Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-206

Clubhouse 230kV
67.9 MW Capacity / 100 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 and battery storage generating facility located in Greensville County, VA. The installed facilities will have a total capability of 100 MW with 67.9 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 10/01/2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-206 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new breaker bay in the Clubhouse 230kV substation

Option 2 will connect via a new breaker bay in the Clubhouse 115kV substation.

Cost Summary

The AC1-206 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,200,000
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$8,000,000
Total Costs	**$9,200,000**

In addition, the AC1-206 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$25,000,000
Previously Identified Upgrades	$3,665,000
Total Costs	**$28,665,000**

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

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

Attachment Facilities

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

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

The estimated total cost of the Attachment Facilities is $1,800,000. It is estimated to take 30-36 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Non-Direct Connection Cost Estimate

Substation: Add three breakers at Clubhouse Substation to interconnect the proposed AC1-206 Project and associated equipment. Estimated Cost $6,500,000.

Transmission: Re-arrange existing lines to accommodate new 230 kV Line. Estimated Cost $1,500,000.

The estimated total cost of the Direct Connection Facilities is $8,000,000. It is estimated to take 36-48 months to complete this work.

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

Reinforcement: AC1-208 Tap-Hornertown 230kV line #2056: Rebuild approximately 9.7 miles of the AC1-208 TAP-Hornertown 230kV line #2056 to increase its emergency line rating to a minimum of 620 MVA and its load dump rating to a minimum of 730 MVA. Estimated cost is $25,000,000 and it is estimated to take 30-36 months to engineer, permit and construct.

Contribution to Previously Identified System Reinforcements

Reinforcement: Battleboro – Rocky Mt 115kV: Replace Battleboro substation terminal equipment. Estimated cost is $15,000.
Note: Duke/Progress Energy portion of this line will need to be studied under Duke's FERC tariff process.

Reinforcement: Replace wave trap at Clubhouse substation. Replace the wave trap on the Clubhouse – Sapony 230kV line to increase the emergency rating to 722MVA. It is estimated to take 12-16 months to complete and it is estimated to cost $150,000 to resolve this deficiency.

Reinforcement: Carolina – Lakeview 230 kV line #2141. Uprate/rebuild approximately 1.4 miles of 230 kV Line to increase the line rating by 15% to 360 MVA. It is estimated to take 18-20 months to permit and construct and it is estimated to cost $3,500,000 to resolve this deficiency.

Interconnection Customer Requirements

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

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 AC1-206 was evaluated as a 100.0 MW (Capacity 67.9 MW) injection at the Clubhouse 230kV substation in the ITO area. Project AC1-206 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-206 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
23872	CONTINGENCY '23872' /*_ CARSON OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115 OPEN BRANCH FROM BUS 314282 TO BUS 314902 CKT 1 /*CARSON TX2 500-230 OPEN BRANCH FROM BUS 314282 TO BUS 314455 CKT 1 /*CARSON SC172 END
238T2002	CONTINGENCY '238T2002' /*_ CARSON OPEN BRANCH FROM BUS 314331 TO BUS 314288 CKT 1 /*L2002 POE COGENTRIX OPEN BRANCH FROM BUS 314288 TO BUS 314282 CKT 1 /*L2002 COGENTRIX CARSON OPEN BRANCH FROM BUS 314331 TO BUS 314329 CKT 1 /*POE TX5 230-115 OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115 END
239T2141	CONTINGENCY '239T2141' /* LAKEVIEW OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1 /* 239 OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1 /* 2057 OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1 /* 2141 END

Contingency Name	Description
246T2034_A	CONTINGENCY '246T2034_A' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 921571 CKT 1 /* 246 AA1-138 TAP OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 246 - NUCOR OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 314616 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314616 TO BUS 314613 CKT 1 /* TROWBRIDGE TX #1&2 END
562T563	CONTINGENCY '562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
BASIN 230 B#2	CONTINGENCY 'BASIN 230 B#2' /* OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314274 CKT 2 END
DVP_P1-2: LN 2181	CONTINGENCY 'DVP_P1-2: LN 2181' 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 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
LN 2012	CONTINGENCY 'LN 2012' OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END

Contingency Name	Description
LN 2058-2181	CONTINGENCY 'LN 2058-2181' 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 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 2131A	CONTINGENCY 'LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END
LN 238	CONTINGENCY 'LN 238' OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /* 6CARSON 230.00 - 6SAPONY 230.00 OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /* 6SAPONY 230.00 - 6CLUBHSE 230.00 OPEN BRANCH FROM BUS 314562 TO BUS 314563 CKT 1 /* 3CLUBHSE 115.00 - 6CLUBHSE 230.00 OPEN BUS 314435 /* ISLAND END
LN 259	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END
LN 259-2065	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END

Contingency Name	Description
LN 54-2012_B	CONTINGENCY 'LN 54-2012_B' OPEN BRANCH FROM BUS 921751 TO BUS 314581 CKT 1 /* AA2-053 TAP 115.00 - 3JACKSON 115.00 OPEN BRANCH FROM BUS 314568 TO BUS 314625 CKT 1 /* 3EARLEYS 115.00 - 3AULANDR 115.00 OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1 /* 3JACKSON 115.00 - 3WOODLND 115.00 OPEN BRANCH FROM BUS 314625 TO BUS 314626 CKT 1 /* 3AULANDR 115.00 - 3WOODLND 115.00 OPEN BUS 314581 /* ISLAND OPEN BUS 314625 /* ISLAND OPEN BUS 314626 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END
LN 56-2012_A	CONTINGENCY 'LN 56-2012_A' OPEN BRANCH FROM BUS 314259 TO BUS 314559 CKT Z1 /* 3CAR56_1 115.00 - 3CAROLNA 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 921161 CKT 1 /* 3CAR56_1 115.00 - AA1-063A TAP 115.00 OPEN BRANCH FROM BUS 314558 TO BUS 314587 CKT 1 /* 3BOYKINS 115.00 - 3MARGTSV 115.00 OPEN BRANCH FROM BUS 314587 TO BUS 314604 CKT 1 /* 3MARGTSV 115.00 - 3SEABORD 115.00 OPEN BUS 314259 /* ISLAND OPEN BUS 314587 /* ISLAND OPEN BUS 314604 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 574	CONTINGENCY 'LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END

Contingency Name	Description
LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
T672B	CONTINGENCY 'T672B' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	DCTL	LN 259-2065	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	99.42	100.32	LD	459	9.14	
2	BUS	BASIN 230 B#2	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	99.2	100.1	LD	459	9.16	
3	DCTL	LN 54-2012_B	DVP - DVP	6HORNRTN-AC1-208 TAP 230 kV line	314579	927140	1	DC	96.87	100.83	LD	541	21.41	1

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	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	132.86	133.8	LD	459	9.53	2
5	LFFB	T672B	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.86	101.76	LD	459	9.2	
6	LFFB	562T563	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.71	101.51	LD	459	8.13	
7	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	144.63	145.56	LD	459	9.53	3
8	LFFB	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.63	113.53	LD	459	9.2	
9	LFFB	562T563	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.5	113.29	LD	459	8.13	
10	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	111.19	112.08	LD	459	9.14	
11	BUS	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	110.96	111.86	LD	459	9.16	
12	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	144.78	145.71	LD	459	9.53	4
13	LFFB	T672B	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.78	113.68	LD	459	9.2	
14	LFFB	562T563	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.65	113.45	LD	459	8.13	

#	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	DCTL	LN 259-2065	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	111.34	112.24	LD	459	9.14	
16	BUS	BASIN 230 B#2	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	111.11	112.01	LD	459	9.16	
17	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	168.27	170.34	LD	164	7.52	5
18	LFFB	239T2141	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	111.25	123.58	LD	637	78.52	6
19	LFFB	246T2034_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	108.77	117.69	LD	637	56.84	
20	DCTL	LN 54-2012_B	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	105.28	114.5	LD	637	58.72	
21	DCTL	LN 56-2012_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	104.53	113.82	LD	637	59.22	
22	LFFB	23872	DVP - DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	117.85	131.17	LD	459	61.14	7
23	LFFB	238T2002	DVP - DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	117.59	130.9	LD	459	61.12	

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 – 2	6CHARCTY-6LAKESD 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	
# 3	6HORNRTN-AC1-208 TAP 230 kV line	Rebuild the AC1-208 TAP-Hornerstown 230kV line to increase its emergency line rating to a minimum of 620 MVA and its load dump rating to a minimum of 730 MVA. Rebuild/Uprate is approximately 9.7 miles of Line #2056. Estimated time: 30-36 months.	Pending	**$25,000,000**
			Total New Network Upgrades	**$25,000,000**

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 – 7	6CHARCTY-6LAKESD 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	
# 8 – 12	6MESSER-6CHARCTY 230 kV line			
# 13 – 16	6CHSTF B-6MESSER 230 kV line			

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 17	3BTLEBRO-3ROCKYMT115T 115 kV line	Upgrade Battleboro terminal equipment	Pending	**$15,000**
# 18 – 21	6CLUBHSE-6SAPONY 230 kV line	Replace wave trap at Clubhouse Substation. This will increase emergency rating 722 MVA. Estimated time: 12-16 months.	Pending	**$150,000**
# 22, 23	6LAKEVEW-6CAROLNA 230 kV line	Uprate/rebuild approximately 1.4 miles of 230 kV Line to increase the line rating by 15% to 360 MVA. Estimated time: 18-20 months.	Pending	**$3,500,000**
			Total New Network Upgrades	**$3,665,000**

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
24	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6HATHAWAY-6ROCKYMT230T 230 kV line	313845	304222	1	DC	97.13	100.19	ER	386	11.81
25	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	121.16	122.26	ER	375	9.16
26	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	135.55	136.66	ER	375	9.16

#	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
27	N-1	LN 259	DVP - DVP	6BERMUDA-6CHSTF A 230 kV line	314278	314286	1	DC	96.9	97.65	ER	449	7.53
28	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	135.74	136.84	ER	375	9.16
29	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	149.52	150.59	ER	449	10.76
30	N-1	LN 259	DVP - DVP	6HOPEWLL-6BERMUDA 230 kV line	314303	314278	1	DC	96.9	97.65	ER	449	7.53
31	N-1	LN 2012	DVP - DVP	6CAROLNA 230/115 kV transformer	314561	314559	1	DC	100.29	101.98	ER	240	9.04
32	N-1	LN 2012	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	107.36	117.06	ER	599	58.09
33	N-1	LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	112.25	113.04	ER	572	9.93
34	N-1	LN 2131A	DVP - DVP	6NUCO TP-AA1-138 TAP 230 kV line	314575	921571	1	DC	105.45	106.23	ER	572	9.93
35	N-1	LN 238	DVP - DVP	6HORNRTN-AC1-208 TAP 230 kV line	314579	927140	1	DC	110.93	119.69	ER	442	38.68
36	N-1	LN 238	DVP - DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	143.71	160.01	ER	375	61.12
37	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	170.3	170.81	ER	2442	27.83
38	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	135.57	136.06	ER	2442	26.68

#	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
39	N-1	LN 576	DVP - DVP	8SURRY-8CHCKAHM 500 kV line	314924	314903	1	DC	104.98	105.44	ER	1809	18.45
40	N-1	LN 238	DVP - DVP	AC1-208 TAP-6HATHAWAY 230 kV line	927140	313845	1	DC	110.86	119.62	ER	442	38.68

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 #AC1-206 interconnection of a 100 MW Energy (67.9 MW Capacity) injection into the ITO's Transmission System at Clubhouse 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).

