Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-169

Pantego 115kV
39MW Capacity / 74MW Energy

October / 2016

Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Preface

The intent of the Feasibility Study is to determine a plan, with high level estimated cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the IC. The IC may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the IC may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

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

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

General

The IC has proposed a solar generating facility located in Beaufort County, NC. The installed facilities will have a total capability of 74 MW with 39 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2018. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AB2-039 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via the queue W2-022 attachment facilities into Pantego 115kV substation.

Option 2 will connect via a new three breaker ring bus switching station that connects at the Pantego – Five Points 115kV line.

Cost Summary

The AB2-169 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,500,000
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$tbd
Total Costs	**$1,500,000**

In addition, the AB2-169 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$129,495,000
Previously Identified Upgrades	$0
Total Costs	**$129,495,000**

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

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost $500,000.

Transmission: Construct approximately one span of 115 kV Attachment line between the generation substation and an existing Pantego 115 kV Substation. The estimated cost for this work is $1,000,000.

The estimated total cost of the Attachment Facilities is $1,500,000. It is estimated to take 18-24 months to complete this work. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Non-Direct Connection Cost Estimate

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.

Reinforcement: Rebuild of the Five Point-Wharton 115kV line. It is estimated to take 30-36 months to complete and it is estimated to cost $25,245,000 to resolve this deficiency.

Reinforcement: Rebuild of the Pantego-Five Point 115kV line. It is estimated to take 30-36 months to complete and it is estimated to cost $20,475,000 to resolve this deficiency.

Reinforcement: Rebuild of the Chesterfield-Basin 230kV line. It is estimated to take 44 – 48 months to complete and it is estimated to cost $18,615,000 to resolve the deficiency.

Reinforcement: Rebuild of the Elizabeth City-Shawboro 230kV line. It is estimated to take 44-48 months to complete and it is estimated to cost $15,405,000 to resolve this deficiency.

Reinforcement: Rebuild of the Sunbury-Suffolk 230kV line. It is estimated to take 44-48 months to complete and it is estimated to cost $28,065,000 to resolve this deficiency.

Reinforcement: Rebuild of the W1-029-Sunbury 230kV line. It is estimated to take 44-48 months to complete and it is estimated to cost $14,685,000 to resolve this deficiency.

Reinforcement: Rebuild the AB2-100 TAP-Clubhouse 230kV line. It is estimated to take 44-48 months to complete and it is estimated to cost $6,825,000 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

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 AB2-169 was evaluated as a 74.0 MW (Capacity 39.0 MW) injection at the Pantego 115kV substation in the ITO area. Project AB2-169 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-169 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
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
1020TPAN	CONTINGENCY '1020TPAN' /* PANTEGO OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00 REDUCE BUS 314592 LOAD BY 10 PERCENT 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

Contingency Name	Description
246T247_A	CONTINGENCY '246T247_A' /* 246T247 @ SUFFOLK OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* SUFFOLK - AA1-138 TAP OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* SUFFOLK - SUNBURY OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* SUNBURY - WINFALL END
LN 269-2087_A	CONTINGENCY 'LN 269-2087_A' OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00 OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00 OPEN BUS 314645 /* ISLAND OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00 OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00 OPEN BUS 314468 /* ISLAND OPEN BUS 314476 /* ISLAND OPEN BUS 314550 /* ISLAND 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

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 1020	CONTINGENCY 'LN 1020' OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00 END
LN 247	CONTINGENCY 'LN 247' OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND END
LN 2020	CONTINGENCY 'LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 /* 6ECITYDP2 230.00 - 6ELIZ CT 230.00 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 /* 6ECITYDP2 230.00 - 6TANGLEW 230.00 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 /* 6TANGLEW 230.00 - 6WINFALL 230.00 OPEN BUS 313851 /* ISLAND OPEN BUS 314639 /* ISLAND OPEN BUS 913391 /* ISLAND OPEN BUS 913392 /* ISLAND END
LN 246_B	CONTINGENCY 'LN 246_B' OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* 6SUFFOLK 230.00 - AA1-138 TAP END

Summer Peak Analysis - 2020

System Reinforcement responsible by ITO

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
1	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	116.06	117.35	ER	164	4.7

PJM baseline project (b1794) will eliminate the identified overloads. The scheduled in service date b1794 is 06/01/2017.

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
2	LFFB	1020TPAN	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	44.68	138.35	ER	79	74.0	1
3	LFFB	1020TPAN	DVP - DVP	3PANTEGO-3FIVE PT 115 kV line	314592	314576	1	DC	57.34	151.01	ER	79	74.0	2

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
4	LFFB	562T563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	122.78	123.24	ER	470	4.78	3
5	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	116.06	117.35	ER	164	4.7	4
6	LFFB	246T247_A	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	DC	124.22	127.68	ER	608	21.03	5
7	DCTL	LN 269-2087_A	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	DC	139.66	141.17	ER	478	16	6
8	DCTL	LN 269-2087_A	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	DC	144.2	145.71	ER	478	16	7
9	LFFB	246T2034_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	115.26	117.36	ER	399	8.38	8

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	3BTLEBRO-3ROCKYMT115T 115 kV line	Build a new Hathaway 230/115kV substation	b1794	
# 2	3FIVE PT-3WHARTON 115 kV line	Rebuild of the Five Point-Wharton 115kV line	Pending	**$25,245,000**
# 3	3PANTEGO-3FIVE PT 115 kV line	Rebuild of the Pantego-Five Point 115kV line	Pending	**$20,475,000**
			Total New Network Upgrades	**$45,720,000**

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 4	6CHSTF B-6BASIN 230 kV line	Rebuild the Chesterfield-Basin 230kV line	Pending	**$18,615,000**
# 5	3BTLEBRO-3ROCKYMT115T 115 kV line	Build a new Hathaway 230/115kV substation	b1794	
# 6	6ELIZ CT-6SHAWBRO 230 kV line	Rebuild of the Elizabeth City-Shawboro 230kV line	Pending	**$15,405,000**
# 7	6SUNBURY-6SUFFOLK 230 kV line	Rebuild of the Sunbury - Suffolk 230kV line	Pending	**$28,065,000**
# 8	W1-029-6SUNBURY 230 kV line	Rebuild of the W1-029-Sunbury 230kV line	Pending	**$14,865,000**
# 9	AB2-100 TAP-6CLUBHSE 230 kV line	AB2-100 Tap-Clubhouse 230kV line	Pending	**$6,825,000**
			Total New Network Upgrades	**$83,775,000**

