.7*
931231	*AB1-173 C*	*1.56*
931232	*AB1-173 E*	*0.73*
931241	*AB1-173AC*	*1.56*
931242	*AB1-173AE*	*0.73*
923801	*AB2-015 C O1*	*3.94*
923802	*AB2-015 E O1*	*3.23*
923852	*AB2-025 E*	*0.45*
923911	*AB2-031 C O1*	*1.55*
923912	*AB2-031 E O1*	*0.76*
923991	*AB2-040 C O1*	*5.07*
923992	*AB2-040 E O1*	*4.15*
924151	*AB2-059 C O1*	*17.15*
924152	*AB2-059 E O1*	*8.84*
924501	*AB2-099 C*	*0.4*
924502	*AB2-099 E*	*0.17*
924511	*AB2-100 C*	*8.3*
924512	*AB2-100 E*	*4.09*
925121	*AB2-169 C*	*4.03*
925122	*AB2-169 E*	*3.62*
925171	*AB2-174 C O1*	*4.75*
925172	*AB2-174 E O1*	*4.3*
925591	*AC1-034 C*	*11.11*
925592	*AC1-034 E*	*8.38*
926071	*AC1-086 C*	*23.01*

926072	*AC1-086 E*	*10.47*
926201	*AC1-098 C*	*6.58*
926202	*AC1-098 E*	*3.92*
926211	*AC1-099 C*	*2.21*
926212	*AC1-099 E*	*1.3*
927021	*AC1-189 C*	*12.21*
927022	*AC1-189 E*	*6.08*
927141	*AC1-208 C*	*10.44*
927142	*AC1-208 E*	*4.64*

Appendix 7

(DVP - DVP) The 6CHESTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 104.02% to 105.04% (AC power flow) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 562T563'. This project contributes approximately 6.52 MW to the thermal violation.

CONTINGENCY 'DVP_P4-2: 562T563' /*CARSON
OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN
OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*32.84*
315131	*1EDGECMA*	*3.05*
315132	*1EDGECMB*	*3.05*
315074	*1HOPCGN1*	*5.89*
315075	*1HOPCGN2*	*5.81*
315077	*1HOPHCF1*	*1.74*
315078	*1HOPHCF2*	*1.74*
315079	*1HOPHCF3*	*1.74*
315080	*1HOPHCF4*	*2.64*
315076	*1HOPPOLC*	*1.24*
315073	*1STONECA*	*4.88*
314557	*3BETHELC*	*0.3*
314554	*3BTLEBRO*	*0.3*
314572	*3EMPORIA*	*0.22*
314578	*3HORNRTN*	*1.43*
314582	*3KELFORD*	*0.33*
314314	*3LOCKS*	*0.06*

314315	*3LOCKS E*	*0.83*
314603	*3SCOT NK*	*1.31*
314617	*3TUNIS*	*0.33*
314539	*3UNCAMP*	*0.94*
314541	*3WATKINS*	*0.27*
314620	*6CASHIE*	*0.31*
314594	*6PLYMOTH*	*0.3*
932591	*AC2-079 C*	*2.7*
932592	*AC2-079 E*	*4.41*
932631	*AC2-084 C*	*2.64*
932632	*AC2-084 E*	*1.3*
933991	*AD1-023 C*	*4.75*
933992	*AD1-023 E*	*2.59*
934011	*AD1-025 C O1*	*9.49*
934012	*AD1-025 E O1*	*5.62*
934331	*AD1-057 C O1*	*4.25*
934332	*AD1-057 E O1*	*2.27*
934521	*AD1-076 C O1*	*19.36*
934522	*AD1-076 E O1*	*9.86*
934571	*AD1-082 C O1*	*4.48*
934572	*AD1-082 E O1*	*2.55*