Option Two

Attachment Facilities

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

Transmission: Build approximately 0.5 miles of 115 kV Line. Estimated Cost $1,000,000

The estimated total cost of the Attachment Facilities is $1,600,000. It is estimated to take 30-36 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase.

Non-Direct Connection Cost Estimate

Substation: Add single 115 kV breaker at Clubhouse Substation to interconnect the proposed AC1-206 Project and associated equipment. Estimated Cost $1,100,000.

Transmission: Re-arrange existing lines to accommodate new 115 kV Line. Estimated Cost $1,000,000.

The estimated total cost of the Direct Connection Facilities is $2,100,000. It is estimated to take 36-48 months to complete this work.

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

Network Impacts

The Queue Project AC1-206 was evaluated as a 100.0 MW (Capacity 0.0 MW) injection at the Clubhouse 115kV substation in the ITO area. Project AC1-206 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-206 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

Contingency Name	Description
2202	CONTINGENCY '2202' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314571 TO BUS 314702 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END
3312	CONTINGENCY '3312' /* CHASE CITY OPEN BUS 314267 /*CHASE CITY 115KV BUS 3 OPEN BUS 314669 /*LINE 33 BARNS J OPEN BUS 314684 /*LINE 33 MT LAUREL OPEN BUS 314696 /*LINE 33 HALIFAX OPEN BUS 314518 /*SC312 END
239T2141	CONTINGENCY '239T2141' /* LAKEVIEW OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1 /* 239 OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1 /* 2057 OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1 /* 2141 END
246T2034_A	CONTINGENCY '246T2034_A' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 921571 CKT 1 /* 246 AA1-138 TAP OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 246 - NUCOR OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 314616 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314616 TO BUS 314613 CKT 1 /* TROWBRIDGE TX #1&2 END
5402_A	CONTINGENCY '5402_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314626 TO BUS 314625 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314625 TO BUS 314568 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Contingency Name	Description
5602_A	CONTINGENCY '5602_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314259 TO BUS 921161 CKT 1 /* LINE 56 AA1-063A TAP OPEN BRANCH FROM BUS 314604 TO BUS 314587 CKT 1 /* LINE 56 OPEN BRANCH FROM BUS 314587 TO BUS 314558 CKT 1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END
562T563	CONTINGENCY '562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
BASIN 230 B#2	CONTINGENCY 'BASIN 230 B#2' /* OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314274 CKT 2 END
DVP_P1-2: LN 2181	CONTINGENCY 'DVP_P1-2: LN 2181' 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 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
DVP_P1-2:2056	CONTINGENCY 'DVP_P1-2:2056' OPEN BRANCH FROM BUS 313845 TO BUS 314579 CKT 1 /* 6HATHAWAY 230.00 - 6HORNRTN 230.00 END

Contingency Name	Description
DVP_P7-1: LN 229-2058	CONTINGENCY 'DVP_P7-1: LN 229-2058' OPEN BRANCH FROM BUS 314564 TO BUS 314610 CKT 1 /* 6EDGECOM 230.00 - 6TOTDP4 230.00 OPEN BRANCH FROM BUS 314608 TO BUS 314609 CKT 1 /* 3TARBORO 115.00 - 6TARBORO 230.00 OPEN BRANCH FROM BUS 314609 TO BUS 314610 CKT 1 /* 6TARBORO 230.00 - 6TOTDP4 230.00 OPEN BUS 314610 /* ISLAND: 6TOTDP4 230.00 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END
H2T557	CONTINGENCY 'H2T557' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314908 TO BUS 314218 CKT 2 /*ELMONT 500-230 (TX#2) END
LN 2012	CONTINGENCY 'LN 2012' OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END
LN 2058	CONTINGENCY 'LN 2058-2181' 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 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END
LN 2058-2181	CONTINGENCY 'LN 2058-2181' 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 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END

Contingency Name	Description
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 2131A	CONTINGENCY 'LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END
LN 238	CONTINGENCY 'LN 238' OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /* 6CARSON 230.00 - 6SAPONY 230.00 OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /* 6SAPONY 230.00 - 6CLUBHSE 230.00 OPEN BRANCH FROM BUS 314562 TO BUS 314563 CKT 1 /* 3CLUBHSE 115.00 - 6CLUBHSE 230.00 OPEN BUS 314435 /* ISLAND END
LN 259	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END
LN 259-2065	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END

Contingency Name	Description
LN 54-2012_B	CONTINGENCY 'LN 54-2012_B' OPEN BRANCH FROM BUS 921751 TO BUS 314581 CKT 1 /* AA2-053 TAP 115.00 - 3JACKSON 115.00 OPEN BRANCH FROM BUS 314568 TO BUS 314625 CKT 1 /* 3EARLEYS 115.00 - 3AULANDR 115.00 OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1 /* 3JACKSON 115.00 - 3WOODLND 115.00 OPEN BRANCH FROM BUS 314625 TO BUS 314626 CKT 1 /* 3AULANDR 115.00 - 3WOODLND 115.00 OPEN BUS 314581 /* ISLAND OPEN BUS 314625 /* ISLAND OPEN BUS 314626 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END
LN 556	CONTINGENCY 'LN 556' OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 1 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 2 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 3 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314906 TO BUS 314936 CKT 1 /* 8CLOVER 500.00 - 8RAWLINGS 500.00 OPEN BUS 314906 /* ISLAND END
LN 56-2012_A	CONTINGENCY 'LN 56-2012_A' OPEN BRANCH FROM BUS 314259 TO BUS 314559 CKT Z1 /* 3CAR56_1 115.00 - 3CAROLNA 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 921161 CKT 1 /* 3CAR56_1 115.00 - AA1-063A TAP 115.00 OPEN BRANCH FROM BUS 314558 TO BUS 314587 CKT 1 /* 3BOYKINS 115.00 - 3MARGTSV 115.00 OPEN BRANCH FROM BUS 314587 TO BUS 314604 CKT 1 /* 3MARGTSV 115.00 - 3SEABORD 115.00 OPEN BUS 314259 /* ISLAND OPEN BUS 314587 /* ISLAND OPEN BUS 314604 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END

Contingency Name	Description
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 568	CONTINGENCY 'LN 568' OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1 /* 8LDYSMTH 500.00 - 8POSSUM 500.00 END
LN 574	CONTINGENCY 'LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END
LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
LN 68	CONTINGENCY 'LN 68-93' OPEN BRANCH FROM BUS 314527 TO BUS 314536 CKT 1 /* 3HOLLAND 115.00 - 3SUFFOLK 115.00 OPEN BRANCH FROM BUS 314527 TO BUS 314539 CKT 1 /* 3HOLLAND 115.00 - 3UNCAMP 115.00 OPEN BUS 314527 /* ISLAND OPEN BRANCH FROM BUS 314524 TO BUS 314539 CKT 1 /* 3FRNKLN 115.00 - 3UNCAMP 115.00 OPEN BRANCH FROM BUS 314524 TO BUS 314541 CKT 1 /* 3FRNKLN 115.00 - 3WATKINS 115.00 OPEN BRANCH FROM BUS 314534 TO BUS 314541 CKT 1 /* 3S HAMPT 115.00 - 3WATKINS 115.00 OPEN BRANCH FROM BUS 314541 TO BUS 314826 CKT 1 /* 3WATKINS 115.00 - 3WATKI_1 115.00 OPEN BRANCH FROM BUS 314541 TO BUS 314827 CKT 1 /* 3WATKINS 115.00 - 3WATKI_2 115.00 OPEN BUS 314524 /* ISLAND OPEN BUS 314541 /* ISLAND OPEN BUS 314826 /* ISLAND OPEN BUS 314827 /* ISLAND END

Contingency Name	Description
LN 68-93	CONTINGENCY 'LN 68-93' OPEN BRANCH FROM BUS 314527 TO BUS 314536 CKT 1 /* 3HOLLAND 115.00 - 3SUFFOLK 115.00 OPEN BRANCH FROM BUS 314527 TO BUS 314539 CKT 1 /* 3HOLLAND 115.00 - 3UNCAMP 115.00 OPEN BUS 314527 /* ISLAND OPEN BRANCH FROM BUS 314524 TO BUS 314539 CKT 1 /* 3FRNKLN 115.00 - 3UNCAMP 115.00 OPEN BRANCH FROM BUS 314524 TO BUS 314541 CKT 1 /* 3FRNKLN 115.00 - 3WATKINS 115.00 OPEN BRANCH FROM BUS 314534 TO BUS 314541 CKT 1 /* 3S HAMPT 115.00 - 3WATKINS 115.00 OPEN BRANCH FROM BUS 314541 TO BUS 314826 CKT 1 /* 3WATKINS 115.00 - 3WATKI_1 115.00 OPEN BRANCH FROM BUS 314541 TO BUS 314827 CKT 1 /* 3WATKINS 115.00 - 3WATKI_2 115.00 OPEN BUS 314524 /* ISLAND OPEN BUS 314541 /* ISLAND OPEN BUS 314826 /* ISLAND OPEN BUS 314827 /* ISLAND END
T122C	CONTINGENCY 'T122C' /* CAROLINA OPEN BUS 314559 /* CAROLINA 115KV BUS OPEN BUS 315126 /* ROANOKE RAPIDS GEN 1 AND 2 OPEN BUS 315128 /* ROANOKE RAPIDS GEN 3 AND 4 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 END
T132_A	CONTINGENCY 'T132_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Contingency Name	Description
T672B	CONTINGENCY 'T672B' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	DCTL	LN 68-93	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	97.99	126.7	ER	209	59.9	
2	DCTL	LN 54-2012_B	DVP - DVP	6HORNRTN-6HATHAWAY 230 kV line	314579	313845	1	DC	96.78	100.26	ER	541	18.83	8
3	DCTL	DVP_P7-1: LN 229-2058	DVP - CPLE	6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	DC	97.21	100.01	ER	470	13.16	9
4	LFFB	3312	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	93.63	96.57	ER	86	5.61	10
5	LFFB	3312	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	98.4	101.34	ER	86	5.61	11

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 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
6	LFFB	H2T557	DVP - DVP	8ELMONT 500/230 kV transformer	314218	314908	1	DC	104.61	105.22	ER	1051	14.14	12
7	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	134.06	134.84	ER	459	8.03	13
8	LFFB	T672B	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	101.89	102.65	ER	459	7.74	
9	LFFB	562T563	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	101.16	101.85	ER	459	7.05	
10	DCTL	LN 259-2065	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.44	101.19	ER	459	7.69	
11	BUS	BASIN 230 B#2	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	100.22	100.98	ER	459	7.7	
12	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	145.8	146.59	ER	459	8.03	14
13	LFFB	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	113.63	114.39	ER	459	7.74	
14	LFFB	562T563	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.9	113.59	ER	459	7.05	