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

#	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
10	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	122.53	122.98	ER	470	4.76
11	N-1	LN 1020	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	40.63	134.3	ER	79	74
12	N-1	LN 1020	DVP - DVP	3PANTEGO-3FIVE PT 115 kV line	314592	314576	1	DC	53.29	146.96	ER	79	74
13	N-1	LN 247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	DC	109.5	112.33	ER	608	17.26
14	N-1	LN 2020	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	DC	129.16	132.51	ER	478	16.01
15	N-1	LN 2020	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	DC	133.68	137.03	ER	478	16.01
16	N-1	LN 246_B	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	102.79	105.4	ER	399	10.39

Light Load Analysis

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AB2-169 interconnection of a 74.0 MW Energy (39.0 MW Capacity) injection into the ITO's Transmission System, 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 – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

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

Import/Export Analysis (Single Contingency) are tabulated in Table A and B below.

Table A: Import Study Results

Import Study Results			
Area	Summer 2020	Summer 2020 with AB2-169	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-169	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

ITO's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies indicate that the proposed interconnection will impact ITO's import or export capability.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

Overload #1 and 5: 3BTLEBRO-3ROCKYMT115T 115 kV line overload was identified on PJM Queue projects in the AA2 queue with current rating of 94MVA. Duke Progress requires a project to enter into an Affected System Study with Duke Progress so that Duke Progress can determine if a network upgrade is required. In the AA2 queue, Duke Progress preliminary analysis has identified a network upgrade to increase the rating of the line rating from 94MVA to 164MVA. The network upgrade cost responsibility will be governed by the Duke Progress FERC tariff.

Option Two

Network Impacts

The Queue Project AB2-169 was evaluated as a 74.0 MW (Capacity 39.0 MW) injection tapping the Pantego-Five Point 115kV line in the ITO area. Project AB2-169 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-169 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
1020TPAN	CONTINGENCY '1020TPAN' /* PANTEGO OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00 REDUCE BUS 314592 LOAD BY 10 PERCENT 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
246T247_A	CONTINGENCY '246T247_A' /* 246T247 @ SUFFOLK OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* SUFFOLK - AA1-138 TAP OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* SUFFOLK - SUNBURY OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* SUNBURY - WINFALL END

Contingency Name	Description
LN 269-2087_A	CONTINGENCY 'LN 269-2087_A' OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00 OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00 OPEN BUS 314645 /* ISLAND OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00 OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00 OPEN BUS 314468 /* ISLAND OPEN BUS 314476 /* ISLAND OPEN BUS 314550 /* 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 1020	CONTINGENCY 'LN 1020' OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00 END
LN 247	CONTINGENCY 'LN 247' OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND END

Contingency Name	Description
LN 2020	CONTINGENCY 'LN 2020' OPEN BRANCH FROM BUS 313851 TO BUS 314638 CKT 1 /* 6ECITYDP2 230.00 - 6ELIZ CT 230.00 OPEN BRANCH FROM BUS 313851 TO BUS 314639 CKT 1 /* 6ECITYDP2 230.00 - 6TANGLEW 230.00 OPEN BRANCH FROM BUS 314639 TO BUS 314651 CKT 1 /* 6TANGLEW 230.00 - 6WINFALL 230.00 OPEN BUS 313851 /* ISLAND OPEN BUS 314639 /* ISLAND OPEN BUS 913391 /* ISLAND OPEN BUS 913392 /* ISLAND END
Z1-086_GEN	CONTINGENCY 'Z1-086_GEN' REMOVE MACHINE 1 FROM BUS 916301 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 contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

#	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
1	LFFB	1020TPAN	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	44.68	138.35	ER	79	74.0	9
2	LFFB	1020TPAN	DVP - DVP	AB2-169 TAP-3FIVE PT 115 kV line	925120	314576	1	DC	57.34	151.01	ER	79	74.0	10

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
3	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	111.11	112.42	ER	164	4.75	11
4	LFFB	246T247_A	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	DC	124.22	127.51	ER	608	20.01	12
5	DCTL	LN 269-2087_A	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	DC	139.66	141.08	ER	478	15.03	13
6	DCTL	LN 269-2087_A	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	DC	144.2	145.62	ER	478	15.03	14

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 Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
7	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	124.48	124.93	ER	470	4.74
8	N-1	LN 1020	DVP - DVP	3FIVE PT-3WHARTON 115 kV line	314576	314622	1	DC	40.63	134.3	ER	79	74
9	N-1	LN 247	DVP - DVP	6ELIZ CT-6SHAWBRO 230 kV line	314638	314647	1	DC	109.5	112.17	ER	608	16.25
10	N-1	LN 2020	DVP - DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	DC	129.35	132.5	ER	478	15.04
11	N-1	LN 2020	DVP - DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	DC	133.87	137.01	ER	478	15.04
12	N-1	Z1-086_GEN	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	103.03	104.95	ER	399	7.64
13	N-1	LN 1020	DVP - DVP	AB2-169 TAP-3FIVE PT 115 kV line	925120	314576	1	DC	53.29	146.96	ER	79	74

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 #AB2-169 interconnection of a 74.0 MW Energy (39.0 MW Capacity) injection into the ITO's Transmission System, 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 – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

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

Import/Export Analysis (Single Contingency) are tabulated in Table A and B below.

Table A: Import Study Results

Import Study Results			
Area	Summer 2020	Summer 2020 with AB2-169	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-169	Limiting Element
AEP	2000+	2000+	6DOZIER-6GRENWCH 230 kV line under contingency outage of 'LN 2070' 8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	6DOZIER-6GRENWCH 230 kV line under contingency outage of 'LN 2070' 8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
CPL	2000+	2000+	6DOZIER-6GRENWCH 230 kV line under contingency outage of 'LN 2070' 8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	6DOZIER-6GRENWCH 230 kV line under contingency outage of 'LN 2070' 8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

ITO's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies indicate that the proposed interconnection will impact ITO's import or export capability.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

Overload #3: 3BTLEBRO-3ROCKYMT115T 115 kV line overload was identified on PJM Queue projects in the AA2 queue with current rating of 94MVA. Duke Progress requires a project to enter into an Affected System Study with Duke Progress so that Duke Progress can determine if a network upgrade is required. In the AA2 queue, Duke Progress preliminary analysis has identified a network upgrade to increase the rating of the line rating from 94MVA to 164MVA. The network upgrade cost responsibility will be governed by the Duke Progress FERC tariff.

