

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-083/AC2-084***

***Dawson Crossroads – South Justice 115kV
53.6 MW Capacity / 80.0 MW Energy***

September 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 two solar generating facilities located in Halifax County, North Carolina. Queue project AC2-083 will have a total installed capability of 20 MW (13.4 MW Capacity) and AC2-084 will have a total installed capability of 60 MW (40.2 MW capacity). The AC2-083 and AC2-084 projects will share the same point of interconnection and were evaluated as a single combined project in this Feasibility Study. The installed AC2-083/084 facilities will have a total capability of 80 MW, with 53.6 MW of this output being recognized by PJM as capacity. The proposed in-service date for the combined project is June 2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC2-083 and AC2-084 will interconnect with the ITO transmission system via a new three breaker ring bus that connects the future Scotland Neck – South Justice Branch 115kV line. The Scotland Neck – South Justice 115kV line will be constructed under PJM baseline project b2654. The scheduled in-service date for b2654 is June 2018.

Cost Summary

The AC2-083/AC2-084 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 1,550,000
Direct Connection Network Upgrades	\$ 5,500,000
Non Direct Connection Network Upgrades	\$ 800,000
Total Costs	\$ 7,850,000

In addition, the AC2-083/AC2-084 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$83,520,000
Previously Identified Upgrades	\$46,150,000
Total Costs	\$129,670,000

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

System Reinforcement

Violation #	Upgrade Description	Upgrade Cost
1 - 3	Wreck and rebuild the line #1001 Cox DP - Whitakers - Battleboro 115kV of 9.51 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost is \$19,020,000 and it is estimated to take 44-48 months to permit engineer and construct. NC CPCN is required.	\$19,020,000
4	Wreck and rebuild the line #2056 Nash – City of Rocky Mount Pod #4 230kV of 3.3 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost \$8,250,000 and it is estimated to take 44-48 months to permit, engineer and construct. VA CPCN is required.	\$8,250,000
5	Wreck and rebuild the line #594 Morrisville - Spotsylvania of 17 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost \$56,250,000 and it is estimated to 44-48 months to permit, engineer and construct. VA CPCN required.	\$56,250,000
6	CPLE (Duke) owns the limiting element on the Battleboro - Rocky Mountain line. This violation will be further analyzed in the System Impact Study.	Pending
7 - 9	Replace wave trap at the Clubhouse and Sapony substations. This will increase emergency rating to 722 MVA. The estimated cost is \$150,000 and it is estimated to 12-16 months to engineer and construct.	\$150,000
10 - 13	Rebuild the AB2-100 TAP-Lakeview 230kV line to increase its emergency line rating to a minimum of 460 MVA and its load dump rating to a minimum of 530 MVA. It is estimated to take 44-48 months to permit and construct. A Virginia CPCN and potentially a certificate from the NC PUC will most likely be required for this rebuild. The estimated cost is \$41,000,000 to resolve this deficiency.	\$41,000,000
14 - 18	Rebuild the AB2-100 TAP-Clubhouse 230kV line to increase its line rating to a minimum of 460 MVA. It is estimated to take 24-28 months to permit and construct and a Virginia CPCN will most likely be required for this rebuild. The estimated cost is \$5,000,000 to resolve this deficiency.	\$5,000,000
Total Network Upgrades		\$129,670,000

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$550,000.

Transmission: Construct approximately one span of 115 kV Attachment line between the generation substation and a new AC2-083/AC2-084 Switching Station. The estimated cost for this work is \$1,000,000.

The estimated total cost of the Attachment Facilities is \$1,550,000. It is estimated to take 18-24 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase.

These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: Establish the new 115 kV AC2-083/AC2-084 Switching Substation (interconnection substation). The estimated cost of this work scope is \$5,500,000. It is estimated to take 24-36 months to complete this work upon execution of an Interconnection Construction Service Agreement.

Non-Direct Connection Cost Estimate

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. The estimated cost is \$800,000 and it is estimated to take 24-30 months to complete.

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

Interconnection Customer Requirements

ITO's Facility Connection Requirements as posted on PJM's website

<http://www.pjm.com/~media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx>

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

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

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

Revenue Metering and SCADA Requirements

PJM Requirements

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

Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

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

Network Impacts

The Queue Project AC2-084 (AC2-083 & AC2-084 studied as 1 project, AC2-084) was evaluated as an 80.0 MW (Capacity 53.6 MW) injection tapping the Scotland Neck – South Justice 115 kV line in the ITO area. Project AC2-084 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-084 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
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
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_A	CONTINGENCY 'DVP_P1-2:2056_A' OPEN BRANCH FROM BUS 313845 TO BUS 927140 CKT 1 /* 6HATHAWAY 230.00 - AC1-208 TAP 230.00 END
DVP_P1-2:2056_B	CONTINGENCY 'DVP_P1-2:2056_B' OPEN BRANCH FROM BUS 927140 TO BUS 314579 CKT 1 /* AC1-208 TAP 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
H1T581	CONTINGENCY 'H1T581' /* LADYSMITH OPEN BRANCH FROM BUS 314911 TO BUS 314905 CKT 1 /*LADYSMITH TO CHANCELLOR (LINE 581) OPEN BRANCH FROM BUS 314905 TO BUS 314135 CKT 2 /*CHANCELLOR 500-115 (TX#4) OPEN BRANCH FROM BUS 314911 TO BUS 314196 CKT 1 /*LADYSMITH 500-230 (TX#1) END
LN 1015_A	CONTINGENCY 'LN 1015_A' OPEN BRANCH FROM BUS 313858 TO BUS 926200 CKT 1 /* 3SO JUSTICE 115.00 - AC1-098 TAP 115.00 END
LN 1015_B	CONTINGENCY 'LN 1015_B' OPEN BRANCH FROM BUS 926200 TO BUS 314603 CKT 1 /* AC1-098 TAP 115.00 - 3SCOT NK 115.00 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
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

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 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 246_B	CONTINGENCY 'LN 246_B' OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* 6SUFFOLK 230.00 - AA1-138 TAP END
LN 259	CONTINGENCY 'LN 259' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 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