#	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	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	112.18	112.94	ER	459	7.69	
16	BUS	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	111.96	112.72	ER	459	7.7	
17	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	145.95	146.74	ER	459	8.03	15
18	LFFB	T672B	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	113.76	114.52	ER	459	7.74	
19	LFFB	562T563	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	113.05	113.75	ER	459	7.05	
20	DCTL	LN 259-2065	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.33	113.09	ER	459	7.69	
21	BUS	BASIN 230 B#2	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	112.12	112.87	ER	459	7.7	
22	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	170.63	172.73	ER	164	7.65	16
23	LFFB	T122C	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	125.81	163.87	ER	209	79.38	17
24	LFFB	2202	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	124.18	162.19	ER	209	79.28	
25	LFFB	T132_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	123.27	161.27	ER	209	79.28	
26	LFFB	5602_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	123.17	161.18	ER	209	79.28	

#	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	5402_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	123.03	161.04	ER	209	79.28	
28	LFFB	239T2141	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	111.37	119.92	ER	637	54.51	18
29	LFFB	246T2034_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	110.25	117.24	ER	637	44.55	
30	DCTL	LN 54-2012_B	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	106.72	113.93	ER	637	45.96	
31	DCTL	LN 56-2012_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	106	113.34	ER	637	46.7	

Steady-State Voltage Requirements

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

To be determined during Impact Study

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined during Impact Study

Potential Congestion due to Local Energy Deliverability

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

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
32	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6HATHAWAY-6ROCKYMT230T 230 kV line	313845	304222	1	DC	99.06	101.93	ER	386	11.07
33	N-1	LN 2058	DVP - DVP	6HATHAWAY-6NASH 230 kV line	313845	314591	1	DC	98.8	101.53	ER	449	12.27
34	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	122.44	123.36	ER	375	7.7
35	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	136.81	137.73	ER	375	7.7
36	N-1	LN 238	DVP - DVP	6NORTHAMPTON-6EARLEYS 230 kV line	314266	314569	1	DC	100.7	103.27	ER	559	14.37
37	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	136.99	137.92	ER	375	7.7
38	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	150.98	151.9	ER	449	9.2
39	N-1	LN 2012	DVP - DVP	6SAPONY-6CARSON 230 kV line	314435	314282	1	DC	94.6	101.23	ER	679	44.97
40	N-1	LN 68	DVP - DVP	6CAROLNA 230/115 kV transformer	314559	314561	1	DC	103.83	105.46	ER	240	8.69
41	N-1	LN 556	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	109.47	142.07	ER	183	59.55
42	N-1	LN 2012	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	110.58	118.09	ER	599	44.97

#	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
43	N-1	LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	111	111.86	ER	572	10.91
44	N-1	LN 2131A	DVP - DVP	6NUCO TP-AA1-138 TAP 230 kV line	314575	921571	1	DC	104.19	105.05	ER	572	10.91
45	N-1	LN 2012	DVP - DVP	6HORNRTN-6HATHAWAY 230 kV line	314579	313845	1	DC	111.12	115.16	ER	442	17.88
46	N-1	DVP_P1-2:2056	DVP - DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	133.53	137.05	ER	375	13.18
47	N-1	LN 238	DVP - DVP	6ROA VAL-6NORTHAMPTON 230 kV line	314599	314266	1	DC	106.67	109.3	ER	548	14.37
48	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	DC	163.55	164.04	ER	2442	26.77
49	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	DC	132.9	133.37	ER	2442	25.7
50	N-1	LN 568	DVP - DVP	8NO ANNA-8SPOTSYL 500 kV line	314918	314934	1	DC	99.91	100.15	ER	3219	17.15
51	N-1	LN 576	DVP - DVP	8SURRY-AC1-216 TAP 500 kV line	314924	927220	1	DC	100.46	100.91	ER	1809	18.21
52	N-1	LN 2131A	DVP - DVP	AA1-138 TAP-6SUFFOLK 230 kV line	921571	314537	1	DC	113.7	114.56	ER	572	10.91
53	N-1	LN 576	DVP - DVP	AC1-216 TAP-8CHCKAHM 500 kV line	927220	314903	1	DC	100.46	100.91	ER	1809	18.21

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 #AC1-206 interconnection of a 100 MW Energy (67.9 MW Capacity) injection into the ITO's Transmission System at Clubhouse Substation at 115 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).