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 3FIVE PT-3WHARTON 115 kV line (from bus 314576 to bus 314622 ckt 1) loads from 44.68% to 138.35% (**DC power flow**) of its emergency rating (79 MVA) for the line fault with failed breaker contingency outage of '1020TPAN'. This project contributes approximately 74.0 MW to the thermal violation.

CONTINGENCY '1020TPAN' /* PANTEGO
OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00
REDUCE BUS 314592 LOAD BY 10 PERCENT
END

Bus Number	*Bus Name*	*Full Contribution*
902241	*W2-022 C OP1*	*9.57*
902242	*W2-022 E OP1*	*64.03*
925121	*AB2-169 C OP*	*39.*
925122	*AB2-169 E OP*	*35.*

Appendix 2

(DVP - DVP) The 3PANTEGO-3FIVE PT 115 kV line (from bus 314592 to bus 314576 ckt 1) loads from 57.34% to 151.01% (**DC power flow**) of its emergency rating (79 MVA) for the line fault with failed breaker contingency outage of '1020TPAN'. This project contributes approximately 74.0 MW to the thermal violation.

CONTINGENCY '1020TPAN' /* PANTEGO
OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00
REDUCE BUS 314592 LOAD BY 10 PERCENT
END

Bus Number	*Bus Name*	*Full Contribution*
902241	*W2-022 C OP1*	*9.57*
902242	*W2-022 E OP1*	*64.03*
925121	*AB2-169 C OP*	*39.*
925122	*AB2-169 E OP*	*35.*

Appendix 3

(DVP - DVP) The 6CHSTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 122.78% to 123.24% (**DC power flow**) of its emergency rating (470 MVA) for the line fault with failed breaker contingency outage of '562T563'. This project contributes approximately 4.78 MW to the thermal violation.

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

Bus Number	*Bus Name*	*Full Contribution*
315065	*1CHESTF6*	*37.57*
315077	*1HOPHCF1*	*1.99*
315078	*1HOPHCF2*	*1.99*
315079	*1HOPHCF3*	*1.99*
315080	*1HOPHCF4*	*3.03*
315076	*1HOPPOLC*	*1.7*
315073	*1STONECA*	*5.24*
314784	*1WEYRHSB*	*0.81*
314314	*3LOCKS*	*0.97*
314539	*3UNCAMP*	*1.01*
314541	*3WATKINS*	*0.29*
292791	*U1-032 E*	*2.73*
900672	*V4-068 E*	*0.13*
901082	*W1-029E*	*15.92*
902241	*W2-022 C OP1*	*0.62*
902242	*W2-022 E OP1*	*4.13*
907092	*X1-038 E*	*2.52*
913392	*Y1-086 E*	*0.74*
914231	*Y2-077*	*0.8*
916042	*Z1-036 E*	*16.2*
916302	*Z1-086 E*	*3.97*
917122	*Z2-027 E*	*0.36*
917332	*Z2-043 E*	*0.42*
917342	*Z2-044 E*	*0.24*
917512	*Z2-088 E OP1*	*3.19*
917592	*Z2-099 E*	*0.19*
LTF	*AA1-058*	*0.31*

921162	*AA1-063AC*	*3.88*
921163	*AA1-063AE*	*1.83*
921172	*AA1-064 C*	*3.54*
921173	*AA1-064 E*	*1.67*
918512	*AA1-065 E OP*	*1.82*
921182	*AA1-067 C*	*0.67*
921183	*AA1-067 E*	*0.29*
918562	*AA1-072 E*	*0.07*
921552	*AA1-134 C*	*3.42*
921553	*AA1-134 E*	*1.46*
921562	*AA1-135 C*	*3.71*
921563	*AA1-135 E*	*1.59*
921572	*AA1-138 C*	*3.57*
921573	*AA1-138 E*	*1.53*
921752	*AA2-053 C*	*3.99*
921753	*AA2-053 E*	*1.71*
921762	*AA2-057 C*	*3.01*
921763	*AA2-057 E*	*1.51*
921772	*AA2-059 C*	*0.86*
921773	*AA2-059 E*	*0.39*
921862	*AA2-068 C*	*0.96*
921863	*AA2-068 E*	*0.44*
920022	*AA2-086 E*	*0.1*
921982	*AA2-088 C*	*2.79*
921983	*AA2-088 E*	*4.56*
922032	*AA2-105 C*	*1.05*
922033	*AA2-105 E*	*0.49*
922072	*AA2-113 C*	*1.05*
922073	*AA2-113 E*	*0.49*
922442	*AA2-165 C*	*0.41*
922443	*AA2-165 E*	*0.2*
922472	*AA2-169 C*	*0.9*
922473	*AA2-169 E*	*0.42*
922512	*AA2-174 C*	*0.18*
922513	*AA2-174 E*	*0.2*
922522	*AA2-177 C*	*6.06*
922523	*AA2-177 E*	*2.6*
922532	*AA2-178 C*	*3.58*
922533	*AA2-178 E*	*1.53*
922602	*AB1-013 C*	*1.08*
922603	*AB1-013 E*	*7.23*
922722	*AB1-053 C*	*0.53*
922723	*AB1-053 E*	*0.3*
922732	*AB1-054 C*	*2.96*
922733	*AB1-054 E*	*1.46*