Contingency Name	Description
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 68	CONTINGENCY 'LN 68' 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 END

Summer Peak Analysis - 2020

Generator Deliverability

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Ckt	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
1	N-1	DVP_P1-2:2056_A	DVP - DVP	3COX DP-3WITAKRS 115 kV line	314577	314623	1	DC	88.28	103.35	ER	134	20.25	1
2	N-1	DVP_P1-2:2056_B	DVP - DVP	3COX DP-3WITAKRS 115 kV line	314577	314623	1	DC	85.88	100.95	ER	134	20.25	
3	N-1	DVP_P1-2:2056_A	DVP - DVP	3WITAKRS-3BTLEBRO 115 kV line	314623	314554	1	DC	86.72	101.78	ER	134	20.25	2

Multiple Facility Contingency

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Ckt	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
4	DCTL	DVP_P7-1: LN 229-2058	DVP - CPLE	6NASH-6PA-RMOUNT#4 230 kV line	314591	304226	1	DC	98.02	101.36	ER	470	15.73	3
5	LFFB	H1T581	DVP - DVP	8SPOTSYL-8MORRSVL 500 kV line	314934	314916	1	DC	99.96	100.12	LDR	3938	13.32	4

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Contributions to previously identified circuit breakers found to be over-duty:

None

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Ckt		Initial	Final	Type	M VA		
6	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	179.25	189.64	ER	164	17.04	5
7	LFFB	246T2034_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	123.28	126.32	LDR	637	19.32	6
8	DCTL	LN 54-2012_B	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	123.03	125.23	LDR	637	14	
9	DCTL	LN 56-2012_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	120.6	122.95	LDR	637	14.97	
10	LFFB	246T2034_A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	109.48	112.86	LDR	459	15.55	7
11	N-1	LN 2012	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	103.78	105.71	ER	375	7.23	
12	DCTL	LN 54-2012_B	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	103.07	105.39	LDR	459	10.67	
13	DCTL	LN 56-2012_A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	102.27	104.72	LDR	459	11.24	
14	LFFB	246T2034_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	130.24	133.63	LDR	459	15.55	8
15	DCTL	LN 56-2012_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	124.48	126.93	LDR	459	11.24	
16	DCTL	LN 54-2012_B	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	124.49	126.82	LDR	459	10.67	
17	N-1	LN 2012	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	122.28	124.2	ER	375	7.23	
18	N-1	DVP_P1-2:2056_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	114.63	116.46	ER	375	6.85	

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

ITO Criteria Analysis Performed by PJM

PJM also studied the delivery of the capacity portion of this interconnection request under Dominion Critical Conditions. The following units were removed from the case and single contingencies were tested using Generation Deliverability.

Units removed to prepare the base case:

- Yorktown 3
- Possum Point 5

Critical Condition - No Surry Unit 1

No criteria violations

Critical Condition - No Possum Point 6

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Ckt		Initial	Final	Type	MVA	
19	N-1	DVP_P1-2:2056_B	DVP - DVP	3WITAKRS-3BTLEBRO 115 kV	314623	314554	1	DC	82.88	97.95	ER	134.42	20.25

New System Reinforcements

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

#	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1 - 3	3COX DP-3WITAKRS 115 kV line; 3WITAKRS-3BTLEBRO 115 kV	Wreck and rebuild the line of 9.51 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost is \$19,020,000 dollars and it is estimated to take 44-48 months to permit engineer and construct. VA CPCN is required.	Pending	\$19,020,000
4	6NASH-6PA-RMOUNT#4 230 kV line	Wreck and rebuild the line of 3.3 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost \$8,250,000 dollars and it is estimated to take 44-48 months to permit, engineer and construct. VA CPCN is required.	Pending	\$8,250,000
5	8SPOTSYL-8MORRSVL 500 kV line	Wreck and rebuild the line of 17 miles for a higher capacity since the overload exceeds the conductor rating. The estimated cost \$56,250,000 and it is estimated to 44-48 months to permit, engineer and construct. VA CPCN required.	Pending	\$56,250,000
Total New Network Upgrades				\$83,520,000

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 %

#	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
6	3BTLEBRO-3ROCKYMT115T 115 kV line	CPL (Duke) owns the limiting element on the line; this violation will be further analyzed in the System Impact Study.	Pending	Pending

#	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
7 - 9	6CLUBHSE-6SAPONY 230 kV line	Replace wave trap at both substations. This will increase emergency rating to 722 MVA. Estimated cost is \$150,000 and it is estimated to 12-16 months to engineer and construct.	Pending	\$ 150,000
10 - 13	6LAKEVEW-AB2-100 TAP 230 kV line	Rebuild the AB2-100 TAP-Lakeview 230kV line to increase its emergency line rating to a minimum of 460 MVA and its load dump rating to a minimum of 530 MVA. It is estimated to take 44-48 months to permit and construct. A Virginia CPCN and potentially a certificate from the NC PUC will most likely be required for this rebuild; the estimated cost is \$41,000,000 to resolve this deficiency.	Pending	\$41,000,000
14 - 18	AB2-100 TAP-6CLUBHSE 230 kV line	Rebuild the AB2-100 TAP-Clubhouse 230kV line to increase its line rating to a minimum of 460 MVA. It is estimated to take 24-28 months to permit and construct and a Virginia CPCN will most likely be required for this rebuild. The estimated cost is \$5,000,000 to resolve this deficiency.	Pending	\$5,000,000
Total New Network Upgrades				\$46,150,000