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 6HORNRTN-AC1-208 TAP 230 kV line (from bus 314579 to bus 927140 ckt 1) loads from 96.87% to 100.83% (**DC power flow**) of its load dump rating (541 MVA) for the tower line contingency outage of 'LN 54-2012_B'. This project contributes approximately 21.41 MW to the thermal violation.

```
CONTINGENCY 'LN 54-2012_B'
  OPEN BRANCH FROM BUS 921751 TO BUS 314581 CKT 1              /* AA2-053 TAP
115.00 - 3JACKSON 115.00
  OPEN BRANCH FROM BUS 314568 TO BUS 314625 CKT 1              /* 3EARLEYS
115.00 - 3AULANDR 115.00
  OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1              /* 3JACKSON
115.00 - 3WOODLND 115.00
  OPEN BRANCH FROM BUS 314625 TO BUS 314626 CKT 1              /* 3AULANDR
115.00 - 3WOODLND 115.00
  OPEN BUS 314581                                  /* ISLAND
  OPEN BUS 314625                                  /* ISLAND
  OPEN BUS 314626                                  /* ISLAND
  OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1              /*
6NORTHAMPTON230.00 - 6EARLEYS 230.00
  OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1              /*
6NORTHAMPTON230.00 - 6ROA VAL 230.00
  OPEN BUS 314266                                  /* ISLAND
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*7.53*
315141	*1GASTONB*	*7.53*
315126	*1ROARAP2*	*1.79*
315128	*1ROARAP4*	*1.72*
315134	*1ROAVALA*	*11.06*
315135	*1ROAVALB*	*2.95*
315136	*1ROSEMG1*	*6.21*
315138	*1ROSEMG2*	*2.91*
315137	*1ROSEMS1*	*3.85*
314704	*3LAWRENC*	*0.34*
917592	*Z2-099 E*	*0.22*
921162	*AA1-063AC*	*7.63*
921163	*AA1-063AE*	*3.6*
921752	*AA2-053 C*	*10.*
921753	*AA2-053 E*	*4.3*
920022	*AA2-086 E*	*0.12*

921982	*AA2-088 C*	*3.17*
921983	*AA2-088 E*	*5.17*
922472	*AA2-169 C*	*1.63*
922473	*AA2-169 E*	*0.75*
922512	*AA2-174 C*	*0.46*
922513	*AA2-174 E*	*0.5*
922722	*AB1-053 C*	*2.66*
922723	*AB1-053 E*	*1.5*
922732	*AB1-054 C*	*3.42*
922733	*AB1-054 E*	*1.69*
923262	*AB1-132 C OP*	*30.44*
923263	*AB1-132 E OP*	*13.05*
923572	*AB1-173 C OP*	*2.56*
923573	*AB1-173 E OP*	*1.19*
923582	*AB1-173AC OP*	*2.56*
923583	*AB1-173AE OP*	*1.19*
923851	*AB2-025 C*	*1.71*
923852	*AB2-025 E*	*0.77*
923911	*AB2-031 C OP*	*2.54*
923912	*AB2-031 E OP*	*1.25*
923991	*AB2-040 C OP*	*8.33*
923992	*AB2-040 E OP*	*6.82*
924401	*AB2-089 C*	*1.19*
924402	*AB2-089 E*	*0.61*
924511	*AB2-100 C*	*19.31*
924512	*AB2-100 E*	*9.51*
924761	*AB2-128 C*	*16.55*
924762	*AB2-128 E*	*6.51*
924931	*AB2-147 C*	*2.81*
924932	*AB2-147 E*	*4.59*
924951	*AB2-150 C OP*	*2.81*
924952	*AB2-150 E OP*	*4.59*
925171	*AB2-174 C OP*	*7.94*
925172	*AB2-174 E OP*	*7.18*
925781	*AC1-054 C OP*	*4.51*
925782	*AC1-054 E OP*	*2.08*
926071	*AC1-086 C*	*44.83*
926072	*AC1-086 E*	*20.4*
927111	*AC1-206 C OP*	*14.54*
927112	*AC1-206 E OP*	*6.87*

Appendix 2

(DVP - DVP) The 6CHARCTY-6LAKESD 230 kV line (from bus 314225 to bus 314227 ckt 1) loads from 132.86% to 133.8% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 9.53 MW to the thermal violation.

CONTINGENCY 'LN 208-259'
 OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00
 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00
 OPEN BUS 314309 /* ISLAND
 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*35.89*
315077	*1HOPHCF1*	*2.08*
315078	*1HOPHCF2*	*2.08*
315079	*1HOPHCF3*	*2.08*
315080	*1HOPHCF4*	*3.16*
315076	*1HOPPOLC*	*1.78*
315073	*1STONECA*	*5.66*
314784	*1WEYRHSB*	*0.65*
314539	*3UNCAMP*	*0.86*
314541	*3WATKINS*	*0.24*
314229	*6MT R221*	*-0.33*
315074	*CIR_AB2-152*	*0.89*
315075	*CIR_AB2-152*	*0.87*
292791	*U1-032 E*	*2.95*
900672	*V4-068 E*	*0.11*
901082	*W1-029E*	*13.46*
907092	*X1-038 E*	*2.14*
913392	*Y1-086 E*	*0.63*
914231	*Y2-077*	*0.84*
916042	*Z1-036 E*	*13.56*
916192	*Z1-068 E*	*0.53*
917122	*Z2-027 E*	*0.31*
917332	*Z2-043 E*	*0.34*
917342	*Z2-044 E*	*0.18*

917592	*Z2-099 E*	*0.16*
921162	*AA1-063AC*	*3.19*
921163	*AA1-063AE*	*1.5*
918512	*AA1-065 E OP*	*1.48*
918562	*AA1-072 E*	*0.06*
921552	*AA1-134 C*	*2.89*
921553	*AA1-134 E*	*1.24*
921562	*AA1-135 C*	*2.95*
921563	*AA1-135 E*	*1.26*
921572	*AA1-138 C*	*2.99*
921573	*AA1-138 E*	*1.28*
921752	*AA2-053 C*	*3.25*
921753	*AA2-053 E*	*1.4*
921762	*AA2-057 C*	*2.34*
921763	*AA2-057 E*	*1.17*
921772	*AA2-059 C*	*0.71*
921773	*AA2-059 E*	*0.33*
921862	*AA2-068 C*	*0.76*
921863	*AA2-068 E*	*0.35*
920022	*AA2-086 E*	*0.09*
921982	*AA2-088 C*	*2.33*
921983	*AA2-088 E*	*3.8*
922442	*AA2-165 C*	*0.32*
922443	*AA2-165 E*	*0.15*
922472	*AA2-169 C*	*0.71*
922473	*AA2-169 E*	*0.32*
922512	*AA2-174 C*	*0.15*
922513	*AA2-174 E*	*0.16*
922522	*AA2-177 C*	*6.38*
922523	*AA2-177 E*	*2.74*
922532	*AA2-178 C*	*2.95*
922533	*AA2-178 E*	*1.27*
922602	*AB1-013 C*	*0.89*
922603	*AB1-013 E*	*5.97*
922722	*AB1-053 C*	*0.44*
922723	*AB1-053 E*	*0.25*
922732	*AB1-054 C*	*2.46*
922733	*AB1-054 E*	*1.21*
923262	*AB1-132 C OP*	*5.96*
923263	*AB1-132 E OP*	*2.55*
923572	*AB1-173 C OP*	*0.98*
923573	*AB1-173 E OP*	*0.46*
923582	*AB1-173AC OP*	*0.98*
923583	*AB1-173AE OP*	*0.46*
923801	*AB2-015 C OP*	*3.06*

923802	*AB2-015 E OP*	*2.51*
923831	*AB2-022 C*	*0.66*
923832	*AB2-022 E*	*0.35*
923851	*AB2-025 C*	*1.62*
923852	*AB2-025 E*	*0.73*
923911	*AB2-031 C OP*	*0.98*
923912	*AB2-031 E OP*	*0.48*
923981	*AB2-039 C OP*	*4.91*
923982	*AB2-039 E OP*	*3.97*
923991	*AB2-040 C OP*	*3.21*
923992	*AB2-040 E OP*	*2.62*
924071	*AB2-051 C OP*	*38.98*
924072	*AB2-051 E OP*	*5.35*
924381	*AB2-087 C*	*0.19*
924382	*AB2-087 E*	*0.09*
924501	*AB2-099 C*	*0.2*
924502	*AB2-099 E*	*0.09*
924511	*AB2-100 C*	*5.57*
924512	*AB2-100 E*	*2.74*
924761	*AB2-128 C*	*4.77*
924762	*AB2-128 E*	*1.88*
924811	*AB2-134 C OP*	*8.18*
924812	*AB2-134 E OP*	*10.94*
924931	*AB2-147 C*	*1.2*
924932	*AB2-147 E*	*1.96*
924941	*AB2-149 C OP*	*1.58*
924942	*AB2-149 E OP*	*2.58*
924951	*AB2-150 C OP*	*1.2*
924952	*AB2-150 E OP*	*1.96*
924961	*AB2-152*	*2.21*
925051	*AB2-160 C OP*	*4.18*
925052	*AB2-160 E OP*	*6.82*
925061	*AB2-161 C OP*	*1.99*
925062	*AB2-161 E OP*	*3.24*
925121	*AB2-169 C OP*	*2.01*
925122	*AB2-169 E OP*	*1.81*
925141	*AB2-171 C OP*	*1.75*
925142	*AB2-171 E OP*	*2.85*
925171	*AB2-174 C OP*	*3.17*
925172	*AB2-174 E OP*	*2.87*
925281	*AB2-186 C*	*0.18*
925282	*AB2-186 E*	*0.08*
925291	*AB2-188 C OP*	*0.73*
925292	*AB2-188 E OP*	*0.33*
925331	*AB2-190 C*	*14.59*

925332	*AB2-190 E*	*3.65*
925361	*AC1-007 C OP*	*0.24*
925362	*AC1-007 E OP*	*0.39*
925521	*AC1-027 C*	*0.57*
925522	*AC1-027 E*	*0.32*
925691	*AC1-045 C*	*0.53*
925692	*AC1-045 E*	*0.29*
925821	*AC1-061*	*0.03*
926071	*AC1-086 C*	*8.77*
926072	*AC1-086 E*	*3.99*
926201	*AC1-098 C*	*2.1*
926202	*AC1-098 E*	*1.25*
926211	*AC1-099 C*	*0.7*
926212	*AC1-099 E*	*0.41*
926661	*AC1-147 C*	*0.65*
926662	*AC1-147 E*	*0.38*
926741	*AC1-159 C*	*38.68*
926771	*AC1-163 C*	*0.73*
926772	*AC1-163 E*	*0.34*
927051	*AC1-193 C*	*1.28*
927052	*AC1-193 E*	*2.09*
927111	*AC1-206 C OP*	*6.47*
927112	*AC1-206 E OP*	*3.06*
927141	*AC1-208 C*	*3.25*
927142	*AC1-208 E*	*1.44*
927221	*AC1-216 C OP*	*6.25*
927222	*AC1-216 E OP*	*4.91*

Appendix 3

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 144.63% to 145.56% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 9.53 MW to the thermal violation.

CONTINGENCY 'LN 208-259'
OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00
OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00
OPEN BUS 314309 /* ISLAND
OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*35.89*
315077	*1HOPHCF1*	*2.08*
315078	*1HOPHCF2*	*2.08*
315079	*1HOPHCF3*	*2.08*
315080	*1HOPHCF4*	*3.16*
315076	*1HOPPOLC*	*1.78*
315073	*1STONECA*	*5.66*
314784	*1WEYRHSB*	*0.65*
314539	*3UNCAMP*	*0.86*
314541	*3WATKINS*	*0.24*
314229	*6MT R221*	*-0.33*
315074	*CIR_AB2-152*	*0.89*
315075	*CIR_AB2-152*	*0.87*
292791	*U1-032 E*	*2.95*
900672	*V4-068 E*	*0.11*
901082	*W1-029E*	*13.46*
907092	*X1-038 E*	*2.14*
913392	*Y1-086 E*	*0.63*
914231	*Y2-077*	*0.84*
916042	*Z1-036 E*	*13.56*
916192	*Z1-068 E*	*0.53*
917122	*Z2-027 E*	*0.31*
917332	*Z2-043 E*	*0.34*
917342	*Z2-044 E*	*0.18*

917592	*Z2-099 E*	*0.16*
921162	*AA1-063AC*	*3.19*
921163	*AA1-063AE*	*1.5*
918512	*AA1-065 E OP*	*1.48*
918562	*AA1-072 E*	*0.06*
921552	*AA1-134 C*	*2.89*
921553	*AA1-134 E*	*1.24*
921562	*AA1-135 C*	*2.95*
921563	*AA1-135 E*	*1.26*
921572	*AA1-138 C*	*2.99*
921573	*AA1-138 E*	*1.28*
921752	*AA2-053 C*	*3.25*
921753	*AA2-053 E*	*1.4*
921762	*AA2-057 C*	*2.34*
921763	*AA2-057 E*	*1.17*
921772	*AA2-059 C*	*0.71*
921773	*AA2-059 E*	*0.33*
921862	*AA2-068 C*	*0.76*
921863	*AA2-068 E*	*0.35*
920022	*AA2-086 E*	*0.09*
921982	*AA2-088 C*	*2.33*
921983	*AA2-088 E*	*3.8*
922442	*AA2-165 C*	*0.32*
922443	*AA2-165 E*	*0.15*
922472	*AA2-169 C*	*0.71*
922473	*AA2-169 E*	*0.32*
922512	*AA2-174 C*	*0.15*
922513	*AA2-174 E*	*0.16*
922522	*AA2-177 C*	*6.38*
922523	*AA2-177 E*	*2.74*
922532	*AA2-178 C*	*2.95*
922533	*AA2-178 E*	*1.27*
922602	*AB1-013 C*	*0.89*
922603	*AB1-013 E*	*5.97*
922722	*AB1-053 C*	*0.44*
922723	*AB1-053 E*	*0.25*
922732	*AB1-054 C*	*2.46*
922733	*AB1-054 E*	*1.21*
923262	*AB1-132 C OP*	*5.96*
923263	*AB1-132 E OP*	*2.55*
923572	*AB1-173 C OP*	*0.98*
923573	*AB1-173 E OP*	*0.46*
923582	*AB1-173AC OP*	*0.98*
923583	*AB1-173AE OP*	*0.46*
923801	*AB2-015 C OP*	*3.06*

923802	*AB2-015 E OP*	*2.51*
923831	*AB2-022 C*	*0.66*
923832	*AB2-022 E*	*0.35*
923851	*AB2-025 C*	*1.62*
923852	*AB2-025 E*	*0.73*
923911	*AB2-031 C OP*	*0.98*
923912	*AB2-031 E OP*	*0.48*
923981	*AB2-039 C OP*	*4.91*
923982	*AB2-039 E OP*	*3.97*
923991	*AB2-040 C OP*	*3.21*
923992	*AB2-040 E OP*	*2.62*
924071	*AB2-051 C OP*	*38.98*
924072	*AB2-051 E OP*	*5.35*
924381	*AB2-087 C*	*0.19*
924382	*AB2-087 E*	*0.09*
924501	*AB2-099 C*	*0.2*
924502	*AB2-099 E*	*0.09*
924511	*AB2-100 C*	*5.57*
924512	*AB2-100 E*	*2.74*
924761	*AB2-128 C*	*4.77*
924762	*AB2-128 E*	*1.88*
924811	*AB2-134 C OP*	*8.18*
924812	*AB2-134 E OP*	*10.94*
924931	*AB2-147 C*	*1.2*
924932	*AB2-147 E*	*1.96*
924941	*AB2-149 C OP*	*1.58*
924942	*AB2-149 E OP*	*2.58*
924951	*AB2-150 C OP*	*1.2*
924952	*AB2-150 E OP*	*1.96*
924961	*AB2-152*	*2.21*
925051	*AB2-160 C OP*	*4.18*
925052	*AB2-160 E OP*	*6.82*
925061	*AB2-161 C OP*	*1.99*
925062	*AB2-161 E OP*	*3.24*
925121	*AB2-169 C OP*	*2.01*
925122	*AB2-169 E OP*	*1.81*
925141	*AB2-171 C OP*	*1.75*
925142	*AB2-171 E OP*	*2.85*
925171	*AB2-174 C OP*	*3.17*
925172	*AB2-174 E OP*	*2.87*
925281	*AB2-186 C*	*0.18*
925282	*AB2-186 E*	*0.08*
925291	*AB2-188 C OP*	*0.73*
925292	*AB2-188 E OP*	*0.33*
925331	*AB2-190 C*	*14.59*

925332	*AB2-190 E*	*3.65*
925361	*AC1-007 C OP*	*0.24*
925362	*AC1-007 E OP*	*0.39*
925521	*AC1-027 C*	*0.57*
925522	*AC1-027 E*	*0.32*
925691	*AC1-045 C*	*0.53*
925692	*AC1-045 E*	*0.29*
925821	*AC1-061*	*0.03*
926071	*AC1-086 C*	*8.77*
926072	*AC1-086 E*	*3.99*
926201	*AC1-098 C*	*2.1*
926202	*AC1-098 E*	*1.25*
926211	*AC1-099 C*	*0.7*
926212	*AC1-099 E*	*0.41*
926661	*AC1-147 C*	*0.65*
926662	*AC1-147 E*	*0.38*
926741	*AC1-159 C*	*38.68*
926771	*AC1-163 C*	*0.73*
926772	*AC1-163 E*	*0.34*
927051	*AC1-193 C*	*1.28*
927052	*AC1-193 E*	*2.09*
927111	*AC1-206 C OP*	*6.47*
927112	*AC1-206 E OP*	*3.06*
927141	*AC1-208 C*	*3.25*
927142	*AC1-208 E*	*1.44*
927221	*AC1-216 C OP*	*6.25*
927222	*AC1-216 E OP*	*4.91*

Appendix 4

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 144.78% to 145.71% (**DC power flow**) of its load dump rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 9.53 MW to the thermal violation.

CONTINGENCY 'LN 208-259'
 OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00
 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00
 OPEN BUS 314309 /* ISLAND
 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00
 END

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*35.89*
315077	*1HOPHCF1*	*2.08*
315078	*1HOPHCF2*	*2.08*
315079	*1HOPHCF3*	*2.08*
315080	*1HOPHCF4*	*3.16*
315076	*1HOPPOLC*	*1.78*
315073	*1STONECA*	*5.66*
314784	*1WEYRHSB*	*0.65*
314539	*3UNCAMP*	*0.86*
314541	*3WATKINS*	*0.24*
314229	*6MT R221*	*-0.33*
315074	*CIR_AB2-152*	*0.89*
315075	*CIR_AB2-152*	*0.87*
292791	*U1-032 E*	*2.95*
900672	*V4-068 E*	*0.11*
901082	*W1-029E*	*13.46*
907092	*X1-038 E*	*2.14*
913392	*Y1-086 E*	*0.63*
914231	*Y2-077*	*0.84*
916042	*Z1-036 E*	*13.56*
916192	*Z1-068 E*	*0.53*
917122	*Z2-027 E*	*0.31*
917332	*Z2-043 E*	*0.34*
917342	*Z2-044 E*	*0.18*

917592	*Z2-099 E*	*0.16*
921162	*AA1-063AC*	*3.19*
921163	*AA1-063AE*	*1.5*
918512	*AA1-065 E OP*	*1.48*
918562	*AA1-072 E*	*0.06*
921552	*AA1-134 C*	*2.89*
921553	*AA1-134 E*	*1.24*
921562	*AA1-135 C*	*2.95*
921563	*AA1-135 E*	*1.26*
921572	*AA1-138 C*	*2.99*
921573	*AA1-138 E*	*1.28*
921752	*AA2-053 C*	*3.25*
921753	*AA2-053 E*	*1.4*
921762	*AA2-057 C*	*2.34*
921763	*AA2-057 E*	*1.17*
921772	*AA2-059 C*	*0.71*
921773	*AA2-059 E*	*0.33*
921862	*AA2-068 C*	*0.76*
921863	*AA2-068 E*	*0.35*
920022	*AA2-086 E*	*0.09*
921982	*AA2-088 C*	*2.33*
921983	*AA2-088 E*	*3.8*
922442	*AA2-165 C*	*0.32*
922443	*AA2-165 E*	*0.15*
922472	*AA2-169 C*	*0.71*
922473	*AA2-169 E*	*0.32*
922512	*AA2-174 C*	*0.15*
922513	*AA2-174 E*	*0.16*
922522	*AA2-177 C*	*6.38*
922523	*AA2-177 E*	*2.74*
922532	*AA2-178 C*	*2.95*
922533	*AA2-178 E*	*1.27*
922602	*AB1-013 C*	*0.89*
922603	*AB1-013 E*	*5.97*
922722	*AB1-053 C*	*0.44*
922723	*AB1-053 E*	*0.25*
922732	*AB1-054 C*	*2.46*
922733	*AB1-054 E*	*1.21*
923262	*AB1-132 C OP*	*5.96*
923263	*AB1-132 E OP*	*2.55*
923572	*AB1-173 C OP*	*0.98*
923573	*AB1-173 E OP*	*0.46*
923582	*AB1-173AC OP*	*0.98*
923583	*AB1-173AE OP*	*0.46*
923801	*AB2-015 C OP*	*3.06*

923802	*AB2-015 E OP*	*2.51*
923831	*AB2-022 C*	*0.66*
923832	*AB2-022 E*	*0.35*
923851	*AB2-025 C*	*1.62*
923852	*AB2-025 E*	*0.73*
923911	*AB2-031 C OP*	*0.98*
923912	*AB2-031 E OP*	*0.48*
923981	*AB2-039 C OP*	*4.91*
923982	*AB2-039 E OP*	*3.97*
923991	*AB2-040 C OP*	*3.21*
923992	*AB2-040 E OP*	*2.62*
924071	*AB2-051 C OP*	*38.98*
924072	*AB2-051 E OP*	*5.35*
924381	*AB2-087 C*	*0.19*
924382	*AB2-087 E*	*0.09*
924501	*AB2-099 C*	*0.2*
924502	*AB2-099 E*	*0.09*
924511	*AB2-100 C*	*5.57*
924512	*AB2-100 E*	*2.74*
924761	*AB2-128 C*	*4.77*
924762	*AB2-128 E*	*1.88*
924811	*AB2-134 C OP*	*8.18*
924812	*AB2-134 E OP*	*10.94*
924931	*AB2-147 C*	*1.2*
924932	*AB2-147 E*	*1.96*
924941	*AB2-149 C OP*	*1.58*
924942	*AB2-149 E OP*	*2.58*
924951	*AB2-150 C OP*	*1.2*
924952	*AB2-150 E OP*	*1.96*
924961	*AB2-152*	*2.21*
925051	*AB2-160 C OP*	*4.18*
925052	*AB2-160 E OP*	*6.82*
925061	*AB2-161 C OP*	*1.99*
925062	*AB2-161 E OP*	*3.24*
925121	*AB2-169 C OP*	*2.01*
925122	*AB2-169 E OP*	*1.81*
925141	*AB2-171 C OP*	*1.75*
925142	*AB2-171 E OP*	*2.85*
925171	*AB2-174 C OP*	*3.17*
925172	*AB2-174 E OP*	*2.87*
925281	*AB2-186 C*	*0.18*
925282	*AB2-186 E*	*0.08*
925291	*AB2-188 C OP*	*0.73*
925292	*AB2-188 E OP*	*0.33*
925331	*AB2-190 C*	*14.59*

925332	*AB2-190 E*	*3.65*
925361	*AC1-007 C OP*	*0.24*
925362	*AC1-007 E OP*	*0.39*
925521	*AC1-027 C*	*0.57*
925522	*AC1-027 E*	*0.32*
925691	*AC1-045 C*	*0.53*
925692	*AC1-045 E*	*0.29*
925821	*AC1-061*	*0.03*
926071	*AC1-086 C*	*8.77*
926072	*AC1-086 E*	*3.99*
926201	*AC1-098 C*	*2.1*
926202	*AC1-098 E*	*1.25*
926211	*AC1-099 C*	*0.7*
926212	*AC1-099 E*	*0.41*
926661	*AC1-147 C*	*0.65*
926662	*AC1-147 E*	*0.38*
926741	*AC1-159 C*	*38.68*
926771	*AC1-163 C*	*0.73*
926772	*AC1-163 E*	*0.34*
927051	*AC1-193 C*	*1.28*
927052	*AC1-193 E*	*2.09*
927111	*AC1-206 C OP*	*6.47*
927112	*AC1-206 E OP*	*3.06*
927141	*AC1-208 C*	*3.25*
927142	*AC1-208 E*	*1.44*
927221	*AC1-216 C OP*	*6.25*
927222	*AC1-216 E OP*	*4.91*

Appendix 5

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 168.27% to 170.34% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 7.52 MW to the thermal violation.

CONTINGENCY 'LN 2058-2181'
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
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*2.54*
315132	*1EDGECMB*	*2.54*
315139	*1GASTONA*	*2.41*
315141	*1GASTONB*	*2.41*
315126	*1ROARAP2*	*1.*
315128	*1ROARAP4*	*0.96*
315134	*1ROAVALA*	*3.42*
315135	*1ROAVALB*	*0.91*
315136	*1ROSEMG1*	*1.96*
315138	*1ROSEMG2*	*0.92*
315137	*1ROSEMS1*	*1.21*
900672	*V4-068 E*	*0.15*
917331	*Z2-043 C*	*0.36*
917332	*Z2-043 E*	*0.83*
917341	*Z2-044 C*	*0.55*
917342	*Z2-044 E*	*1.25*
917511	*Z2-088 C OP1*	*0.71*
917512	*Z2-088 E OP1*	*6.1*
917592	*Z2-099 E*	*0.2*
918411	*AA1-050*	*0.59*
LTF	*AA1-055*	*9.47*
921162	*AA1-063AC*	*4.88*
921163	*AA1-063AE*	*2.3*

918512	*AA1-065 E OP*	*1.96*
921182	*AA1-067 C*	*0.73*
921183	*AA1-067 E*	*0.31*
918561	*AA1-072 C*	*0.05*
918562	*AA1-072 E*	*0.14*
921562	*AA1-135 C*	*4.03*
921563	*AA1-135 E*	*1.73*
921752	*AA2-053 C*	*5.42*
921753	*AA2-053 E*	*2.33*
921762	*AA2-057 C*	*12.88*
921763	*AA2-057 E*	*6.44*
921862	*AA2-068 C*	*3.3*
921863	*AA2-068 E*	*1.52*
920022	*AA2-086 E*	*0.11*
921982	*AA2-088 C*	*2.94*
921983	*AA2-088 E*	*4.8*
922442	*AA2-165 C*	*1.76*
922443	*AA2-165 E*	*0.85*
922512	*AA2-174 C*	*0.25*
922513	*AA2-174 E*	*0.27*
922722	*AB1-053 C*	*0.84*
922723	*AB1-053 E*	*0.47*
922732	*AB1-054 C*	*3.16*
922733	*AB1-054 E*	*1.55*
922922	*AB1-081 C OP*	*20.07*
922923	*AB1-081 E OP*	*8.6*
923262	*AB1-132 C OP*	*9.76*
923263	*AB1-132 E OP*	*4.18*
923572	*AB1-173 C OP*	*1.21*
923573	*AB1-173 E OP*	*0.57*
923582	*AB1-173AC OP*	*1.21*
923583	*AB1-173AE OP*	*0.57*
923911	*AB2-031 C OP*	*1.2*
923912	*AB2-031 E OP*	*0.59*
923941	*AB2-035 C*	*0.37*
923942	*AB2-035 E*	*0.16*
923991	*AB2-040 C OP*	*3.95*
923992	*AB2-040 E OP*	*3.23*
924151	*AB2-059 C OP*	*23.66*
924152	*AB2-059 E OP*	*12.19*
924381	*AB2-087 C*	*0.31*
924382	*AB2-087 E*	*0.15*
924391	*AB2-088 C*	*0.47*
924392	*AB2-088 E*	*0.23*
924491	*AB2-098 C*	*0.24*

924492	*AB2-098 E*	*0.1*
924501	*AB2-099 C*	*0.32*
924502	*AB2-099 E*	*0.14*
924511	*AB2-100 C*	*6.41*
924512	*AB2-100 E*	*3.16*
924761	*AB2-128 C*	*5.49*
924762	*AB2-128 E*	*2.16*
924931	*AB2-147 C*	*1.14*
924932	*AB2-147 E*	*1.86*
924951	*AB2-150 C OP*	*1.14*
924952	*AB2-150 E OP*	*1.86*
925141	*AB2-171 C OP*	*1.93*
925142	*AB2-171 E OP*	*3.14*
925171	*AB2-174 C OP*	*3.57*
925172	*AB2-174 E OP*	*3.23*
925591	*AC1-034 C OP*	*7.52*
925592	*AC1-034 E OP*	*5.67*
926071	*AC1-086 C*	*14.37*
926072	*AC1-086 E*	*6.54*
926201	*AC1-098 C*	*8.*
926202	*AC1-098 E*	*4.76*
926211	*AC1-099 C*	*2.68*
926212	*AC1-099 E*	*1.57*
926771	*AC1-163 C*	*1.14*
926772	*AC1-163 E*	*0.53*
927021	*AC1-189 C*	*5.15*
927022	*AC1-189 E*	*2.56*
927051	*AC1-193 C*	*1.41*
927052	*AC1-193 E*	*2.31*
927111	*AC1-206 C OP*	*5.11*
927112	*AC1-206 E OP*	*2.42*
927141	*AC1-208 C*	*10.06*
927142	*AC1-208 E*	*4.47*

Appendix 6

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 111.25% to 123.58% (**DC power flow**) of its load dump rating (637 MVA) for the line fault with failed breaker contingency outage of '239T2141'. This project contributes approximately 78.52 MW to the thermal violation.