922882	*AB1-077 C*	*1.19*
922883	*AB1-077 E*	*7.96*
922922	*AB1-081 C OP*	*3.65*
922923	*AB1-081 E OP*	*1.56*
923262	*AB1-132 C OP*	*7.23*
923263	*AB1-132 E OP*	*3.1*
923572	*AB1-173 C OP*	*1.19*
923573	*AB1-173 E OP*	*0.55*
923582	*AB1-173AC OP*	*1.19*
923583	*AB1-173AE OP*	*0.55*
923801	*AB2-015 C OP*	*4.48*
923802	*AB2-015 E OP*	*3.25*
923831	*AB2-022 C*	*0.77*
923832	*AB2-022 E*	*0.42*
923851	*AB2-025 C*	*1.86*
923852	*AB2-025 E*	*0.84*
923911	*AB2-031 C OP*	*1.18*
923912	*AB2-031 E OP*	*0.58*
923941	*AB2-035 C*	*0.14*
923942	*AB2-035 E*	*0.06*
923981	*AB2-039 C OP*	*6.11*
923982	*AB2-039 E OP*	*5.*
923991	*AB2-040 C OP*	*4.01*
923992	*AB2-040 E OP*	*3.02*
924011	*AB2-042 C OP*	*6.75*
924012	*AB2-042 E OP*	*5.38*
924151	*AB2-059 C OP*	*4.3*
924152	*AB2-059 E OP*	*2.21*
924381	*AB2-087 C*	*0.24*
924382	*AB2-087 E*	*0.11*
924391	*AB2-088 C*	*0.17*
924392	*AB2-088 E*	*0.08*
924401	*AB2-089 C*	*0.81*
924402	*AB2-089 E*	*0.42*
924491	*AB2-098 C*	*0.22*
924492	*AB2-098 E*	*0.1*
924501	*AB2-099 C*	*0.25*
924502	*AB2-099 E*	*0.11*
924511	*AB2-100 C*	*6.62*
924512	*AB2-100 E*	*3.26*
924761	*AB2-128 C*	*5.67*
924762	*AB2-128 E*	*2.23*
924811	*AB2-134 C OP*	*7.77*
924812	*AB2-134 E OP*	*10.38*
924931	*AB2-147 C*	*1.41*

924932	*AB2-147 E*	*2.3*
924941	*AB2-149 C OP*	*1.71*
924942	*AB2-149 E OP*	*2.79*
924951	*AB2-150 C OP*	*1.41*
924952	*AB2-150 E OP*	*2.3*
924961	*AB2-152*	*14.65*
925051	*AB2-160 C OP*	*3.9*
925052	*AB2-160 E OP*	*6.36*
925061	*AB2-161 C OP*	*2.11*
925062	*AB2-161 E OP*	*3.45*
925121	*AB2-169 C OP*	*2.52*
925122	*AB2-169 E OP*	*2.26*
925141	*AB2-171 C OP*	*2.07*
925142	*AB2-171 E OP*	*3.38*
925171	*AB2-174 C OP*	*3.81*
925172	*AB2-174 E OP*	*3.44*
925281	*AB2-186 C*	*0.22*
925282	*AB2-186 E*	*0.09*
925291	*AB2-188 C OP*	*0.88*
925292	*AB2-188 E OP*	*0.4*
925331	*AB2-190 C*	*13.84*
925332	*AB2-190 E*	*3.46*

Appendix 4

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 116.06% to 117.35% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 4.7 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*	*2.63*
315132	*1EDGECMB*	*2.63*
315139	*1GASTONA*	*2.5*
315141	*1GASTONB*	*2.5*
315126	*1ROARAP2*	*1.04*
315128	*1ROARAP4*	*1.*
315134	*1ROAVALA*	*3.54*
315135	*1ROAVALB*	*0.94*
315136	*1ROSEMG1*	*2.03*
315138	*1ROSEMG2*	*0.95*
315137	*1ROSEMS1*	*1.26*
314541	*3WATKINS*	*0.26*
900672	*V4-068 E*	*0.15*
902241	*W2-022 C OP1*	*0.61*
902242	*W2-022 E OP1*	*4.07*
917331	*Z2-043 C*	*0.38*
917332	*Z2-043 E*	*0.83*
917341	*Z2-044 C*	*0.57*
917342	*Z2-044 E*	*1.25*
917511	*Z2-088 C OP1*	*0.73*
917512	*Z2-088 E OP1*	*6.09*
917592	*Z2-099 E*	*0.2*
918411	*AA1-050*	*0.62*

LTF	*AA1-053*	*6.16*
LTF	*AA1-054*	*5.36*
LTF	*AA1-055*	*9.54*
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*
922032	*AA2-105 C*	*1.71*
922033	*AA2-105 E*	*0.8*
922072	*AA2-113 C*	*1.71*
922073	*AA2-113 E*	*0.8*
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*	*4.09*
923992	*AB2-040 E OP*	*3.09*
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*	*1.11*
924932	*AB2-147 E*	*1.81*
924951	*AB2-150 C OP*	*1.11*
924952	*AB2-150 E OP*	*1.81*
925121	*AB2-169 C OP*	*2.48*
925122	*AB2-169 E OP*	*2.22*
925141	*AB2-171 C OP*	*1.88*
925142	*AB2-171 E OP*	*3.07*
925171	*AB2-174 C OP*	*3.57*
925172	*AB2-174 E OP*	*3.23*

Appendix 5

(DVP - DVP) The 6ELIZ CT-6SHAWBRO 230 kV line (from bus 314638 to bus 314647 ckt 1) loads from 124.22% to 127.68% (**DC power flow**) of its emergency rating (608 MVA) for the line fault with failed breaker contingency outage of '246T247_A'. This project contributes approximately 21.03 MW to the thermal violation.