935161	*AD1-151 C O1*	*9.07*
935162	*AD1-151 E O1*	*6.05*
LTF	*CARR*	*0.23*
LTF	*CBM-S1*	*3.99*
LTF	*CBM-S2*	*8.63*

LTF	*CBM-W1*	*7.45*
LTF	*CBM-W2*	*20.89*
LTF	*CIN*	*1.7*
LTF	*CPLE*	*2.76*
LTF	*G-007*	*1.04*
LTF	*IPL*	*1.08*
LTF	*LGEE*	*0.37*
LTF	*MEC*	*4.07*
LTF	*MECS*	*1.38*
LTF	*O-066*	*6.63*
LTF	*RENSSELAER*	*0.18*
292791	*U1-032 E*	*2.54*
900672	*V4-068 E*	*0.12*
LTF	*WEC*	*0.47*
907092	*X1-038 E*	*2.34*
914231	*Y2-077*	*0.7*
916302	*Z1-086 E*	*3.71*
917332	*Z2-043 E*	*0.39*
917342	*Z2-044 E*	*0.22*
917512	*Z2-088 E OP1*	*1.45*
918492	*AA1-063AE OP*	*1.7*
918512	*AA1-065 E OP*	*1.69*
918562	*AA1-072 E*	*0.07*
919692	*AA2-053 E*	*1.6*
919701	*AA2-057 C*	*2.8*
919702	*AA2-057 E*	*1.4*

LTF	*AA2-074*	*1.88*
920042	*AA2-088 E*	*4.24*
920592	*AA2-165 E*	*0.18*
920672	*AA2-174 E*	*0.18*
930402	*AB1-081 E*	*1.46*
930861	*AB1-132 C*	*6.74*
930862	*AB1-132 E*	*2.89*
931231	*AB1-173 C*	*1.1*
931232	*AB1-173 E*	*0.52*
931241	*AB1-173AC*	*1.1*
931242	*AB1-173AE*	*0.52*
923801	*AB2-015 C O1*	*3.36*
923802	*AB2-015 E O1*	*2.76*
923851	*AB2-025 C*	*0.32*
923852	*AB2-025 E*	*0.78*
923911	*AB2-031 C O1*	*1.1*
923912	*AB2-031 E O1*	*0.54*
923991	*AB2-040 C O1*	*3.6*
923992	*AB2-040 E O1*	*2.94*
924151	*AB2-059 C O1*	*4.01*
924152	*AB2-059 E O1*	*2.06*
924501	*AB2-099 C*	*0.23*
924502	*AB2-099 E*	*0.1*
924511	*AB2-100 C*	*6.79*
924512	*AB2-100 E*	*3.35*
924811	*AB2-134 C O1*	*7.23*

924812	*AB2-134 E O1*	*7.11*
925051	*AB2-160 C O1*	*3.59*
925052	*AB2-160 E O1*	*5.86*
925061	*AB2-161 C O1*	*1.96*
925062	*AB2-161 E O1*	*3.2*
925171	*AB2-174 C O1*	*3.52*
925172	*AB2-174 E O1*	*3.18*
925331	*AB2-190 C*	*11.28*
925332	*AB2-190 E*	*4.84*
925591	*AC1-034 C*	*2.6*
925592	*AC1-034 E*	*1.96*
925821	*AC1-061*	*< 0.01*
926071	*AC1-086 C*	*9.93*
926072	*AC1-086 E*	*4.52*
926201	*AC1-098 C*	*2.46*
926202	*AC1-098 E*	*1.47*
926211	*AC1-099 C*	*0.83*
926212	*AC1-099 E*	*0.49*
927141	*AC1-208 C*	*3.74*
927142	*AC1-208 E*	*1.66*
927221	*AC1-216 C O1*	*5.52*
927222	*AC1-216 E O1*	*4.34*

Appendix 8

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 229.1% to 239.31% (AC power flow) of its emergency rating (164 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 2058-2181'. This project contributes approximately 17.02 MW to the thermal violation.