```
CONTINGENCY '239T2141'                                  /* LAKEVIEW
  OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1       /* 239
  OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1       /* 2057
  OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1       /* 2141
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*16.32*
315141	*1GASTONB*	*16.32*
315159	*1KERR 2*	*1.15*
315164	*1KERR 7*	*1.13*
315126	*1ROARAP2*	*1.53*
315128	*1ROARAP4*	*1.47*
314704	*3LAWRENC*	*0.96*
921162	*AA1-063AC*	*6.84*
921163	*AA1-063AE*	*3.22*
921752	*AA2-053 C*	*7.37*
921753	*AA2-053 E*	*3.16*
922472	*AA2-169 C*	*1.83*
922473	*AA2-169 E*	*0.84*
922512	*AA2-174 C*	*0.34*
922513	*AA2-174 E*	*0.37*
923262	*AB1-132 C OP*	*65.96*
923263	*AB1-132 E OP*	*28.27*
923572	*AB1-173 C OP*	*5.09*
923573	*AB1-173 E OP*	*2.38*
923582	*AB1-173AC OP*	*5.09*
923583	*AB1-173AE OP*	*2.38*
923911	*AB2-031 C OP*	*5.05*
923912	*AB2-031 E OP*	*2.49*
923991	*AB2-040 C OP*	*16.59*
923992	*AB2-040 E OP*	*13.57*
924021	*AB2-043 C OP*	*2.48*
924022	*AB2-043 E OP*	*4.07*
924301	*AB2-077 C OP*	*1.53*