CONTINGENCY '246T247_A' /* 246T247 @ SUFFOLK
OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* SUFFOLK - AA1-138 TAP
OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* SUFFOLK - SUNBURY
OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* SUNBURY - WINFALL
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*3.16*
315134	*1ROAVALA*	*3.67*
315135	*1ROAVALB*	*0.98*
314784	*1WEYRHSB*	*4.03*
901081	*W1-029C*	*5.13*
901082	*W1-029E*	*175.15*
902241	*W2-022 C OP1*	*2.72*
902242	*W2-022 E OP1*	*18.2*
913391	*Y1-086 C*	*1.1*
913392	*Y1-086 E*	*9.14*
916041	*Z1-036 C*	*4.57*
916042	*Z1-036 E*	*156.13*
917121	*Z2-027 C*	*2.02*
917122	*Z2-027 E*	*4.42*
917331	*Z2-043 C*	*0.41*
917332	*Z2-043 E*	*0.9*
917511	*Z2-088 C OP1*	*0.81*
917512	*Z2-088 E OP1*	*6.78*
918411	*AA1-050*	*0.69*
LTF	*AA1-058*	*0.38*
918511	*AA1-065 C OP*	*2.13*
918512	*AA1-065 E OP*	*5.35*
921182	*AA1-067 C*	*1.67*
921183	*AA1-067 E*	*0.71*
918561	*AA1-072 C*	*0.06*

918562	*AA1-072 E*	*0.15*
921552	*AA1-134 C*	*37.58*
921553	*AA1-134 E*	*16.11*
921562	*AA1-135 C*	*10.12*
921563	*AA1-135 E*	*4.34*
921572	*AA1-138 C*	*11.34*
921573	*AA1-138 E*	*4.86*
921752	*AA2-053 C*	*5.63*
921753	*AA2-053 E*	*2.42*
921772	*AA2-059 C*	*7.57*
921773	*AA2-059 E*	*3.48*
921862	*AA2-068 C*	*1.42*
921863	*AA2-068 E*	*0.65*
922512	*AA2-174 C*	*0.26*
922513	*AA2-174 E*	*0.28*
922532	*AA2-178 C*	*25.74*
922533	*AA2-178 E*	*11.03*
922602	*AB1-013 C*	*7.77*
922603	*AB1-013 E*	*51.99*
922882	*AB1-077 C*	*13.09*
922883	*AB1-077 E*	*87.57*
923831	*AB2-022 C*	*10.04*
923832	*AB2-022 E*	*5.41*
923941	*AB2-035 C*	*0.24*
923942	*AB2-035 E*	*0.1*
924381	*AB2-087 C*	*0.58*
924382	*AB2-087 E*	*0.27*
924391	*AB2-088 C*	*0.31*
924392	*AB2-088 E*	*0.15*
924491	*AB2-098 C*	*0.56*
924492	*AB2-098 E*	*0.24*
924501	*AB2-099 C*	*0.54*
924502	*AB2-099 E*	*0.23*
925121	*AB2-169 C OP*	*11.08*
925122	*AB2-169 E OP*	*9.95*
925281	*AB2-186 C*	*1.93*
925282	*AB2-186 E*	*0.83*
925291	*AB2-188 C OP*	*6.34*
925292	*AB2-188 E OP*	*2.85*

Appendix 6

(DVP - DVP) The 6SUNBURY-6SUFFOLK 230 kV line (from bus 314648 to bus 314537 ckt 1) loads from 139.66% to 141.17% (**DC power flow**) of its emergency rating (478 MVA) for the tower line contingency outage of 'LN 269-2087_A'. This project contributes approximately 16.0 MW to the thermal violation.

CONTINGENCY 'LN 269-2087_A'
OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00
OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00
OPEN BUS 314645 /* ISLAND
OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00
OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00
OPEN BUS 314468 /* ISLAND
OPEN BUS 314476 /* ISLAND
OPEN BUS 314550 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*2.47*
314784	*1WEYRHSB*	*3.16*
314643	*3O INLET*	*1.82*
901081	*W1-029C*	*5.25*
901082	*W1-029E*	*179.33*
902241	*W2-022 C OP1*	*2.07*
902242	*W2-022 E OP1*	*13.85*
903520	*W3-066 C1OP1*	*12.11*
903531	*W3-066 C2OP1*	*12.11*
903522	*W3-066 E1OP1*	*81.02*
903532	*W3-066 E2OP1*	*81.02*
913391	*Y1-086 C*	*0.92*
913392	*Y1-086 E*	*7.7*
916041	*Z1-036 C*	*4.14*
916042	*Z1-036 E*	*141.53*
917121	*Z2-027 C*	*1.7*
917122	*Z2-027 E*	*3.72*
921542	*AA1-133 C*	*34.77*

921543	*AA1-133 E*	*14.9*
921552	*AA1-134 C*	*38.48*
921553	*AA1-134 E*	*16.49*
921582	*AA1-139 C*	*52.15*
921583	*AA1-139 E*	*22.35*
921772	*AA2-059 C*	*6.75*
921773	*AA2-059 E*	*3.11*
922532	*AA2-178 C*	*22.02*
922533	*AA2-178 E*	*9.44*
922602	*AB1-013 C*	*6.65*
922603	*AB1-013 E*	*44.48*
922882	*AB1-077 C*	*13.4*
922883	*AB1-077 E*	*89.66*
923831	*AB2-022 C*	*8.07*
923832	*AB2-022 E*	*4.35*
925121	*AB2-169 C OP*	*8.43*
925122	*AB2-169 E OP*	*7.57*
925281	*AB2-186 C*	*1.73*
925282	*AB2-186 E*	*0.74*
925291	*AB2-188 C OP*	*5.43*
925292	*AB2-188 E OP*	*2.44*

Appendix 7

(DVP - DVP) The W1-029-6SUNBURY 230 kV line (from bus 901080 to bus 314648 ckt 1) loads from 144.2% to 145.71% (**DC power flow**) of its emergency rating (478 MVA) for the tower line contingency outage of 'LN 269-2087_A'. This project contributes approximately 16.0 MW to the thermal violation.

CONTINGENCY 'LN 269-2087_A'
OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00
OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00
OPEN BUS 314645 /* ISLAND
OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00
OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00
OPEN BUS 314468 /* ISLAND
OPEN BUS 314476 /* ISLAND
OPEN BUS 314550 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*2.47*
314784	*1WEYRHSB*	*3.16*
314643	*3O INLET*	*1.82*
901081	*W1-029C*	*5.25*
901082	*W1-029E*	*179.33*
902241	*W2-022 C OP1*	*2.07*
902242	*W2-022 E OP1*	*13.85*
903520	*W3-066 C1OP1*	*12.11*
903531	*W3-066 C2OP1*	*12.11*
903522	*W3-066 E1OP1*	*81.02*
903532	*W3-066 E2OP1*	*81.02*
913391	*Y1-086 C*	*0.92*
913392	*Y1-086 E*	*7.7*
916041	*Z1-036 C*	*4.14*
916042	*Z1-036 E*	*141.53*
917121	*Z2-027 C*	*1.7*
917122	*Z2-027 E*	*3.72*
921542	*AA1-133 C*	*34.77*