Potential Congestion due to Local Energy Deliverability

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

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Ckt	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
20	N-1	DVP_P1-2: LN 2181	DVP - CPLE	6HATHAWAY-6ROCKYMT230T 230 kV line	313845	304222	1	DC	104.28	107.56	ER	386	12.65
21	N-1	LN 2058	DVP - DVP	6HATHAWAY-6NASH 230 kV line	313845	314591	1	DC	103.75	106.87	ER	449	14.03
22	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	129.05	129.56	ER	375	4.22
23	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	143.42	143.93	ER	375	4.22
24	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	143.58	144.09	ER	375	4.22
25	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	168.7	169.24	ER	449	5.44
26	N-1	LN 246_B	DVP - DVP	6SAPONY-6CARSON 230 kV line	314435	314282	1	DC	106.37	108.91	ER	679	17.19
27	N-1	LN 68	DVP - DVP	6CAROLNA 230/115 kV transformer	314559	314561	1	DC	110.72	112.82	ER	240	11.18
28	N-1	LN 2012	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	124.82	127.2	ER	599	14.23
29	N-1	LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	117.76	120.72	ER	572	16.89
30	N-1	LN 2131A	DVP - DVP	6NUCO TP-AA1-138 TAP 230 kV line	314575	921571	1	DC	110.97	113.93	ER	572	16.89
31	N-1	LN 1015_B	DVP - DVP	3COX DP-3WITAKRS 115 kV line	314577	314623	1	DC	78.9	112.14	ER	134	44.68
32	N-1	LN 1015_A	DVP - DVP	3KELFORD-3EARLEYS 115 kV line	314582	314568	1	DC	52.23	108.22	ER	143	79.99
33	N-1	LN 246_B	DVP - DVP	6LAKEVIEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	122.66	126.27	ER	375	13.56
34	N-1	LN 1015_A	DVP - DVP	3SAMS HD-3KELFORD 115 kV line	314602	314582	1	DC	50.81	110.33	ER	134	80
35	N-1	LN 1015_A	DVP - DVP	3SCOT NK-3SAMS HD 115 kV line	314603	314602	1	DC	52.08	111.59	ER	134	80

#	Contingency		Affected Area	Facility Description	Bus		Ckt	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
36	N-1	LN 1015_B	DVP - DVP	3WITAKRS-3BTLEBRO 115 kV line	314623	314554	1	DC	71.43	104.67	ER	134	44.68
37	N-1	LN 2131A	DVP - DVP	AA1-138 TAP-6SUFFOLK 230 kV line	921571	314537	1	DC	119.25	122.21	ER	572	16.89
38	N-1	LN 2012	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	148.84	151.72	ER	375	10.8

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 #AC2-083/084 interconnection of a 80 MW Energy (53.6 MW Capacity) injection into the ITO's Transmission System at a new interconnection switching station located between the Scotland Neck – South Justice DP 115kV line, 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

2. Critical System Condition (No Surry 230 kV or Possum Point 6 Unit) – Same as PJM

Category C Analysis: (Multiple Facility Analysis)

1. Bus Fault - Same as PJM
2. Line Stuck Breaker - Same as PJM
3. Tower Line – Same as PJM

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.

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 3COX DP-3WITAKRS 115 kV line (from bus 314577 to bus 314623 ckt 1) loads from 88.28% to 103.35% (**DC power flow**) of its emergency rating (134 MVA) for the single line contingency outage of 'DVP_P1-2:2056_A'. This project contributes approximately 20.25 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2:2056_A'

OPEN BRANCH FROM BUS 313845 TO BUS 927140 CKT 1

/* 6HATHAWAY

230.00 - AC1-208 TAP 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315139	1GASTONA	1.13
315141	1GASTONB	1.13
315126	1ROARAP2	0.97
315128	1ROARAP4	0.93
315134	1ROAVALA	9.34
315135	1ROAVALB	2.49
315136	1ROSEMG1	0.81
315138	1ROSEMG2	0.38
315137	1ROSEMS1	0.5
315115	1SHAMPT1	0.66
931631	AC2-084 C	20.25
900671	V4-068 C	0.04
917331	Z2-043 C	0.48
917591	Z2-099 C	0.08
921162	AA1-063AC	4.9
918561	AA1-072 C	0.07
921752	AA2-053 C	5.44
921762	AA2-057 C	25.38
921862	AA2-068 C	6.13
920021	AA2-086 C	0.04
921982	AA2-088 C	2.75
922442	AA2-165 C	3.46
922472	AA2-169 C	0.91
922512	AA2-174 C	0.25
923262	AB1-132 C OP	4.89
923572	AB1-173 C OP	1.09
923582	AB1-173AC OP	1.09
923801	AB2-015 C OP	2.74
923911	AB2-031 C OP	1.08
923991	AB2-040 C OP	3.56
924381	AB2-087 C	0.28

924501	AB2-099 C	0.28
924511	AB2-100 C	3.39
924761	AB2-128 C	2.9
924931	AB2-147 C	0.86
924951	AB2-150 C OP	0.86
925141	AB2-171 C OP	1.74
925171	AB2-174 C OP	3.04
925781	AC1-054 C OP	2.48
926071	AC1-086 C	7.2
926201	AC1-098 C	14.21
926211	AC1-099 C	4.76
926771	AC1-163 C	1.02
927051	AC1-193 C	1.28
927141	AC1-208 C	3.23

Appendix 2

(DVP - DVP) The 3WITAKRS-3BTLEBRO 115 kV line (from bus 314623 to bus 314554 ckt 1) loads from 86.72% to 101.78% (**DC power flow**) of its emergency rating (134 MVA) for the single line contingency outage of 'DVP_P1-2:2056_A'. This project contributes approximately 20.25 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2:2056_A'

OPEN BRANCH FROM BUS 313845 TO BUS 927140 CKT 1

/* 6HATHAWAY

230.00 - AC1-208 TAP 230.00

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315139	1GASTONA	1.13
315141	1GASTONB	1.13
315126	1ROARAP2	0.97
315128	1ROARAP4	0.93
315134	1ROAVALA	9.34
315135	1ROAVALB	2.49
315136	1ROSEMG1	0.81
315138	1ROSEMG2	0.38
315137	1ROSEMS1	0.5
315115	1SHAMPT1	0.66
931631	AC2-084 C	20.25
900671	V4-068 C	0.04
917331	Z2-043 C	0.48
917341	Z2-044 C	1.05
917591	Z2-099 C	0.08
921162	AA1-063AC	4.9
918561	AA1-072 C	0.07
921752	AA2-053 C	5.44
921762	AA2-057 C	25.38
921862	AA2-068 C	6.12
920021	AA2-086 C	0.04
921982	AA2-088 C	2.75
922442	AA2-165 C	3.46
922472	AA2-169 C	0.91
922512	AA2-174 C	0.25
923262	AB1-132 C OP	4.89
923572	AB1-173 C OP	1.09
923582	AB1-173AC OP	1.09
923801	AB2-015 C OP	2.74
923911	AB2-031 C OP	1.08
923991	AB2-040 C OP	3.55
924381	AB2-087 C	0.28
924501	AB2-099 C	0.28