924302	*AB2-077 E OP*	*1.02*
924311	*AB2-078 C OP*	*1.53*
924312	*AB2-078 E OP*	*1.02*
924321	*AB2-079 C OP*	*1.53*
924322	*AB2-079 E OP*	*1.02*
924401	*AB2-089 C*	*1.61*
924402	*AB2-089 E*	*0.83*
924411	*AB2-090 C*	*3.12*
924412	*AB2-090 E*	*1.6*
924511	*AB2-100 C*	*52.61*
924512	*AB2-100 E*	*25.91*
924761	*AB2-128 C*	*45.07*
924762	*AB2-128 E*	*17.75*
924931	*AB2-147 C*	*8.12*
924932	*AB2-147 E*	*13.25*
924951	*AB2-150 C OP*	*8.12*
924952	*AB2-150 E OP*	*13.25*
925171	*AB2-174 C OP*	*18.36*
925172	*AB2-174 E OP*	*16.61*
925221	*AB2-176 C*	*1.29*
925222	*AB2-176 E*	*0.55*
925781	*AC1-054 C OP*	*5.63*
925782	*AC1-054 E OP*	*2.59*
926071	*AC1-086 C*	*97.13*
926072	*AC1-086 E*	*44.21*
926281	*AC1-106*	*2.06*
927111	*AC1-206 C OP*	*53.31*
927112	*AC1-206 E OP*	*25.2*
927211	*AC1-215 C*	*8.2*
927212	*AC1-215 E*	*3.72*

Appendix 7

(DVP - DVP) The 6LAKEVEW-6CAROLNA 230 kV line (from bus 314583 to bus 314561 ckt 1) loads from 117.85% to 131.17% (**DC power flow**) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of '23872'. This project contributes approximately 61.14 MW to the thermal violation.

CONTINGENCY '23872' /*_ CARSON
OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY
OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE
OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115
OPEN BRANCH FROM BUS 314282 TO BUS 314902 CKT 1 /*CARSON TX2 500-230
OPEN BRANCH FROM BUS 314282 TO BUS 314455 CKT 1 /*CARSON SC172
END

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*1.97*
315132	*1EDGECMB*	*1.97*
315139	*1GASTONA*	*12.71*
315141	*1GASTONB*	*12.71*
315136	*1ROSEMG1*	*8.31*
315138	*1ROSEMG2*	*3.89*
315137	*1ROSEMS1*	*5.15*
922722	*AB1-053 C*	*3.56*
922723	*AB1-053 E*	*2.*
922922	*AB1-081 C OP*	*7.68*
922923	*AB1-081 E OP*	*3.29*
923262	*AB1-132 C OP*	*51.36*
923263	*AB1-132 E OP*	*22.01*
923941	*AB2-035 C*	*0.25*
923942	*AB2-035 E*	*0.11*
924151	*AB2-059 C OP*	*9.06*
924152	*AB2-059 E OP*	*4.66*
924391	*AB2-088 C*	*0.33*
924392	*AB2-088 E*	*0.16*
924511	*AB2-100 C*	*40.96*
924512	*AB2-100 E*	*20.18*
924761	*AB2-128 C*	*35.09*

924762	*AB2-128 E*	*13.82*
925591	*AC1-034 C OP*	*5.17*
925592	*AC1-034 E OP*	*3.9*
926071	*AC1-086 C*	*75.63*
926072	*AC1-086 E*	*34.42*
927111	*AC1-206 C OP*	*41.51*
927112	*AC1-206 E OP*	*19.63*
927141	*AC1-208 C*	*20.4*
927142	*AC1-208 E*	*9.06*

Appendix 8

(DVP - DVP) The 6HORNRTN-6HATHAWAY 230 kV line (from bus 314579 to bus 313845 ckt 1) loads from 96.78% to 100.26% (**DC power flow**) of its emergency rating (541 MVA) for the tower line contingency outage of 'LN 54-2012_B'. This project contributes approximately 18.83 MW to the thermal violation.

```
CONTINGENCY 'LN 54-2012_B'
  OPEN BRANCH FROM BUS 921751 TO BUS 314581 CKT 1              /* AA2-053 TAP
115.00 - 3JACKSON 115.00
  OPEN BRANCH FROM BUS 314568 TO BUS 314625 CKT 1              /* 3EARLEYS
115.00 - 3AULANDR 115.00
  OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1              /* 3JACKSON
115.00 - 3WOODLND 115.00
  OPEN BRANCH FROM BUS 314625 TO BUS 314626 CKT 1              /* 3AULANDR
115.00 - 3WOODLND 115.00
  OPEN BUS 314581                                  /* ISLAND
  OPEN BUS 314625                                  /* ISLAND
  OPEN BUS 314626                                  /* ISLAND
  OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1              /*
6NORTHAMPTON230.00 - 6EARLEYS 230.00
  OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1              /*
6NORTHAMPTON230.00 - 6ROA VAL 230.00
  OPEN BUS 314266                                  /* ISLAND
  END
```

Bus Number	Bus Name	Full Contribution
315139	1GASTONA	7.64
315141	1GASTONB	7.64
315126	1ROARAP2	1.82
315128	1ROARAP4	1.75
315134	1ROAVALA	11.21
315135	1ROAVALB	2.99
315136	1ROSEMG1	6.29
315138	1ROSEMG2	2.95
315137	1ROSEMS1	3.9
314704	3LAWRENC	0.35
917592	Z2-099 E	0.22
921162	AA1-063AC	7.63
921163	AA1-063AE	3.6
921752	AA2-053 C	10.
921753	AA2-053 E	4.3
920022	AA2-086 E	0.12

921982	AA2-088 C	3.17
921983	AA2-088 E	5.17
922472	AA2-169 C	1.63
922473	AA2-169 E	0.75
922512	AA2-174 C	0.46
922513	AA2-174 E	0.5
922722	AB1-053 C	2.66
922723	AB1-053 E	1.5
922732	AB1-054 C	3.42
922733	AB1-054 E	1.69
923262	AB1-132 C OP	30.44
923263	AB1-132 E OP	13.05
923572	AB1-173 C OP	2.56
923573	AB1-173 E OP	1.19
923582	AB1-173AC OP	2.56
923583	AB1-173AE OP	1.19
923851	AB2-025 C	1.71
923852	AB2-025 E	0.77
923911	AB2-031 C OP	2.54
923912	AB2-031 E OP	1.25
923991	AB2-040 C OP	8.33
923992	AB2-040 E OP	6.82
924401	AB2-089 C	1.19
924402	AB2-089 E	0.61
924511	AB2-100 C	19.31
924512	AB2-100 E	9.51
924761	AB2-128 C	16.55
924762	AB2-128 E	6.51
924931	AB2-147 C	2.81
924932	AB2-147 E	4.59
924951	AB2-150 C OP	2.81
924952	AB2-150 E OP	4.59
925171	AB2-174 C OP	7.94
925172	AB2-174 E OP	7.18
925781	AC1-054 C OP	4.66
925782	AC1-054 E OP	2.15
926071	AC1-086 C	44.83
926072	AC1-086 E	20.4
927111	AC1-206 C OP	12.78
927112	AC1-206 E OP	6.04

Appendix 9

(DVP - CPLE) The 6NASH-6PA-RMOUNT#4 230 kV line (from bus 314591 to bus 304226 ckt 1) loads from 97.21% to 100.01% (**DC power flow**) of its emergency rating (470 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 229-2058'. This project contributes approximately 13.16 MW to the thermal violation.

CONTINGENCY 'DVP_P7-1: LN 229-2058'
 OPEN BRANCH FROM BUS 314564 TO BUS 314610 CKT 1 /* 6EDGECOM 230.00 - 6TOTDP4 230.00
 OPEN BRANCH FROM BUS 314608 TO BUS 314609 CKT 1 /* 3TARBORO 115.00 - 6TARBORO 230.00
 OPEN BRANCH FROM BUS 314609 TO BUS 314610 CKT 1 /* 6TARBORO 230.00 - 6TOTDP4 230.00
 OPEN BUS 314610 /* ISLAND: 6TOTDP4 230.00
 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
 END

Bus Number	Bus Name	Full Contribution
315131	1EDGECMA	6.3
315132	1EDGECMB	6.3
315139	1GASTONA	4.77
315141	1GASTONB	4.77
315126	1ROARAP2	1.5
315128	1ROARAP4	1.44
315134	1ROAVALA	6.4
315135	1ROAVALB	1.71
315136	1ROSEMG1	4.09
315138	1ROSEMG2	1.91
315137	1ROSEMS1	2.53
314541	3WATKINS	0.35
900672	V4-068 E	0.19
917331	Z2-043 C	0.37
917332	Z2-043 E	0.83
917341	Z2-044 C	0.45
917342	Z2-044 E	1.
917591	Z2-099 C	0.12
917592	Z2-099 E	0.28
921162	AA1-063AC	7.
921163	AA1-063AE	3.3
918561	AA1-072 C	0.06