```
CONTINGENCY 'DVP_P7-1: LN 2058-2181'
  OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1              /*
6ROCKYMT230T230.00 - 6HATHAWAY 230.00
  OPEN BUS 304226                                  /* ISLAND: 6PA-RMOUNT#4115.00
  OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1              /* 6PA-
RMOUNT#4230.00 - 6NASH 230.00
  OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1              /* 6HATHAWAY
230.00 - 6NASH 230.00
  OPEN BUS 314591                                  /* ISLAND: 6NASH 230.00
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*11.56*
315132	*1EDGECMB*	*11.56*
315139	*1GASTONA*	*2.33*
315141	*1GASTONB*	*2.33*
315126	*1ROARAP2*	*0.97*
315128	*1ROARAP4*	*0.93*
315136	*1ROSEMG1*	*1.89*
315138	*1ROSEMG2*	*0.88*
315137	*1ROSEMS1*	*1.17*
314557	*3BETHELC*	*0.88*
314554	*3BTLEBRO*	*1.95*
314572	*3EMPORIA*	*0.2*
314578	*3HORNRTN*	*2.51*
314582	*3KELFORD*	*0.69*

314603	*3SCOT NK*	*3.67*
314617	*3TUNIS*	*0.44*
314541	*3WATKINS*	*0.26*
314620	*6CASHIE*	*0.32*
314574	*6EVERETS*	*1.04*
932631	*AC2-084 C*	*8.5*
932632	*AC2-084 E*	*4.19*
933991	*AD1-023 C*	*4.71*
933992	*AD1-023 E*	*2.56*
934331	*AD1-057 C O1*	*11.1*
934332	*AD1-057 E O1*	*5.92*
LTF	*AMIL*	*0.26*
LTF	*BLUEG*	*1.35*
LTF	*CALDERWOOD*	*0.8*
LTF	*CANNELTON*	*0.26*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*0.78*
LTF	*CHEOAH*	*0.74*
LTF	*CLIFTY*	*4.95*
LTF	*COTTONWOOD*	*2.67*
LTF	*EDWARDS*	*0.42*
LTF	*ELMERSMITH*	*0.75*
LTF	*FARMERCITY*	*0.33*
LTF	*G-007A*	*0.49*
LTF	*GIBSON*	*0.47*
LTF	*HAMLET*	*1.56*

LTF	*MORGAN*	*2.34*
LTF	*NEWTON*	*1.14*
LTF	*O-066A*	*0.23*
LTF	*PRAIRIE*	*2.46*
LTF	*RENSSELAER*	*< 0.01*
LTF	*SMITHLAND*	*0.22*
LTF	*TATANKA*	*0.55*
LTF	*TILTON*	*0.49*
LTF	*TRIMBLE*	*0.26*
LTF	*TVA*	*0.99*
LTF	*UNIONPOWER*	*1.32*
900672	*V4-068 E*	*0.15*
LTF	*VFT*	*1.3*
917331	*Z2-043 C*	*0.35*
917332	*Z2-043 E*	*0.82*
917341	*Z2-044 C*	*0.53*
917342	*Z2-044 E*	*1.25*
917511	*Z2-088 C OP1*	*0.86*
917512	*Z2-088 E OP1*	*3.69*
918411	*AA1-050*	*0.72*
918492	*AA1-063AE OP*	*2.28*
918512	*AA1-065 E OP*	*1.94*
918532	*AA1-067 E*	*0.31*
918561	*AA1-072 C*	*0.05*
918562	*AA1-072 E*	*0.14*
919691	*AA2-053 C*	*0.99*

919692	*AA2-053 E*	*2.32*
919701	*AA2-057 C*	*13.27*
919702	*AA2-057 E*	*6.64*
920042	*AA2-088 E*	*4.77*
920591	*AA2-165 C*	*0.33*
920592	*AA2-165 E*	*0.87*
920671	*AA2-174 C*	*0.05*