921543	*AA1-133 E*	*14.9*
921552	*AA1-134 C*	*38.48*
921553	*AA1-134 E*	*16.49*
921582	*AA1-139 C*	*52.15*
921583	*AA1-139 E*	*22.35*
921772	*AA2-059 C*	*6.75*
921773	*AA2-059 E*	*3.11*
922532	*AA2-178 C*	*22.02*
922533	*AA2-178 E*	*9.44*
922602	*AB1-013 C*	*6.65*
922603	*AB1-013 E*	*44.48*
922882	*AB1-077 C*	*13.4*
922883	*AB1-077 E*	*89.66*
923831	*AB2-022 C*	*8.07*
923832	*AB2-022 E*	*4.35*
925121	*AB2-169 C OP*	*8.43*
925122	*AB2-169 E OP*	*7.57*
925281	*AB2-186 C*	*1.73*
925282	*AB2-186 E*	*0.74*
925291	*AB2-188 C OP*	*5.43*
925292	*AB2-188 E OP*	*2.44*

Appendix 8

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 115.26% to 117.36% (**DC power flow**) of its emergency rating (399 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 8.38 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
```

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*2.15*
315132	*1EDGECMB*	*2.15*
315139	*1GASTONA*	*8.28*
315141	*1GASTONB*	*8.28*
315126	*1ROARAP2*	*1.77*
315128	*1ROARAP4*	*1.71*
315134	*1ROAVALA*	*11.5*
315135	*1ROAVALB*	*3.07*
315136	*1ROSEMG1*	*5.56*
315138	*1ROSEMG2*	*2.61*
315137	*1ROSEMS1*	*3.45*
314784	*1WEYRHSB*	*1.17*
900671	*V4-068 C*	*0.1*
900672	*V4-068 E*	*0.28*
902241	*W2-022 C OP1*	*1.08*
902242	*W2-022 E OP1*	*7.25*
917331	*Z2-043 C*	*0.58*
917332	*Z2-043 E*	*1.27*
917341	*Z2-044 C*	*0.3*
917342	*Z2-044 E*	*0.65*
917511	*Z2-088 C OP1*	*1.07*
917512	*Z2-088 E OP1*	*8.87*
917591	*Z2-099 C*	*0.15*

917592	*Z2-099 E*	*0.33*
918411	*AA1-050*	*0.9*
LTF	*AA1-058*	*0.53*
921162	*AA1-063AC*	*8.21*
921163	*AA1-063AE*	*3.87*
918511	*AA1-065 C OP*	*2.56*
918512	*AA1-065 E OP*	*6.44*
921182	*AA1-067 C*	*1.83*
921183	*AA1-067 E*	*0.78*
918561	*AA1-072 C*	*0.09*
918562	*AA1-072 E*	*0.21*
921562	*AA1-135 C*	*11.7*
921563	*AA1-135 E*	*5.01*
921752	*AA2-053 C*	*10.03*
921753	*AA2-053 E*	*4.31*
921762	*AA2-057 C*	*8.1*
921763	*AA2-057 E*	*4.05*
921862	*AA2-068 C*	*2.57*
921863	*AA2-068 E*	*1.18*
LTF	*AA2-074*	*2.29*
920021	*AA2-086 C*	*0.08*
920022	*AA2-086 E*	*0.18*
921982	*AA2-088 C*	*4.76*
921983	*AA2-088 E*	*7.76*
922032	*AA2-105 C*	*2.49*
922033	*AA2-105 E*	*1.17*
922072	*AA2-113 C*	*2.49*
922073	*AA2-113 E*	*1.17*
922442	*AA2-165 C*	*1.1*
922443	*AA2-165 E*	*0.53*
922472	*AA2-169 C*	*1.51*
922473	*AA2-169 E*	*0.69*
922512	*AA2-174 C*	*0.46*
922513	*AA2-174 E*	*0.5*
922722	*AB1-053 C*	*2.3*
922723	*AB1-053 E*	*1.29*
922732	*AB1-054 C*	*5.17*
922733	*AB1-054 E*	*2.54*
922922	*AB1-081 C OP*	*10.09*
922923	*AB1-081 E OP*	*4.32*
923262	*AB1-132 C OP*	*32.27*
923263	*AB1-132 E OP*	*13.83*
923941	*AB2-035 C*	*0.39*
923942	*AB2-035 E*	*0.17*
924151	*AB2-059 C OP*	*11.89*

924152	*AB2-059 E OP*	*6.13*
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*	*35.64*
924512	*AB2-100 E*	*17.55*
924761	*AB2-128 C*	*30.53*
924762	*AB2-128 E*	*12.02*
925121	*AB2-169 C OP*	*4.42*
925122	*AB2-169 E OP*	*3.96*
925141	*AB2-171 C OP*	*2.64*
925142	*AB2-171 E OP*	*4.31*

Appendix 9

(DVP - DVP) The 3FIVE PT-3WHARTON 115 kV line (from bus 314576 to bus 314622 ckt 1) loads from 44.68% to 138.35% (**DC power flow**) of its emergency rating (79 MVA) for the line fault with failed breaker contingency outage of '1020TPAN'. This project contributes approximately 74.0 MW to the thermal violation.

CONTINGENCY '1020TPAN' /* PANTEGO
OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00
REDUCE BUS 314592 LOAD BY 10 PERCENT
END

Bus Number	*Bus Name*	*Full Contribution*
902241	*W2-022 C OP1*	*9.57*
902242	*W2-022 E OP1*	*64.03*
925121	*AB2-169 C OP*	*39.*
925122	*AB2-169 E OP*	*35.*

Appendix 10

(DVP - DVP) The AB2-169 TAP-3FIVE PT 115 kV line (from bus 925120 to bus 314576 ckt 1) loads from 57.34% to 151.01% (**DC power flow**) of its emergency rating (79 MVA) for the line fault with failed breaker contingency outage of '1020TPAN'. This project contributes approximately 74.0 MW to the thermal violation.

CONTINGENCY '1020TPAN' /* PANTEGO
OPEN BRANCH FROM BUS 314592 TO BUS 314613 CKT 1 /* 3PANTEGO 115.00 - 3TRWBRDG 115.00