918562	AA1-072 E	0.14
921752	AA2-053 C	7.58
921753	AA2-053 E	3.26
921762	AA2-057 C	10.9
921763	AA2-057 E	5.45
921862	AA2-068 C	2.98
921863	AA2-068 E	1.37
920021	AA2-086 C	0.06
920022	AA2-086 E	0.15
921982	AA2-088 C	3.97
921983	AA2-088 E	6.48
922442	AA2-165 C	1.49
922443	AA2-165 E	0.72
922472	AA2-169 C	1.29
922473	AA2-169 E	0.59
922512	AA2-174 C	0.35
922513	AA2-174 E	0.38
922722	AB1-053 C	1.73
922723	AB1-053 E	0.97
922732	AB1-054 C	4.27
922733	AB1-054 E	2.1
922922	AB1-081 C OP	20.11
922923	AB1-081 E OP	8.62
923262	AB1-132 C OP	19.03
923263	AB1-132 E OP	8.15
923572	AB1-173 C OP	1.93
923573	AB1-173 E OP	0.9
923582	AB1-173AC OP	1.93
923583	AB1-173AE OP	0.9
923911	AB2-031 C OP	1.91
923912	AB2-031 E OP	0.94
923991	AB2-040 C OP	6.29
923992	AB2-040 E OP	5.14
924151	AB2-059 C OP	23.7
924152	AB2-059 E OP	12.21
924381	AB2-087 C	0.35
924382	AB2-087 E	0.17
924501	AB2-099 C	0.36
924502	AB2-099 E	0.16
924511	AB2-100 C	12.29
924512	AB2-100 E	6.05
924761	AB2-128 C	10.53
924762	AB2-128 E	4.14
924931	AB2-147 C	1.96
924932	AB2-147 E	3.21

924951	AB2-150 C OP	1.96
924952	AB2-150 E OP	3.21
925141	AB2-171 C OP	2.59
925142	AB2-171 E OP	4.23
925171	AB2-174 C OP	5.83
925172	AB2-174 E OP	5.28
925591	AC1-034 C OP	24.25
925592	AC1-034 E OP	18.3
926071	AC1-086 C	28.02
926072	AC1-086 E	12.75
926201	AC1-098 C	7.37
926202	AC1-098 E	4.39
926211	AC1-099 C	2.47
926212	AC1-099 E	1.45
926771	AC1-163 C	1.31
926772	AC1-163 E	0.61
927051	AC1-193 C	1.9
927052	AC1-193 E	3.1
927111	AC1-206 C OP	8.94
927112	AC1-206 E OP	4.22
927141	AC1-208 C	14.58
927142	AC1-208 E	6.47

Appendix 10

(DVP - DVP) The 3MADSONV-3S84T154 115 kV line (from bus 314715 to bus 314434 ckt 1) loads from 93.63% to 96.57% (**DC power flow**) of its emergency rating (86 MVA) for the line fault with failed breaker contingency outage of '3312'. This project contributes approximately 5.61 MW to the thermal violation.

```
CONTINGENCY '3312'                    /* CHASE CITY
  OPEN BUS 314267                     /*CHASE CITY 115KV BUS 3
  OPEN BUS 314669                     /*LINE 33 BARNS J
  OPEN BUS 314684                     /*LINE 33 MT LAUREL
  OPEN BUS 314696                     /*LINE 33 HALIFAX
  OPEN BUS 314518                     /*SC312
  END
```

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	2.23
315151	1BUGGS 2	2.23
315159	1KERR 2	1.21
315164	1KERR 7	1.2
315266	1PLYWOOD A	1.53
922472	AA2-169 C	1.22
922473	AA2-169 E	0.56
923572	AB1-173 C OP	0.68
923573	AB1-173 E OP	0.32
923582	AB1-173AC OP	0.68
923583	AB1-173AE OP	0.32
923911	AB2-031 C OP	0.68
923912	AB2-031 E OP	0.33
923991	AB2-040 C OP	2.22
923992	AB2-040 E OP	1.82
924021	AB2-043 C OP	4.22
924022	AB2-043 E OP	6.93
924301	AB2-077 C OP	2.61
924302	AB2-077 E OP	1.74
924311	AB2-078 C OP	2.61
924312	AB2-078 E OP	1.74
924321	AB2-079 C OP	2.61
924322	AB2-079 E OP	1.74
924401	AB2-089 C	1.42
924402	AB2-089 E	0.73
924411	AB2-090 C	5.32

924412	AB2-090 E	2.73
924931	AB2-147 C	0.92
924932	AB2-147 E	1.5
924951	AB2-150 C OP	0.92
924952	AB2-150 E OP	1.5
925171	AB2-174 C OP	2.21
925172	AB2-174 E OP	2.
925221	AB2-176 C	2.19
925222	AB2-176 E	0.94
925611	AC1-036 C	2.34
925612	AC1-036 E	3.82
925781	AC1-054 C OP	4.37
925782	AC1-054 E OP	2.01
926281	AC1-106	3.51
927111	AC1-206 C OP	3.81
927112	AC1-206 E OP	1.8
927211	AC1-215 C	21.24
927212	AC1-215 E	9.63

Appendix 11

(DVP - DVP) The 3TWITTYS-3MADSONV 115 kV line (from bus 314722 to bus 314715 ckt 1) loads from 98.4% to 101.34% (**DC power flow**) of its emergency rating (86 MVA) for the line fault with failed breaker contingency outage of '3312'. This project contributes approximately 5.61 MW to the thermal violation.

```
CONTINGENCY '3312'                    /* CHASE CITY
  OPEN BUS 314267                     /*CHASE CITY 115KV BUS 3
  OPEN BUS 314669                     /*LINE 33 BARNS J
  OPEN BUS 314684                     /*LINE 33 MT LAUREL
  OPEN BUS 314696                     /*LINE 33 HALIFAX
  OPEN BUS 314518                     /*SC312
  END
```

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	2.23
315151	1BUGGS 2	2.23
315159	1KERR 2	1.21
315164	1KERR 7	1.2
315266	1PLYWOOD A	1.53
922472	AA2-169 C	1.22
922473	AA2-169 E	0.56
923572	AB1-173 C OP	0.68
923573	AB1-173 E OP	0.32
923582	AB1-173AC OP	0.68
923583	AB1-173AE OP	0.32
923911	AB2-031 C OP	0.68
923912	AB2-031 E OP	0.33
923991	AB2-040 C OP	2.22
923992	AB2-040 E OP	1.82
924021	AB2-043 C OP	4.22
924022	AB2-043 E OP	6.93
924301	AB2-077 C OP	2.61
924302	AB2-077 E OP	1.74
924311	AB2-078 C OP	2.61
924312	AB2-078 E OP	1.74
924321	AB2-079 C OP	2.61
924322	AB2-079 E OP	1.74
924401	AB2-089 C	1.42
924402	AB2-089 E	0.73
924411	AB2-090 C	5.32

924412	AB2-090 E	2.73
924931	AB2-147 C	0.92
924932	AB2-147 E	1.5
924951	AB2-150 C OP	0.92
924952	AB2-150 E OP	1.5
925171	AB2-174 C OP	2.21
925172	AB2-174 E OP	2.
925221	AB2-176 C	2.19
925222	AB2-176 E	0.94
925611	AC1-036 C	2.34
925612	AC1-036 E	3.82
925781	AC1-054 C OP	4.37
925782	AC1-054 E OP	2.01
926281	AC1-106	3.51
927111	AC1-206 C OP	3.81
927112	AC1-206 E OP	1.8
927211	AC1-215 C	21.24
927212	AC1-215 E	9.63

Appendix 12

(DVP - DVP) The 8ELMONT 500/230 kV transformer (from bus 314218 to bus 314908 ckt 1) loads from 104.61% to 105.22% (**DC power flow**) of its emergency rating (1051 MVA) for the line fault with failed breaker contingency outage of 'H2T557'. This project contributes approximately 14.14 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
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
923573	AB1-173 E OP	0.86
923582	AB1-173AC OP	1.85
923583	AB1-173AE OP	0.86
923801	AB2-015 C OP	7.57
923802	AB2-015 E OP	6.21
923831	AB2-022 C	2.07
923832	AB2-022 E	1.11
923841	AB2-024 C	3.3
923842	AB2-024 E	1.48
923851	AB2-025 C	2.36
923852	AB2-025 E	1.06
923861	AB2-026 C	1.94
923862	AB2-026 E	0.87
923911	AB2-031 C OP	1.84
923912	AB2-031 E OP	0.9
923981	AB2-039 C OP	8.77
923982	AB2-039 E OP	7.09
923991	AB2-040 C OP	6.03
923992	AB2-040 E OP	4.93
924061	AB2-050	6.
924071	AB2-051 C OP	126.81
924072	AB2-051 E OP	17.41
924241	AB2-068 OP	175.54
924381	AB2-087 C	0.47
924382	AB2-087 E	0.22
924501	AB2-099 C	0.48
924502	AB2-099 E	0.21
924511	AB2-100 C	9.74
924512	AB2-100 E	4.8
924761	AB2-128 C	8.34
924762	AB2-128 E	3.28
924811	AB2-134 C OP	15.54
924812	AB2-134 E OP	20.78
924931	AB2-147 C	2.13
924932	AB2-147 E	3.48
924941	AB2-149 C OP	3.35
924942	AB2-149 E OP	5.46
924951	AB2-150 C OP	2.13
924952	AB2-150 E OP	3.48
924961	AB2-152	3.57
925051	AB2-160 C OP	7.
925052	AB2-160 E OP	11.42
925061	AB2-161 C OP	3.55

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

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

Appendix 13

(DVP - DVP) The 6CHARCTY-6LAKESD 230 kV line (from bus 314225 to bus 314227 ckt 1) loads from 134.06% to 134.84% (**DC power flow**) of its emergency rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 8.03 MW to the thermal violation.

```
CONTINGENCY 'LN 208-259'
  OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1              /* 6CHSTF A
230.00 - 6IRON208 230.00
  OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1              /* 6IRON208
230.00 - 6SOUWEST 230.00
  OPEN BUS 314309                                  /* ISLAND
  OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1              /* 6BASIN 230.00 -
6CHSTF B 230.00
  END
```

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	36.4
315077	1HOPHCF1	2.11
315078	1HOPHCF2	2.11
315079	1HOPHCF3	2.11
315080	1HOPHCF4	3.2
315076	1HOPPOLC	1.8
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	6.83
315075	CIR_AB2-152	6.74
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.48
907092	X1-038 E	2.15
913392	Y1-086 E	0.63
914231	Y2-077	0.85
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18

917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.47
922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06

923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.04
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6

925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.22
925362	AC1-007 E OP	0.36
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.74
926751	AC1-161 C OP	12.61
926752	AC1-161 E OP	5.38
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	5.45
927112	AC1-206 E OP	2.58
927141	AC1-208 C	2.89
927142	AC1-208 E	1.28

Appendix 14

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 145.8% to 146.59% (**DC power flow**) of its emergency rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 8.03 MW to the thermal violation.

CONTINGENCY 'LN 208-259'
OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00
OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00
OPEN BUS 314309 /* ISLAND
OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00
END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	36.4
315077	1HOPHCF1	2.11
315078	1HOPHCF2	2.11
315079	1HOPHCF3	2.11
315080	1HOPHCF4	3.2
315076	1HOPPOLC	1.8
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	6.83
315075	CIR_AB2-152	6.74
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.48
907092	X1-038 E	2.15
913392	Y1-086 E	0.63
914231	Y2-077	0.85
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18

917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.47
922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06

923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.04
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6

925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.22
925362	AC1-007 E OP	0.36
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.74
926751	AC1-161 C OP	12.61
926752	AC1-161 E OP	5.38
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	5.45
927112	AC1-206 E OP	2.58
927141	AC1-208 C	2.89
927142	AC1-208 E	1.28

Appendix 15

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 145.95% to 146.74% (**DC power flow**) of its emergency rating (459 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 8.03 MW to the thermal violation.