920672	*AA2-174 E*	*0.27*
930401	*AB1-081 C*	*3.67*
930402	*AB1-081 E*	*8.59*
930861	*AB1-132 C*	*9.71*
930862	*AB1-132 E*	*4.16*
931231	*AB1-173 C*	*1.21*
931232	*AB1-173 E*	*0.56*
931241	*AB1-173AC*	*1.21*
931242	*AB1-173AE*	*0.56*
923801	*AB2-015 C O1*	*3.09*
923802	*AB2-015 E O1*	*2.53*
923911	*AB2-031 C O1*	*1.2*
923912	*AB2-031 E O1*	*0.59*
923991	*AB2-040 C O1*	*3.93*
923992	*AB2-040 E O1*	*3.22*
924151	*AB2-059 C O1*	*23.61*
924152	*AB2-059 E O1*	*12.16*
924501	*AB2-099 C*	*0.31*
924502	*AB2-099 E*	*0.13*

924511	*AB2-100 C*	*5.32*
924512	*AB2-100 E*	*2.62*
925121	*AB2-169 C*	*2.45*
925122	*AB2-169 E*	*2.2*
925171	*AB2-174 C O1*	*3.6*
925172	*AB2-174 E O1*	*3.26*
925591	*AC1-034 C*	*15.3*
925592	*AC1-034 E*	*11.54*
926071	*AC1-086 C*	*14.3*
926072	*AC1-086 E*	*6.51*
926201	*AC1-098 C*	*7.95*
926202	*AC1-098 E*	*4.74*
926211	*AC1-099 C*	*2.66*
926212	*AC1-099 E*	*1.56*
927021	*AC1-189 C*	*6.74*
927022	*AC1-189 E*	*3.36*
927141	*AC1-208 C*	*11.27*
927142	*AC1-208 E*	*5.*

Appendix 10

(DVP - CPLE) The 6EVERETS-6GREENVILE T 230 kV line (from bus 314574 to bus 304451 ckt 1) loads from 103.02% to 105.73% (AC power flow) of its emergency rating (478 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 2058-2181'. This project contributes approximately 13.5 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 2058-2181'
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00
OPEN BUS 314591 /* ISLAND: 6NASH 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315294	*1DOMTR10*	*2.92*
315292	*1DOMTR78*	*1.97*
315293	*1DOMTR9*	*1.61*
315131	*1EDGECMA*	*8.*
315132	*1EDGECMB*	*8.*
315136	*1ROSEMG1*	*1.85*
315138	*1ROSEMG2*	*0.87*
315137	*1ROSEMS1*	*1.15*
314557	*3BETHELC*	*1.15*
314554	*3BTLEBRO*	*0.43*
314566	*3CRESWEL*	*2.04*
314572	*3EMPORIA*	*0.21*
314578	*3HORNRTN*	*2.04*
314582	*3KELFORD*	*0.72*

314603	*3SCOT NK*	*2.51*
314617	*3TUNIS*	*0.7*
314539	*3UNCAMP*	*1.18*
314541	*3WATKINS*	*0.36*
314620	*6CASHIE*	*0.88*
314574	*6EVERETS*	*5.39*
314594	*6PLYMOTH*	*0.83*
314648	*6SUNBURY*	*0.4*
314651	*6WINFALL*	*0.97*
932631	*AC2-084 C*	*4.63*
932632	*AC2-084 E*	*2.28*
933991	*AD1-023 C*	*13.47*
933992	*AD1-023 E*	*7.33*
934331	*AD1-057 C O1*	*8.81*
934332	*AD1-057 E O1*	*4.7*
934521	*AD1-076 C O1*	*54.76*
934522	*AD1-076 E O1*	*27.89*
LTF	*AMIL*	*0.48*
LTF	*BLUEG*	*2.5*
LTF	*CALDERWOOD*	*1.54*
LTF	*CANNELTON*	*0.48*