924511	AB2-100 C	3.38
924761	AB2-128 C	2.9
924931	AB2-147 C	0.86
924951	AB2-150 C OP	0.86
925141	AB2-171 C OP	1.74
925171	AB2-174 C OP	3.04
925781	AC1-054 C OP	2.48
926071	AC1-086 C	7.2
926201	AC1-098 C	14.21
926211	AC1-099 C	4.76
926771	AC1-163 C	1.02
927051	AC1-193 C	1.28
927141	AC1-208 C	3.22

Appendix 3

(DVP - CPLE) The 6NASH-6PA-RMOUNT#4 230 kV line (from bus 314591 to bus 304226 ckt 1) loads from 98.02% to 101.36% (**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 15.73 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	32.94
315132	1EDGECEMB	32.94
315139	1GASTONA	4.39
315141	1GASTONB	4.39
315126	1ROARAP2	1.38
315128	1ROARAP4	1.33
315134	1ROAVALA	33.5
315135	1ROAVALB	8.93
315136	1ROSEMG1	3.76
315138	1ROSEMG2	1.76
315137	1ROSEMS1	2.33
314541	3WATKINS	0.35
931631	AC2-084 C	10.54
931632	AC2-084 E	5.19
900672	V4-068 E	0.19
917331	Z2-043 C	0.34
917332	Z2-043 E	0.83
917341	Z2-044 C	0.41
917342	Z2-044 E	1.01
917591	Z2-099 C	0.11
917592	Z2-099 E	0.28
921162	AA1-063AC	7.03
921163	AA1-063AE	3.31
918512	AA1-065 E OP	2.17
918561	AA1-072 C	0.05
918562	AA1-072 E	0.14

921752	AA2-053 C	7.61
921753	AA2-053 E	3.27
921762	AA2-057 C	10.92
921763	AA2-057 E	5.46
921862	AA2-068 C	2.99
921863	AA2-068 E	1.38
920021	AA2-086 C	0.06
920022	AA2-086 E	0.15
921982	AA2-088 C	4.
921983	AA2-088 E	6.52
922442	AA2-165 C	1.49
922443	AA2-165 E	0.72
922472	AA2-169 C	1.3
922473	AA2-169 E	0.6
922512	AA2-174 C	0.35
922513	AA2-174 E	0.38
922922	AB1-081 C OP	20.14
922923	AB1-081 E OP	8.63
923262	AB1-132 C OP	19.08
923263	AB1-132 E OP	8.18
923572	AB1-173 C OP	1.94
923573	AB1-173 E OP	0.9
923582	AB1-173AC OP	1.94
923583	AB1-173AE OP	0.9
923801	AB2-015 C OP	4.19
923802	AB2-015 E OP	3.43
923851	AB2-025 C	1.19
923852	AB2-025 E	0.53
923911	AB2-031 C OP	1.92
923912	AB2-031 E OP	0.95
923991	AB2-040 C OP	6.31
923992	AB2-040 E OP	5.17
924151	AB2-059 C OP	23.74
924152	AB2-059 E OP	12.23
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	12.33
924512	AB2-100 E	6.07
924761	AB2-128 C	10.56
924762	AB2-128 E	4.16
924931	AB2-147 C	1.97
924932	AB2-147 E	3.22
924951	AB2-150 C OP	1.97

924952	<i>AB2-150 E OP</i>	3.22
925141	<i>AB2-171 C OP</i>	2.61
925142	<i>AB2-171 E OP</i>	4.26
925171	<i>AB2-174 C OP</i>	5.86
925172	<i>AB2-174 E OP</i>	5.3
925781	<i>AC1-054 C OP</i>	3.51
925782	<i>AC1-054 E OP</i>	1.62
926071	<i>AC1-086 C</i>	28.09
926072	<i>AC1-086 E</i>	12.79
926201	<i>AC1-098 C</i>	7.39
926202	<i>AC1-098 E</i>	4.41
926211	<i>AC1-099 C</i>	2.48
926212	<i>AC1-099 E</i>	1.46
926771	<i>AC1-163 C</i>	1.31
926772	<i>AC1-163 E</i>	0.62
927051	<i>AC1-193 C</i>	1.91
927052	<i>AC1-193 E</i>	3.12
927111	<i>AC1-206 C OP</i>	9.56
927112	<i>AC1-206 E OP</i>	4.52
927141	<i>AC1-208 C</i>	23.22
927142	<i>AC1-208 E</i>	10.31

Appendix 4

(DVP - DVP) The 8SPOTSYL-8MORRSVL 500 kV line (from bus 314934 to bus 314916 ckt 1) loads from 99.96% to 100.12% (**DC power flow**) of its load dump rating (3938 MVA) for the line fault with failed breaker contingency outage of 'H1T581'. This project contributes approximately 13.32 MW to the thermal violation.

CONTINGENCY 'H1T581' /* LADYSMITH
 OPEN BRANCH FROM BUS 314911 TO BUS 314905 CKT 1 /*LADYSMITH TO
 CHANCELLOR (LINE 581)
 OPEN BRANCH FROM BUS 314905 TO BUS 314135 CKT 2 /*CHANCELLOR
 500-115 (TX#4)
 OPEN BRANCH FROM BUS 314911 TO BUS 314196 CKT 1 /*LADYSMITH
 500-230 (TX#1)
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315108	1ELIZAR1	3.86
315109	1ELIZAR2	3.79
315110	1ELIZAR3	3.9
315074	1HOPCGN1	9.13
315075	1HOPCGN2	9.01
315225	1N ANNA1	65.02
315226	1N ANNA2	64.01
315134	1ROAVALA	28.72
315135	1ROAVALB	7.66
315083	1SPRUNCA	11.77
315084	1SPRUNCB	11.77
315085	1SPRUNCC	8.72
315086	1SPRUNCD	8.72
315073	1STONECA	7.57
315233	1SURRY 2	30.42
314784	1WEYRHSB	2.21
315090	1YORKTN1	31.35
315091	1YORKTN2	32.53
314539	3UNCAMP	2.62
314541	3WATKINS	0.74
314229	6MT R221	0.76
314189	6PAPERMILL	6.93
931041	AC2-012 C OP	11.41
931042	AC2-012 E OP	18.62
931501	AC2-070 C	1.76
931502	AC2-070 E	0.73
931531	AC2-073 C	2.47
931532	AC2-073 E	1.24
931581	AC2-078 C OP	4.51