REDUCE BUS 314592 LOAD BY 10 PERCENT
END

Bus Number	*Bus Name*	*Full Contribution*
902241	*W2-022 C OP1*	*9.57*
902242	*W2-022 E OP1*	*64.03*
925121	*AB2-169 C OP*	*39.*
925122	*AB2-169 E OP*	*35.*

Appendix 11

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 111.11% to 112.42% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 4.75 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*	*2.63*
315132	*1EDGECMB*	*2.63*
315139	*1GASTONA*	*2.5*
315141	*1GASTONB*	*2.5*
315126	*1ROARAP2*	*1.04*
315128	*1ROARAP4*	*1.*
315134	*1ROAVALA*	*3.54*
315135	*1ROAVALB*	*0.94*
315136	*1ROSEMG1*	*2.03*
315138	*1ROSEMG2*	*0.95*
315137	*1ROSEMS1*	*1.26*
314784	*1WEYRHSB*	*0.77*
314541	*3WATKINS*	*0.26*
900672	*V4-068 E*	*0.15*
902241	*W2-022 C OP1*	*0.61*
902242	*W2-022 E OP1*	*4.07*
917331	*Z2-043 C*	*0.38*
917332	*Z2-043 E*	*0.83*
917341	*Z2-044 C*	*0.57*
917342	*Z2-044 E*	*1.25*
917511	*Z2-088 C OP1*	*0.73*
917512	*Z2-088 E OP1*	*6.09*
917592	*Z2-099 E*	*0.2*

918411	*AA1-050*	*0.62*
LTF	*AA1-053*	*6.16*
LTF	*AA1-054*	*5.36*
LTF	*AA1-055*	*9.54*
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*
922032	*AA2-105 C*	*1.71*
922033	*AA2-105 E*	*0.8*
922072	*AA2-113 C*	*1.71*
922073	*AA2-113 E*	*0.8*
922442	*AA2-165 C*	*1.76*
922443	*AA2-165 E*	*0.85*
922472	*AA2-169 C*	*0.85*
922473	*AA2-169 E*	*0.39*
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*
923801	*AB2-015 C OP*	*4.03*

923802	*AB2-015 E OP*	*2.92*
923911	*AB2-031 C OP*	*1.28*
923912	*AB2-031 E OP*	*0.63*
923941	*AB2-035 C*	*0.37*
923942	*AB2-035 E*	*0.16*
923991	*AB2-040 C OP*	*4.36*
923992	*AB2-040 E OP*	*3.29*
924151	*AB2-059 C OP*	*15.3*
924152	*AB2-059 E OP*	*7.88*
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*	*1.87*
924951	*AB2-150 C OP*	*1.14*
924952	*AB2-150 E OP*	*1.87*
925121	*AB2-169 C OP*	*2.51*
925122	*AB2-169 E OP*	*2.25*
925141	*AB2-171 C OP*	*1.93*
925142	*AB2-171 E OP*	*3.16*
925171	*AB2-174 C OP*	*4.02*
925172	*AB2-174 E OP*	*3.64*

Appendix 12

(DVP - DVP) The 6ELIZ CT-6SHAWBRO 230 kV line (from bus 314638 to bus 314647 ckt 1) loads from 124.22% to 127.51% (**DC power flow**) of its emergency rating (608 MVA) for the line fault with failed breaker contingency outage of '246T247_A'. This project contributes approximately 20.01 MW to the thermal violation.

CONTINGENCY '246T247_A' /* 246T247 @ SUFFOLK
OPEN BRANCH FROM BUS 314537 TO BUS 921571 CKT 1 /* SUFFOLK - AA1-138 TAP
OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* SUFFOLK - SUNBURY
OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* SUNBURY - WINFALL
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*3.16*
315134	*1ROAVALA*	*3.67*
315135	*1ROAVALB*	*0.98*
314784	*1WEYRHSB*	*4.03*
901081	*W1-029C*	*5.13*
901082	*W1-029E*	*175.15*
902241	*W2-022 C OP1*	*2.72*
902242	*W2-022 E OP1*	*18.2*
913391	*Y1-086 C*	*1.1*
913392	*Y1-086 E*	*9.14*
916041	*Z1-036 C*	*4.57*
916042	*Z1-036 E*	*156.13*
917121	*Z2-027 C*	*2.02*
917122	*Z2-027 E*	*4.42*
917331	*Z2-043 C*	*0.41*
917332	*Z2-043 E*	*0.9*
917511	*Z2-088 C OP1*	*0.81*
917512	*Z2-088 E OP1*	*6.78*
918411	*AA1-050*	*0.69*
LTF	*AA1-058*	*0.38*
918511	*AA1-065 C OP*	*2.13*
918512	*AA1-065 E OP*	*5.35*
921182	*AA1-067 C*	*1.67*
921183	*AA1-067 E*	*0.71*
918561	*AA1-072 C*	*0.06*

918562	*AA1-072 E*	*0.15*
921552	*AA1-134 C*	*37.58*
921553	*AA1-134 E*	*16.11*
921562	*AA1-135 C*	*10.12*
921563	*AA1-135 E*	*4.34*
921572	*AA1-138 C*	*11.34*
921573	*AA1-138 E*	*4.86*
921752	*AA2-053 C*	*5.63*
921753	*AA2-053 E*	*2.42*
921772	*AA2-059 C*	*7.57*
921773	*AA2-059 E*	*3.48*
921862	*AA2-068 C*	*1.42*
921863	*AA2-068 E*	*0.65*
922512	*AA2-174 C*	*0.26*
922513	*AA2-174 E*	*0.28*
922532	*AA2-178 C*	*25.74*
922533	*AA2-178 E*	*11.03*
922602	*AB1-013 C*	*7.77*
922603	*AB1-013 E*	*51.99*
922882	*AB1-077 C*	*13.09*
922883	*AB1-077 E*	*87.57*
923831	*AB2-022 C*	*10.04*
923832	*AB2-022 E*	*5.41*
923941	*AB2-035 C*	*0.24*
923942	*AB2-035 E*	*0.1*
924381	*AB2-087 C*	*0.58*
924382	*AB2-087 E*	*0.27*