CONTINGENCY 'LN 208-259'
 OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00
 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00
 OPEN BUS 314309 /* ISLAND
 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00
 END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	36.4
315077	1HOPHCF1	2.11
315078	1HOPHCF2	2.11
315079	1HOPHCF3	2.11
315080	1HOPHCF4	3.2
315076	1HOPPOLC	1.8
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	6.83
315075	CIR_AB2-152	6.74
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.48
907092	X1-038 E	2.15
913392	Y1-086 E	0.63
914231	Y2-077	0.85
916042	Z1-036 E	13.58
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18

917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.51
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.29
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.33
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.39
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.47
922733	AB1-054 E	1.21
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.56
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.06

923802	AB2-015 E OP	2.51
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	4.92
923982	AB2-039 E OP	3.98
923991	AB2-040 C OP	3.21
923992	AB2-040 E OP	2.63
924071	AB2-051 C OP	39.04
924072	AB2-051 E OP	5.36
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.95
924931	AB2-147 C	1.2
924932	AB2-147 E	1.96
924941	AB2-149 C OP	1.58
924942	AB2-149 E OP	2.59
924951	AB2-150 C OP	1.2
924952	AB2-150 E OP	1.96
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.83
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.6

925332	AB2-190 E	3.65
925361	AC1-007 C OP	0.22
925362	AC1-007 E OP	0.36
925521	AC1-027 C	0.57
925522	AC1-027 E	0.32
925691	AC1-045 C	0.53
925692	AC1-045 E	0.29
925821	AC1-061	0.03
926071	AC1-086 C	8.78
926072	AC1-086 E	4.
926201	AC1-098 C	2.1
926202	AC1-098 E	1.25
926211	AC1-099 C	0.7
926212	AC1-099 E	0.41
926661	AC1-147 C	0.65
926662	AC1-147 E	0.38
926741	AC1-159 C	38.74
926751	AC1-161 C OP	12.61
926752	AC1-161 E OP	5.38
926771	AC1-163 C	0.73
926772	AC1-163 E	0.34
927051	AC1-193 C	1.28
927052	AC1-193 E	2.09
927111	AC1-206 C OP	5.45
927112	AC1-206 E OP	2.58
927141	AC1-208 C	2.89
927142	AC1-208 E	1.28

Appendix 16

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 170.63% to 172.73% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 7.65 MW to the thermal violation.

CONTINGENCY 'LN 2058-2181'
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
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
END

Bus Number	Bus Name	Full Contribution
315131	1EDGECMA	2.58
315132	1EDGECMB	2.58
315139	1GASTONA	2.45
315141	1GASTONB	2.45
315126	1ROARAP2	1.02
315128	1ROARAP4	0.98
315134	1ROAVALA	3.46
315135	1ROAVALB	0.92
315136	1ROSEMG1	1.98
315138	1ROSEMG2	0.93
315137	1ROSEMS1	1.23
900672	V4-068 E	0.15
917331	Z2-043 C	0.37
917332	Z2-043 E	0.83
917341	Z2-044 C	0.56
917342	Z2-044 E	1.25
917511	Z2-088 C OP1	0.72
917512	Z2-088 E OP1	6.1
917592	Z2-099 E	0.2
918411	AA1-050	0.6
LTF	AA1-055	9.46
921162	AA1-063AC	4.88
921163	AA1-063AE	2.3

918512	AA1-065 E OP	1.96
921182	AA1-067 C	0.73
921183	AA1-067 E	0.31
918561	AA1-072 C	0.06
918562	AA1-072 E	0.14
921562	AA1-135 C	4.03
921563	AA1-135 E	1.73
921752	AA2-053 C	5.42
921753	AA2-053 E	2.33
921762	AA2-057 C	12.88
921763	AA2-057 E	6.44
921862	AA2-068 C	3.3
921863	AA2-068 E	1.52
920022	AA2-086 E	0.11
921982	AA2-088 C	2.94
921983	AA2-088 E	4.8
922442	AA2-165 C	1.76
922443	AA2-165 E	0.85
922512	AA2-174 C	0.25
922513	AA2-174 E	0.27
922722	AB1-053 C	0.84
922723	AB1-053 E	0.47
922732	AB1-054 C	3.16
922733	AB1-054 E	1.55
922922	AB1-081 C OP	20.07
922923	AB1-081 E OP	8.6
923262	AB1-132 C OP	9.76
923263	AB1-132 E OP	4.18
923572	AB1-173 C OP	1.21
923573	AB1-173 E OP	0.57
923582	AB1-173AC OP	1.21
923583	AB1-173AE OP	0.57
923911	AB2-031 C OP	1.2
923912	AB2-031 E OP	0.59
923941	AB2-035 C	0.37
923942	AB2-035 E	0.16
923991	AB2-040 C OP	3.95
923992	AB2-040 E OP	3.23
924151	AB2-059 C OP	23.66
924152	AB2-059 E OP	12.19
924381	AB2-087 C	0.31
924382	AB2-087 E	0.15
924391	AB2-088 C	0.47
924392	AB2-088 E	0.23
924491	AB2-098 C	0.24

924492	AB2-098 E	0.1
924501	AB2-099 C	0.32
924502	AB2-099 E	0.14
924511	AB2-100 C	6.41
924512	AB2-100 E	3.16
924761	AB2-128 C	5.49
924762	AB2-128 E	2.16
924931	AB2-147 C	1.14
924932	AB2-147 E	1.86
924951	AB2-150 C OP	1.14
924952	AB2-150 E OP	1.86
925141	AB2-171 C OP	1.93
925142	AB2-171 E OP	3.14
925171	AB2-174 C OP	3.57
925172	AB2-174 E OP	3.23
925591	AC1-034 C OP	9.93
925592	AC1-034 E OP	7.49
926071	AC1-086 C	14.37
926072	AC1-086 E	6.54
926201	AC1-098 C	8.
926202	AC1-098 E	4.76
926211	AC1-099 C	2.68
926212	AC1-099 E	1.57
926771	AC1-163 C	1.14
926772	AC1-163 E	0.53
927021	AC1-189 C	5.15
927022	AC1-189 E	2.57
927051	AC1-193 C	1.41
927052	AC1-193 E	2.31
927111	AC1-206 C OP	5.19
927112	AC1-206 E OP	2.46
927141	AC1-208 C	17.73
927142	AC1-208 E	7.87

Appendix 17

(DVP - DVP) The 6CLUBHSE 230/115 kV transformer (from bus 314562 to bus 314563 ckt 1) loads from 125.81% to 163.87% (**DC power flow**) of its emergency rating (209 MVA) for the line fault with failed breaker contingency outage of 'T122C'. This project contributes approximately 79.38 MW to the thermal violation.

```
CONTINGENCY 'T122C'                                    /* CAROLINA
  OPEN BUS 314559                                    /* CAROLINA 115KV BUS
  OPEN BUS 315126                                    /* ROANOKE RAPIDS GEN 1 AND 2
  OPEN BUS 315128                                    /* ROANOKE RAPIDS GEN 3 AND 4
  OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1          /* TX. #4
  END
```

Bus Number	Bus Name	Full Contribution
315159	1KERR 2	1.24
315163	1KERR 6	1.22
315164	1KERR 7	1.22
314704	3LAWRENC	1.4
923572	AB1-173 C OP	10.72
923573	AB1-173 E OP	5.
923582	AB1-173AC OP	10.72
923583	AB1-173AE OP	5.
923911	AB2-031 C OP	10.64
923912	AB2-031 E OP	5.24
923991	AB2-040 C OP	34.93
923992	AB2-040 E OP	28.58
924021	AB2-043 C OP	3.15
924022	AB2-043 E OP	5.16
924161	AB2-060 C OP	7.15
924162	AB2-060 E OP	3.37
924301	AB2-077 C OP	1.93
924302	AB2-077 E OP	1.29
924311	AB2-078 C OP	1.93
924312	AB2-078 E OP	1.29
924321	AB2-079 C OP	1.93
924322	AB2-079 E OP	1.29
924411	AB2-090 C	3.96
924412	AB2-090 E	2.03
924931	AB2-147 C	11.82
924932	AB2-147 E	19.28
924951	AB2-150 C OP	11.82

924952	AB2-150 E OP	19.28
925171	AB2-174 C OP	33.34
925172	AB2-174 E OP	30.17
925221	AB2-176 C	1.63
925222	AB2-176 E	0.7
925611	AC1-036 C	0.76
925612	AC1-036 E	1.24
926281	AC1-106	2.61
927111	AC1-206 C OP	53.9
927112	AC1-206 E OP	25.48
927211	AC1-215 C	10.43
927212	AC1-215 E	4.73

Appendix 18

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 111.37% to 119.92% (**DC power flow**) of its emergency rating (637 MVA) for the line fault with failed breaker contingency outage of '239T2141'. This project contributes approximately 54.51 MW to the thermal violation.

```
CONTINGENCY '239T2141'                                  /* LAKEVIEW
  OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1       /* 239
  OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1       /* 2057
  OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1       /* 2141
  END
```

Bus Number	Bus Name	Full Contribution
315139	1GASTONA	16.55
315141	1GASTONB	16.55
315159	1KERR 2	1.16
315164	1KERR 7	1.14
315126	1ROARAP2	1.55
315128	1ROARAP4	1.49
314704	3LAWRENC	0.97
921162	AA1-063AC	6.84
921163	AA1-063AE	3.22
921752	AA2-053 C	7.37
921753	AA2-053 E	3.16
922472	AA2-169 C	1.83
922473	AA2-169 E	0.84
922512	AA2-174 C	0.34
922513	AA2-174 E	0.37
923262	AB1-132 C OP	65.95
923263	AB1-132 E OP	28.27
923572	AB1-173 C OP	5.09
923573	AB1-173 E OP	2.38
923582	AB1-173AC OP	5.09
923583	AB1-173AE OP	2.38
923911	AB2-031 C OP	5.05
923912	AB2-031 E OP	2.49
923991	AB2-040 C OP	16.59
923992	AB2-040 E OP	13.57
924021	AB2-043 C OP	2.48
924022	AB2-043 E OP	4.07
924301	AB2-077 C OP	1.53

924302	AB2-077 E OP	1.02
924311	AB2-078 C OP	1.53
924312	AB2-078 E OP	1.02
924321	AB2-079 C OP	1.53
924322	AB2-079 E OP	1.02
924401	AB2-089 C	1.61
924402	AB2-089 E	0.83
924411	AB2-090 C	3.12
924412	AB2-090 E	1.6
924511	AB2-100 C	52.61
924512	AB2-100 E	25.91
924761	AB2-128 C	45.07
924762	AB2-128 E	17.74
924931	AB2-147 C	8.12
924932	AB2-147 E	13.25
924951	AB2-150 C OP	8.12
924952	AB2-150 E OP	13.25
925171	AB2-174 C OP	18.36
925172	AB2-174 E OP	16.61
925221	AB2-176 C	1.29
925222	AB2-176 E	0.55
925781	AC1-054 C OP	5.69
925782	AC1-054 E OP	2.62
926071	AC1-086 C	97.13
926072	AC1-086 E	44.21
926281	AC1-106	2.06
927111	AC1-206 C OP	37.01
927112	AC1-206 E OP	17.5
927211	AC1-215 C	8.2
927212	AC1-215 E	3.72