931582	AC2-078 E OP	7.36
931591	AC2-079 C OP	7.48
931592	AC2-079 E OP	12.2
931631	AC2-084 C	8.93
931632	AC2-084 E	4.4
931701	AC2-093 C	79.08
931702	AC2-093 E	45.23
931711	AC2-094 C	16.12
931712	AC2-094 E	9.32
931831	AC2-110 C	1.4
931832	AC2-110 E	2.29
292791	U1-032 E	3.94
900672	V4-068 E	0.32
901082	W1-029 E	50.65
907092	X1-038 E	6.56
913392	Y1-086 E	2.42
916042	Z1-036 E	49.7
916192	Z1-068 E	2.1
916302	Z1-086 E	10.14
917122	Z2-027 E	1.17
917332	Z2-043 E	1.03
917342	Z2-044 E	0.57
LTF	Z2-067	18.39
917512	Z2-088 E OP1	7.94
917592	Z2-099 E	0.47
921092	AA1-049 C	2.69
921093	AA1-049 E	1.27
LTF	AA1-058	0.82
921162	AA1-063AC	8.9
921163	AA1-063AE	4.2
918512	AA1-065 E OP	4.68
921182	AA1-067 C	1.71
921183	AA1-067 E	0.73
918562	AA1-072 E	0.17
921292	AA1-083	3.33
921532	AA1-132 C	8.31
921533	AA1-132 E	3.56
921562	AA1-135 C	9.52
921563	AA1-135 E	4.08
921572	AA1-138 C	10.68
921573	AA1-138 E	4.58
921582	AA1-139 C	16.67
921583	AA1-139 E	7.14
921622	AA1-145	56.65
921752	AA2-053 C	9.03

921753	AA2-053 E	3.88
921762	AA2-057 C	7.09
921763	AA2-057 E	3.55
921772	AA2-059 C	1.28
921773	AA2-059 E	0.6
921862	AA2-068 C	2.25
921863	AA2-068 E	1.04
LTF	AA2-074	5.47
920022	AA2-086 E	0.25
921982	AA2-088 C	6.88
921983	AA2-088 E	11.22
922442	AA2-165 C	0.97
922443	AA2-165 E	0.47
922472	AA2-169 C	2.21
922473	AA2-169 E	1.02
922512	AA2-174 C	0.41
922513	AA2-174 E	0.45
922522	AA2-177 C	11.07
922523	AA2-177 E	4.75
922532	AA2-178 C	10.34
922533	AA2-178 E	4.43
922602	AB1-013 C	3.12
922603	AB1-013 E	20.88
922682	AB1-027 C	2.68
922683	AB1-027 E	1.15
923262	AB1-132 C OP	14.58
923263	AB1-132 E OP	6.25
923272	AB1-135 C OP	2.71
923273	AB1-135 E OP	1.16
923572	AB1-173 C OP	2.36
923573	AB1-173 E OP	1.1
923582	AB1-173AC OP	2.36
923583	AB1-173AE OP	1.1
923801	AB2-015 C OP	9.31
923802	AB2-015 E OP	7.63
923831	AB2-022 C	2.55
923832	AB2-022 E	1.37
923841	AB2-024 C	2.59
923842	AB2-024 E	1.16
923851	AB2-025 C	2.67
923852	AB2-025 E	1.2
923861	AB2-026 C	2.6
923862	AB2-026 E	1.17
923911	AB2-031 C OP	2.34
923912	AB2-031 E OP	1.15

923941	AB2-035 C	0.33
923942	AB2-035 E	0.14
923981	AB2-039 C OP	9.27
923982	AB2-039 E OP	7.5
923991	AB2-040 C OP	7.68
923992	AB2-040 E OP	6.28
924061	AB2-050	3.33
924071	AB2-051 C OP	153.33
924072	AB2-051 E OP	21.05
924182	AB2-062 E	3.64
924241	AB2-068 OP	210.13
924381	AB2-087 C	0.6
924382	AB2-087 E	0.28
924391	AB2-088 C	0.43
924392	AB2-088 E	0.2
924491	AB2-098 C	0.57
924492	AB2-098 E	0.24
924501	AB2-099 C	0.62
924502	AB2-099 E	0.26
924511	AB2-100 C	11.98
924512	AB2-100 E	5.9
924761	AB2-128 C	10.26
924762	AB2-128 E	4.04
924811	AB2-134 C OP	14.2
924812	AB2-134 E OP	18.98
924931	AB2-147 C	2.68
924932	AB2-147 E	4.37
924941	AB2-149 C OP	3.74
924942	AB2-149 E OP	6.1
924951	AB2-150 C OP	2.68
924952	AB2-150 E OP	4.37
925021	AB2-158 C	10.04
925022	AB2-158 E	4.48
925051	AB2-160 C OP	6.01
925052	AB2-160 E OP	9.81
925061	AB2-161 C OP	3.75
925062	AB2-161 E OP	6.12
925121	AB2-169 C OP	6.76
925122	AB2-169 E OP	6.07
925141	AB2-171 C OP	5.25
925142	AB2-171 E OP	8.57
925171	AB2-174 C OP	7.37
925172	AB2-174 E OP	6.66
925281	AB2-186 C	0.67
925282	AB2-186 E	0.29