924391	*AB2-088 C*	*0.31*
924392	*AB2-088 E*	*0.15*
924491	*AB2-098 C*	*0.56*
924492	*AB2-098 E*	*0.24*
924501	*AB2-099 C*	*0.54*
924502	*AB2-099 E*	*0.23*
925121	*AB2-169 C OP*	*10.54*
925122	*AB2-169 E OP*	*9.46*
925281	*AB2-186 C*	*1.93*
925282	*AB2-186 E*	*0.83*
925291	*AB2-188 C OP*	*6.34*
925292	*AB2-188 E OP*	*2.85*

Appendix 13

(DVP - DVP) The 6SUNBURY-6SUFFOLK 230 kV line (from bus 314648 to bus 314537 ckt 1) loads from 139.66% to 141.08% (**DC power flow**) of its emergency rating (478 MVA) for the tower line contingency outage of 'LN 269-2087_A'. This project contributes approximately 15.03 MW to the thermal violation.

CONTINGENCY 'LN 269-2087_A'
OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00
OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00
OPEN BUS 314645 /* ISLAND
OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00
OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00
OPEN BUS 314468 /* ISLAND
OPEN BUS 314476 /* ISLAND
OPEN BUS 314550 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*2.47*
314784	*1WEYRHSB*	*3.16*
314643	*3O INLET*	*1.82*
901081	*W1-029C*	*5.25*
901082	*W1-029E*	*179.33*
902241	*W2-022 C OP1*	*2.07*
902242	*W2-022 E OP1*	*13.85*
903520	*W3-066 C1OP1*	*12.11*
903531	*W3-066 C2OP1*	*12.11*
903522	*W3-066 E1OP1*	*81.02*
903532	*W3-066 E2OP1*	*81.02*
913391	*Y1-086 C*	*0.92*
913392	*Y1-086 E*	*7.7*
916041	*Z1-036 C*	*4.14*
916042	*Z1-036 E*	*141.53*
917121	*Z2-027 C*	*1.7*
917122	*Z2-027 E*	*3.72*
921542	*AA1-133 C*	*34.77*

921543	*AA1-133 E*	*14.9*
921552	*AA1-134 C*	*38.48*
921553	*AA1-134 E*	*16.49*
921582	*AA1-139 C*	*52.15*
921583	*AA1-139 E*	*22.35*
921772	*AA2-059 C*	*6.75*
921773	*AA2-059 E*	*3.11*
922532	*AA2-178 C*	*22.02*
922533	*AA2-178 E*	*9.44*
922602	*AB1-013 C*	*6.65*
922603	*AB1-013 E*	*44.48*
922882	*AB1-077 C*	*13.4*
922883	*AB1-077 E*	*89.66*
923831	*AB2-022 C*	*8.07*
923832	*AB2-022 E*	*4.35*
925121	*AB2-169 C OP*	*7.92*
925122	*AB2-169 E OP*	*7.11*
925281	*AB2-186 C*	*1.73*
925282	*AB2-186 E*	*0.74*
925291	*AB2-188 C OP*	*5.43*
925292	*AB2-188 E OP*	*2.44*

Appendix 14

(DVP - DVP) The W1-029-6SUNBURY 230 kV line (from bus 901080 to bus 314648 ckt 1) loads from 144.2% to 145.62% (**DC power flow**) of its emergency rating (478 MVA) for the tower line contingency outage of 'LN 269-2087_A'. This project contributes approximately 15.03 MW to the thermal violation.

CONTINGENCY 'LN 269-2087_A'
OPEN BRANCH FROM BUS 314466 TO BUS 314645 CKT 1 /* 6FENTRES 230.00 - 6SLIGO 230.00
OPEN BRANCH FROM BUS 314645 TO BUS 314647 CKT 1 /* 6SLIGO 230.00 - 6SHAWBRO 230.00
OPEN BUS 314645 /* ISLAND
OPEN BRANCH FROM BUS 314466 TO BUS 314550 CKT 1 /* 6FENTRES 230.00 - 6HICKORY 230.00
OPEN BRANCH FROM BUS 314550 TO BUS 921541 CKT 1 /* 6HICKORY 230.00 - AA1-133 TAP 230.00
OPEN BUS 314468 /* ISLAND
OPEN BUS 314476 /* ISLAND
OPEN BUS 314550 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315292	*1DOMTR78*	*2.47*
314784	*1WEYRHSB*	*3.16*
314643	*3O INLET*	*1.82*
901081	*W1-029C*	*5.25*
901082	*W1-029E*	*179.33*
902241	*W2-022 C OP1*	*2.07*
902242	*W2-022 E OP1*	*13.85*
903520	*W3-066 C1OP1*	*12.11*
903531	*W3-066 C2OP1*	*12.11*
903522	*W3-066 E1OP1*	*81.02*
903532	*W3-066 E2OP1*	*81.02*
913391	*Y1-086 C*	*0.92*
913392	*Y1-086 E*	*7.7*
916041	*Z1-036 C*	*4.14*
916042	*Z1-036 E*	*141.53*
917121	*Z2-027 C*	*1.7*
917122	*Z2-027 E*	*3.72*
921542	*AA1-133 C*	*34.77*

921543	*AA1-133 E*	*14.9*
921552	*AA1-134 C*	*38.48*
921553	*AA1-134 E*	*16.49*
921582	*AA1-139 C*	*52.15*
921583	*AA1-139 E*	*22.35*
921772	*AA2-059 C*	*6.75*
921773	*AA2-059 E*	*3.11*
922532	*AA2-178 C*	*22.02*
922533	*AA2-178 E*	*9.44*
922602	*AB1-013 C*	*6.65*
922603	*AB1-013 E*	*44.48*
922882	*AB1-077 C*	*13.4*
922883	*AB1-077 E*	*89.66*
923831	*AB2-022 C*	*8.07*
923832	*AB2-022 E*	*4.35*
925121	*AB2-169 C OP*	*7.92*
925122	*AB2-169 E OP*	*7.11*
925281	*AB2-186 C*	*1.73*
925282	*AB2-186 E*	*0.74*
925291	*AB2-188 C OP*	*5.43*
925292	*AB2-188 E OP*	*2.44*