LTF	*CATAWBA*	*1.5*
LTF	*CBM-N*	*< 0.01*
LTF	*CELEVELAND /* 35% REVERSE 4479079 4642907*	*< 0.01*
LTF	*CHEOAH*	*1.44*
LTF	*CLIFTY*	*9.03*

LTF	*COTTONWOOD*	*5.2*
LTF	*EDWARDS*	*0.78*
LTF	*ELMERSMITH*	*1.41*
LTF	*FARMERCITY*	*0.62*
LTF	*G-007A*	*1.04*
LTF	*GIBSON*	*0.88*
LTF	*HAMLET*	*3.22*
LTF	*MORGAN*	*4.56*
LTF	*NEWTON*	*2.15*
LTF	*NYISO*	*0.09*
LTF	*O-066A*	*0.48*
LTF	*PRAIRIE*	*4.68*
LTF	*SMITHLAND*	*0.42*
LTF	*TATANKA*	*1.05*
LTF	*TILTON*	*0.92*
LTF	*TRIMBLE*	*0.47*
LTF	*TVA*	*1.91*
LTF	*UNIONPOWER*	*2.56*
900672	*V4-068 E*	*0.21*
LTF	*VFT*	*2.76*
901082	*W1-029E*	*16.22*
907092	*X1-038 E*	*2.96*
913392	*Y1-086 E*	*1.05*
LTF	*Y3-032*	*< 0.01*
916041	*Z1-036 C*	*4.35*
916042	*Z1-036 E*	*29.14*

917122	*Z2-027 E*	*0.51*
917331	*Z2-043 C*	*0.37*
917332	*Z2-043 E*	*0.86*
917342	*Z2-044 E*	*0.33*
917511	*Z2-088 C OP1*	*1.42*
917512	*Z2-088 E OP1*	*6.13*
918411	*AA1-050*	*1.2*
918492	*AA1-063AE OP*	*2.44*
918511	*AA1-065 C OP*	*1.8*
918512	*AA1-065 E OP*	*4.84*
918531	*AA1-067 C*	*0.69*
918532	*AA1-067 E*	*1.62*
918561	*AA1-072 C*	*0.06*
918562	*AA1-072 E*	*0.14*
919692	*AA2-053 E*	*2.58*
919701	*AA2-057 C*	*4.25*
919702	*AA2-057 E*	*2.12*
920042	*AA2-088 E*	*6.25*
920592	*AA2-165 E*	*0.28*
920672	*AA2-174 E*	*0.3*
920691	*AA2-178 C*	*1.5*
920692	*AA2-178 E*	*3.5*
930402	*AB1-081 E*	*2.42*
930861	*AB1-132 C*	*10.36*
930862	*AB1-132 E*	*4.44*
931231	*AB1-173 C*	*1.21*

931232	*AB1-173 E*	*0.56*
931241	*AB1-173AC*	*1.21*
931242	*AB1-173AE*	*0.56*
923801	*AB2-015 C O1*	*4.4*
923802	*AB2-015 E O1*	*3.61*
923831	*AB2-022 C*	*1.02*
923832	*AB2-022 E*	*0.55*
923911	*AB2-031 C O1*	*1.2*
923912	*AB2-031 E O1*	*0.59*
923991	*AB2-040 C O1*	*3.93*
923992	*AB2-040 E O1*	*3.22*
924151	*AB2-059 C O1*	*6.64*
924152	*AB2-059 E O1*	*3.42*
924501	*AB2-099 C*	*0.53*
924502	*AB2-099 E*	*0.23*
924511	*AB2-100 C*	*5.86*
924512	*AB2-100 E*	*2.88*
925121	*AB2-169 C*	*10.02*
925122	*AB2-169 E*	*8.99*
925171	*AB2-174 C O1*	*3.64*
925172	*AB2-174 E O1*	*3.3*
925591	*AC1-034 C*	*4.3*
925592	*AC1-034 E*	*3.25*
926071	*AC1-086 C*	*15.26*
926072	*AC1-086 E*	*6.95*
926201	*AC1-098 C*	*4.33*

926202	*AC1-098 E*	*2.58*
926211	*AC1-099 C*	*1.45*
926212	*AC1-099 E*	*0.85*
LTF	*AC1-131*	*5.64*
927021	*AC1-189 C*	*15.46*
927022	*AC1-189 E*	*7.7*
927141	*AC1-208 C*	*5.75*
927142	*AC1-208 E*	*2.55*

Appendix 11