925291	AB2-188 C OP	2.55
925292	AB2-188 E OP	1.14
925331	AB2-190 C	25.31
925332	AB2-190 E	6.33
925521	AC1-027 C	2.24
925522	AC1-027 E	1.28
925591	AC1-034 C OP	6.74
925592	AC1-034 E OP	5.08
925691	AC1-045 C	1.92
925692	AC1-045 E	1.05
925701	AC1-046 C	1.94
925702	AC1-046 E	1.06
925711	AC1-047 C	2.57
925712	AC1-047 E	1.42
925781	AC1-054 C OP	7.06
925782	AC1-054 E OP	3.25
925811	AC1-060	0.08
925821	AC1-061	0.04
925841	AC1-063	0.41
925861	AC1-065 C	3.5
925862	AC1-065 E	5.72
926001	AC1-076 C	4.56
926002	AC1-076 E	7.41
926071	AC1-086 C	21.47
926072	AC1-086 E	9.77
926201	AC1-098 C	6.26
926202	AC1-098 E	3.73
926211	AC1-099 C	2.1
926212	AC1-099 E	1.23
926291	AC1-107 OP	317.18
926411	AC1-112 C	2.09
926412	AC1-112 E	1.17
926551	AC1-134	8.33
926591	AC1-142 C	9.22
926592	AC1-142 E	6.96
926661	AC1-147 C	2.52
926662	AC1-147 E	1.48
926731	AC1-158 C	184.59
926732	AC1-158 E	81.01
926741	AC1-159 C	152.15
926751	AC1-161 C OP	34.14
926752	AC1-161 E OP	14.57
926761	AC1-162 C	26.59
926762	AC1-162 E	11.35
926771	AC1-163 C	2.23

926772	AC1-163 E	1.04
926781	AC1-164 C OP	43.77
926782	AC1-164 E OP	19.67
927021	AC1-189 C	8.62
927022	AC1-189 E	4.29
927041	AC1-191 C	10.14
927042	AC1-191 E	5.05
927051	AC1-193 C	3.85
927052	AC1-193 E	6.28
927111	AC1-206 C OP	12.48
927112	AC1-206 E OP	5.9
927141	AC1-208 C	9.03
927142	AC1-208 E	4.01
927221	AC1-216 C OP	10.84
927222	AC1-216 E OP	8.52

Appendix 5

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 179.25% to 189.64% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 17.04 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	13.46
315132	1EDGECEMB	13.46
315139	1GASTONA	2.25
315141	1GASTONB	2.25
315126	1ROARAP2	0.94
315128	1ROARAP4	0.9
315134	1ROAVALA	18.13
315135	1ROAVALB	4.83
315136	1ROSEMG1	1.82
315138	1ROSEMG2	0.85
315137	1ROSEMS1	1.13
314541	3WATKINS	0.26
931631	AC2-084 C	11.41
931632	AC2-084 E	5.62
900672	V4-068 E	0.15
917331	Z2-043 C	0.34
917332	Z2-043 E	0.83
917341	Z2-044 C	0.51
917342	Z2-044 E	1.25
917511	Z2-088 C OP1	0.66
917512	Z2-088 E OP1	6.11
917592	Z2-099 E	0.2
918411	AA1-050	0.55
LTF	AA1-055	9.15
921162	AA1-063AC	4.89
921163	AA1-063AE	2.31
918512	AA1-065 E OP	1.96

921182	AA1-067 C	0.74
921183	AA1-067 E	0.32
918561	AA1-072 C	0.05
918562	AA1-072 E	0.14
921562	AA1-135 C	4.05
921563	AA1-135 E	1.74
921752	AA2-053 C	5.44
921753	AA2-053 E	2.33
921762	AA2-057 C	12.9
921763	AA2-057 E	6.45
921862	AA2-068 C	3.3
921863	AA2-068 E	1.52
920022	AA2-086 E	0.11
921982	AA2-088 C	2.95
921983	AA2-088 E	4.81
922442	AA2-165 C	1.76
922443	AA2-165 E	0.85
922512	AA2-174 C	0.25
922513	AA2-174 E	0.27
922922	AB1-081 C OP	20.09
922923	AB1-081 E OP	8.61
923262	AB1-132 C OP	9.78
923263	AB1-132 E OP	4.19
923572	AB1-173 C OP	1.22
923573	AB1-173 E OP	0.57
923582	AB1-173AC OP	1.22
923583	AB1-173AE OP	0.57
923911	AB2-031 C OP	1.21
923912	AB2-031 E OP	0.59
923941	AB2-035 C	0.37
923942	AB2-035 E	0.16
923991	AB2-040 C OP	3.96
923992	AB2-040 E OP	3.24
924151	AB2-059 C OP	23.68
924152	AB2-059 E OP	12.2
924381	AB2-087 C	0.32
924382	AB2-087 E	0.15
924391	AB2-088 C	0.48
924392	AB2-088 E	0.23
924491	AB2-098 C	0.25
924492	AB2-098 E	0.11
924501	AB2-099 C	0.32
924502	AB2-099 E	0.14
924511	AB2-100 C	6.43
924512	AB2-100 E	3.17

924761	AB2-128 C	5.51
924762	AB2-128 E	2.17
924931	AB2-147 C	1.15
924932	AB2-147 E	1.87
924951	AB2-150 C OP	1.15
924952	AB2-150 E OP	1.87
925141	AB2-171 C OP	1.93
925142	AB2-171 E OP	3.16
925171	AB2-174 C OP	3.58
925172	AB2-174 E OP	3.24
925591	AC1-034 C OP	7.53
925592	AC1-034 E OP	5.68
926071	AC1-086 C	14.4
926072	AC1-086 E	6.56
926201	AC1-098 C	8.01
926202	AC1-098 E	4.77
926211	AC1-099 C	2.68
926212	AC1-099 E	1.58
LTF	AC1-133	9.07
926771	AC1-163 C	1.14
926772	AC1-163 E	0.53
927021	AC1-189 C	5.16
927022	AC1-189 E	2.57
927051	AC1-193 C	1.42
927052	AC1-193 E	2.31
927111	AC1-206 C OP	5.13
927112	AC1-206 E OP	2.42
927141	AC1-208 C	10.08
927142	AC1-208 E	4.48

Appendix 6

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 123.28% to 126.32% (**DC power flow**) of its load dump rating (637 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 19.32 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	11.37
315132	1EDGECEMB	11.37
315139	1GASTONA	7.15
315141	1GASTONB	7.15
315126	1ROARAP2	2.59
315128	1ROARAP4	2.49
315134	1ROAVALA	57.78
315135	1ROAVALB	15.41
315136	1ROSEMG1	4.83
315138	1ROSEMG2	2.26
315137	1ROSEMS1	3.
314704	3LAWRENC	0.76
314541	3WATKINS	0.52
931631	AC2-084 C	12.95
931632	AC2-084 E	6.38
900671	V4-068 C	0.12
900672	V4-068 E	0.36
917331	Z2-043 C	0.61
917332	Z2-043 E	1.49
917341	Z2-044 C	0.31
917342	Z2-044 E	0.75
917512	Z2-088 E OP1	9.29
917592	Z2-099 E	0.48
LTF	AA1-058	0.57
921162	AA1-063AC	12.88
921163	AA1-063AE	6.07
918511	AA1-065 C OP	2.42

918512	AA1-065 E OP	6.79
921182	AA1-067 C	1.92
921183	AA1-067 E	0.82
918561	AA1-072 C	0.09
918562	AA1-072 E	0.25
921562	AA1-135 C	12.32
921563	AA1-135 E	5.28
921752	AA2-053 C	14.98
921753	AA2-053 E	6.43
921762	AA2-057 C	9.83
921763	AA2-057 E	4.91
921862	AA2-068 C	3.27
921863	AA2-068 E	1.51
LTF	AA2-074	2.66
920022	AA2-086 E	0.26
921982	AA2-088 C	6.87
921983	AA2-088 E	11.2
922442	AA2-165 C	1.34
922443	AA2-165 E	0.65
922472	AA2-169 C	2.96
922473	AA2-169 E	1.36
922512	AA2-174 C	0.69
922513	AA2-174 E	0.74
922922	AB1-081 C OP	10.88
922923	AB1-081 E OP	4.66
923262	AB1-132 C OP	31.04
923263	AB1-132 E OP	13.3
923572	AB1-173 C OP	5.13
923573	AB1-173 E OP	2.39
923582	AB1-173AC OP	5.13
923583	AB1-173AE OP	2.39
923911	AB2-031 C OP	5.09
923912	AB2-031 E OP	2.51
923941	AB2-035 C	0.4
923942	AB2-035 E	0.17
923991	AB2-040 C OP	16.72
923992	AB2-040 E OP	13.68
924021	AB2-043 C OP	2.79
924022	AB2-043 E OP	4.58
924151	AB2-059 C OP	12.82
924152	AB2-059 E OP	6.6
924301	AB2-077 C OP	1.75
924302	AB2-077 E OP	1.17
924311	AB2-078 C OP	1.75
924312	AB2-078 E OP	1.17

924321	AB2-079 C OP	1.75
924322	AB2-079 E OP	1.17
924381	AB2-087 C	0.86
924382	AB2-087 E	0.4
924391	AB2-088 C	0.52
924392	AB2-088 E	0.25
924401	AB2-089 C	2.43
924402	AB2-089 E	1.25
924411	AB2-090 C	3.51
924412	AB2-090 E	1.8
924491	AB2-098 C	0.64
924492	AB2-098 E	0.27
924501	AB2-099 C	0.84
924502	AB2-099 E	0.36
924511	AB2-100 C	31.43
924512	AB2-100 E	15.48
924761	AB2-128 C	26.93
924762	AB2-128 E	10.6
924931	AB2-147 C	6.66
924932	AB2-147 E	10.86
924951	AB2-150 C OP	6.66
924952	AB2-150 E OP	10.86
925141	AB2-171 C OP	4.02
925142	AB2-171 E OP	6.55
925171	AB2-174 C OP	16.95
925172	AB2-174 E OP	15.33
925221	AB2-176 C	1.45
925222	AB2-176 E	0.62
925591	AC1-034 C OP	8.19
925592	AC1-034 E OP	6.18
925781	AC1-054 C OP	8.74
925782	AC1-054 E OP	4.03
926071	AC1-086 C	45.72
926072	AC1-086 E	20.81
926201	AC1-098 C	9.08
926202	AC1-098 E	5.41
926211	AC1-099 C	3.04
926212	AC1-099 E	1.79
926771	AC1-163 C	3.04
926772	AC1-163 E	1.42
927021	AC1-189 C	9.88
927022	AC1-189 E	4.92
927051	AC1-193 C	2.95
927052	AC1-193 E	4.81
927111	AC1-206 C OP	38.62

927112	<i>AC1-206 E OP</i>	18.26
927141	<i>AC1-208 C</i>	15.06
927142	<i>AC1-208 E</i>	6.69
927211	<i>AC1-215 C</i>	9.2
927212	<i>AC1-215 E</i>	4.17

Appendix 7

(DVP - DVP) The 6LAKEVEW-AB2-100 TAP 230 kV line (from bus 314583 to bus 924510 ckt 1) loads from 109.48% to 112.86% (**DC power flow**) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 15.55 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	10.99
315132	1EDGECEMB	10.99
315139	1GASTONA	7.44
315141	1GASTONB	7.44
315126	1ROARAP2	1.6
315128	1ROARAP4	1.53
315134	1ROAVALA	58.77
315135	1ROAVALB	15.67
315136	1ROSEMG1	5.
315138	1ROSEMG2	2.34
315137	1ROSEMS1	3.1
314784	1WEYRHSB	1.17
314541	3WATKINS	0.36
931631	AC2-084 C	10.42
931632	AC2-084 E	5.13
900671	V4-068 C	0.09
900672	V4-068 E	0.28
917331	Z2-043 C	0.52
917332	Z2-043 E	1.27
917341	Z2-044 C	0.27
917342	Z2-044 E	0.65
917511	Z2-088 C OP1	0.96
917512	Z2-088 E OP1	8.89
917591	Z2-099 C	0.13
917592	Z2-099 E	0.34
918411	AA1-050	0.81
LTF	AA1-058	0.53