(DVP - DVP) The 6LAKEVEW-6CAROLNA 230 kV line (from bus 314583 to bus 314561 ckt 1) loads from 117.3% to 126.47% (AC power flow) of its emergency rating (375 MVA) for the single line contingency outage of 'DVP_P1-2: LN 2056-A'. This project contributes approximately 34.82 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 2056-A'
OPEN BRANCH FROM BUS 313845 TO BUS 934330 CKT 1 /* 6HATHAWAY 230.00 - AD1-057 TAP 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*11.44*
315141	*1GASTONB*	*11.44*
315136	*1ROSEMG1*	*8.22*
315138	*1ROSEMG2*	*3.85*
315137	*1ROSEMS1*	*5.1*
314704	*3LAWRENC*	*0.19*
934331	*AD1-057 C O1*	*34.82*
LTF	*AMIL*	*0.18*
LTF	*BLUEG*	*0.92*
LTF	*CALDERWOOD*	*0.54*
LTF	*CANNELTON*	*0.18*
LTF	*CATAWBA*	*0.53*
LTF	*CBM-N*	*< 0.01*
LTF	*CHEOAH*	*0.51*
LTF	*CLIFTY*	*3.38*
LTF	*COTTONWOOD*	*1.83*
LTF	*EDWARDS*	*0.28*
LTF	*ELMERSMITH*	*0.52*

LTF	*FARMERCITY*	*0.22*
LTF	*G-007A*	*0.38*
LTF	*GIBSON*	*0.32*
LTF	*HAMLET*	*1.07*
LTF	*MORGAN*	*1.61*
LTF	*NEWTON*	*0.78*
LTF	*NYISO*	*0.02*
LTF	*O-066A*	*0.17*
LTF	*PRAIRIE*	*1.69*
LTF	*SMITHLAND*	*0.15*
LTF	*TATANKA*	*0.38*
LTF	*TILTON*	*0.34*
LTF	*TRIMBLE*	*0.18*
LTF	*TVA*	*0.68*
LTF	*UNIONPOWER*	*0.9*
LTF	*VFT*	*1.01*
919701	*AA2-057 C*	*-4.57*
930861	*AB1-132 C*	*47.71*
923801	*AB2-015 C O1*	*-4.55*
923851	*AB2-025 C*	*0.41*
924511	*AB2-100 C*	*21.45*
925121	*AB2-169 C*	*-3.86*
925781	*AC1-054 C*	*-3.97*
926071	*AC1-086 C*	*70.26*

Appendix 12

(DVP - DVP) The 3WITAKRS-3BTLEBRO 115 kV line (from bus 314623 to bus 314554 ckt 1) loads from 117.56% to 120.09% (AC power flow) of its emergency rating (134 MVA) for the single line contingency outage of 'DVP_P1-2: LN 2056-A'. This project contributes approximately 3.56 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 2056-A'
OPEN BRANCH FROM BUS 313845 TO BUS 934330 CKT 1 /* 6HATHAWAY 230.00 - AD1-057 TAP 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*1.17*
315141	*1GASTONB*	*1.17*
315126	*1ROARAP2*	*1.01*
315128	*1ROARAP4*	*0.97*
315136	*1ROSEMG1*	*0.84*
315138	*1ROSEMG2*	*0.39*
315137	*1ROSEMS1*	*0.52*
315115	*1S HAMPT1*	*0.58*
932631	*AC2-084 C*	*15.09*
934331	*AD1-057 C O1*	*3.56*
LTF	*AMIL*	*0.14*
LTF	*BLUEG*	*0.75*
LTF	*CALDERWOOD*	*0.45*
LTF	*CANNELTON*	*0.14*
LTF	*CATAWBA*	*0.44*
LTF	*CHEOAH*	*0.42*
LTF	*CLIFTY*	*2.73*
LTF	*COTTONWOOD*	*1.52*

LTF	*EDWARDS*	*0.23*
LTF	*ELMERSMITH*	*0.42*
LTF	*FARMERCITY*	*0.18*
LTF	*G-007A*	*0.29*
LTF	*GIBSON*	*0.26*
LTF	*HAMLET*	*0.91*
LTF	*MORGAN*	*1.33*
LTF	*NEWTON*	*0.64*
LTF	*O-066A*	*0.13*
LTF	*PRAIRIE*	*1.38*
LTF	*SMITHLAND*	*0.12*
LTF	*TATANKA*	*0.31*
LTF	*TILTON*	*0.27*
LTF	*TRIMBLE*	*0.14*
LTF	*TVA*	*0.56*
LTF	*UNIONPOWER*	*0.75*
900671	*V4-068 C*	*0.05*
LTF	*VFT*	*0.76*
917331	*Z2-043 C*	*0.49*
917341	*Z2-044 C*	*1.09*
918491	*AA1-063AC OP*	*0.89*
918561	*AA1-072 C*	*0.07*
919691	*AA2-053 C*	*1.*
919701	*AA2-057 C*	*26.37*
920041	*AA2-088 C*	*0.5*
920591	*AA2-165 C*	*0.66*

920671	*AA2-174 C*	*0.05*
930861	*AB1-132 C*	*4.87*
931231	*AB1-173 C*	*1.09*
931241	*AB1-173AC*	*1.09*
923801	*AB2-015 C O1*	*2.73*
923911	*AB2-031 C O1*	*1.08*
923991	*AB2-040 C O1*	*3.55*
924151	*AB2-059 C O1*	*-10.62*
924501	*AB2-099 C*	*0.28*
925171	*AB2-174 C O1*	*3.12*
925591	*AC1-034 C*	*-6.88*
925781	*AC1-054 C*	*2.48*
926071	*AC1-086 C*	*7.18*
926201	*AC1-098 C*	*14.11*
926211	*AC1-099 C*	*4.73*
927141	*AC1-208 C*	*19.61*

Appendix 14

(DVP - DVP) The AD1-057 TAP-6MORNSTR 230 kV line (from bus 934330 to bus 313845 ckt 1) loads from 120.37% to 137.25% (AC power flow) of its load dump rating (541 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 254T2141'. This project contributes approximately 93.81 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-2: 254T2141'                    /* LAKEVIEW
  OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1   /* 2141
  OPEN BRANCH FROM BUS 314583 TO BUS 924510 CKT 1   /* 254
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*20.11*
315141	*1GASTONB*	*20.11*
315136	*1ROSEMG1*	*14.44*
315138	*1ROSEMG2*	*6.76*
315137	*1ROSEMS1*	*8.96*
934331	*AD1-057 C O1*	*61.18*
934332	*AD1-057 E O1*	*32.63*
LTF	*AMIL*	*0.06*
LTF	*BLUEG*	*0.35*
LTF	*CALDERWOOD*	*0.11*
LTF	*CANNELTON*	*0.06*
LTF	*CARR*	*0.07*
LTF	*CATAWBA*	*0.07*
LTF	*CHEOAH*	*0.1*
LTF	*CLIFTY*	*1.43*
LTF	*COTTONWOOD*	*0.42*
LTF	*EDWARDS*	*0.1*
LTF	*ELMERSMITH*	*0.17*

LTF	*FARMERCITY*	*0.07*
LTF	*G-007*	*0.21*
LTF	*GIBSON*	*0.12*
LTF	*HAMLET*	*0.11*
LTF	*MORGAN*	*0.35*
LTF	*NEWTON*	*0.27*
LTF	*O-066*	*1.34*
LTF	*PRAIRIE*	*0.51*
LTF	*RENSSELAER*	*0.06*
LTF	*SMITHLAND*	*0.04*
LTF	*TATANKA*	*0.13*
LTF	*TILTON*	*0.13*
LTF	*TRIMBLE*	*0.07*
LTF	*TVA*	*0.15*
LTF	*UNIONPOWER*	*0.16*
930861	*AB1-132 C*	*83.83*
930862	*AB1-132 E*	*35.93*
926071	*AC1-086 C*	*123.45*
926072	*AC1-086 E*	*56.19*