921162	AA1-063AC	8.23
921163	AA1-063AE	3.88
918511	AA1-065 C OP	2.3
918512	AA1-065 E OP	6.45
921182	AA1-067 C	1.83
921183	AA1-067 E	0.78
918561	AA1-072 C	0.08
918562	AA1-072 E	0.21
921562	AA1-135 C	11.72
921563	AA1-135 E	5.02
921752	AA2-053 C	10.05
921753	AA2-053 E	4.32
921762	AA2-057 C	8.12
921763	AA2-057 E	4.06
921862	AA2-068 C	2.57
921863	AA2-068 E	1.18
LTF	AA2-074	2.31
920021	AA2-086 C	0.07
920022	AA2-086 E	0.18
921982	AA2-088 C	4.77
921983	AA2-088 E	7.78
922442	AA2-165 C	1.11
922443	AA2-165 E	0.53
922472	AA2-169 C	1.51
922473	AA2-169 E	0.7
922512	AA2-174 C	0.46
922513	AA2-174 E	0.5
922922	AB1-081 C OP	10.11
922923	AB1-081 E OP	4.33
923262	AB1-132 C OP	32.31
923263	AB1-132 E OP	13.85
923941	AB2-035 C	0.39
923942	AB2-035 E	0.17
924151	AB2-059 C OP	11.92
924152	AB2-059 E OP	6.14
924381	AB2-087 C	0.76
924382	AB2-087 E	0.36
924391	AB2-088 C	0.5
924392	AB2-088 E	0.24
924491	AB2-098 C	0.61
924492	AB2-098 E	0.26
924501	AB2-099 C	0.72
924502	AB2-099 E	0.31
925121	AB2-169 C OP	4.43
925122	AB2-169 E OP	3.98

925141	AB2-171 C OP	2.78
925142	AB2-171 E OP	4.54
925591	AC1-034 C OP	7.88
925592	AC1-034 E OP	5.94
925781	AC1-054 C OP	4.11
925782	AC1-054 E OP	1.89
926071	AC1-086 C	47.57
926072	AC1-086 E	21.65
926201	AC1-098 C	7.31
926202	AC1-098 E	4.35
926211	AC1-099 C	2.45
926212	AC1-099 E	1.44
926771	AC1-163 C	2.61
926772	AC1-163 E	1.22
927021	AC1-189 C	9.44
927022	AC1-189 E	4.7
927051	AC1-193 C	2.04
927052	AC1-193 E	3.33
927141	AC1-208 C	15.22
927142	AC1-208 E	6.76

Appendix 8

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 130.24% to 133.63% (**DC power flow**) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 15.55 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	10.99
315132	1EDGECEMB	10.99
315139	1GASTONA	7.44
315141	1GASTONB	7.44
315126	1ROARAP2	1.6
315128	1ROARAP4	1.53
315134	1ROAVALA	58.77
315135	1ROAVALB	15.67
315136	1ROSEMG1	5.
315138	1ROSEMG2	2.34
315137	1ROSEMS1	3.1
314784	1WEYRHSB	1.17
931631	AC2-084 C	10.42
931632	AC2-084 E	5.13
900671	V4-068 C	0.09
900672	V4-068 E	0.28
917331	Z2-043 C	0.52
917332	Z2-043 E	1.27
917341	Z2-044 C	0.27
917342	Z2-044 E	0.65
917511	Z2-088 C OP1	0.96
917512	Z2-088 E OP1	8.89
917591	Z2-099 C	0.13
917592	Z2-099 E	0.34
918411	AA1-050	0.81
LTF	AA1-058	0.53
921162	AA1-063AC	8.23

921163	AA1-063AE	3.88
918511	AA1-065 C OP	2.3
918512	AA1-065 E OP	6.45
921182	AA1-067 C	1.83
921183	AA1-067 E	0.78
918561	AA1-072 C	0.08
918562	AA1-072 E	0.21
921562	AA1-135 C	11.72
921563	AA1-135 E	5.02
921752	AA2-053 C	10.05
921753	AA2-053 E	4.32
921762	AA2-057 C	8.12
921763	AA2-057 E	4.06
921862	AA2-068 C	2.57
921863	AA2-068 E	1.18
LTF	AA2-074	2.31
920021	AA2-086 C	0.07
920022	AA2-086 E	0.18
921982	AA2-088 C	4.77
921983	AA2-088 E	7.78
922442	AA2-165 C	1.11
922443	AA2-165 E	0.53
922472	AA2-169 C	1.51
922473	AA2-169 E	0.7
922512	AA2-174 C	0.46
922513	AA2-174 E	0.5
922922	AB1-081 C OP	10.11
922923	AB1-081 E OP	4.33
923262	AB1-132 C OP	32.31
923263	AB1-132 E OP	13.85
923941	AB2-035 C	0.39
923942	AB2-035 E	0.17
924151	AB2-059 C OP	11.92
924152	AB2-059 E OP	6.14
924381	AB2-087 C	0.76
924382	AB2-087 E	0.36
924391	AB2-088 C	0.5
924392	AB2-088 E	0.24
924491	AB2-098 C	0.61
924492	AB2-098 E	0.26
924501	AB2-099 C	0.72
924502	AB2-099 E	0.31
924511	AB2-100 C	35.66
924512	AB2-100 E	17.56
924761	AB2-128 C	30.55

924762	AB2-128 E	12.03
925121	AB2-169 C OP	4.43
925122	AB2-169 E OP	3.98
925141	AB2-171 C OP	2.78
925142	AB2-171 E OP	4.54
925591	AC1-034 C OP	7.88
925592	AC1-034 E OP	5.94
925781	AC1-054 C OP	4.11
925782	AC1-054 E OP	1.89
926071	AC1-086 C	47.57
926072	AC1-086 E	21.65
926201	AC1-098 C	7.31
926202	AC1-098 E	4.35
926211	AC1-099 C	2.45
926212	AC1-099 E	1.44
926771	AC1-163 C	2.61
926772	AC1-163 E	1.22
927021	AC1-189 C	9.44
927022	AC1-189 E	4.7
927051	AC1-193 C	2.04
927052	AC1-193 E	3.33
927141	AC1-208 C	15.22
927142	AC1-208 E	6.76