Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-015

Franklin 115kV
62MW Capacity / 107MW Energy

August / 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 Southampton County. The installed facilities will have a total capability of 107 MW with 62 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

AB2-015 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new three breaker ring bus switching station that connects at the Franklin 115kV substation.

Option 2 will connect via a new three breaker ring bus switching station that connects at the Watkins Corner 115kV substation.

Cost Summary

The AB2-015 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,500,000
Direct Connection Network Upgrades	$4,500,000
Non Direct Connection Network Upgrades	$ 700,000
Total Costs	**$6,700,000**

In addition, the AB2-015 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$0
Previously Identified Upgrades	$18,615,000
Total Costs	**$18,615,000**

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

Note: Queue project AB2-015 is not expected to have cost responsibility for this network upgrade due to cost allocation rules.

Attachment Facilities

Generation Substation: Install metering and associated Protection Equipment. Estimated Cost $500,000.

Transmission Line: Construct approximately one span of 115 kV Attachment line between the generation substation and the existing Franklin 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.

Direct Connection Cost Estimate

Substation: Establish the new 115 kV AB2-015 Switching Substation (interconnection substation). The estimated cost of this work scope is $4,500,000. . It is estimated to take 24-36 months to complete this work**.**

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. Estimated cost is $700,000 dollars and is estimated to take 24-30 months to complete.

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

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.

Interconnection Customer Requirements

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

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

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

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

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

Revenue Metering and SCADA Requirements

PJM Requirements

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

Option One

Network Impacts

The Queue Project AB2-015 was evaluated as a 107.0 MW (Capacity 62.0 MW) injection at the Franklin 138kV substation in the DVP area. Project AB2-015 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-015 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
259T2003	CONTINGENCY '259T2003' /*_ CHESTERFIELD OPEN BRANCH FROM BUS 314287 TO BUS 314276 CKT 1 /*L259 CHESTERFIELD BASIN OPEN BRANCH FROM BUS 314287 TO BUS 314263 CKT 1 /*L2003 CHESTERFIELD TYLER OPEN BRANCH FROM BUS 314263 TO BUS 314299 CKT 1 /*L2003 TYLER HARROWGATE OPEN BRANCH FROM BUS 314299 TO BUS 314331 CKT 1 /*L2003 HARROWGATE POE OPEN BRANCH FROM BUS 314331 TO BUS 314329 CKT 2 /*POE TX6 230-115 END

Contingency Name	Description
T672B	CONTINGENCY 'T672B' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG END
LN 259-2065	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END
BASIN 230 B#2	CONTINGENCY 'BASIN 230 B#2' /* OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314274 CKT 2 END

Contingency Name	Description
T672B	CONTINGENCY 'T672B' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG END
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 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

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 140_B	CONTINGENCY 'LN 140_B' OPEN BRANCH FROM BUS 921981 TO BUS 314558 CKT 1 /* AA2-088 TAP - 3BOYKINS 115.00 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	LFFB	259T2003	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	99.91	100.52	ER	399	5.38
2	LFFB	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	97.28	97.97	ER	399	6.14
3	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	96.39	97.08	ER	399	6.09
4	BF	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	96.08	96.76	ER	399	6.11
5	LFFB	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	97.43	98.12	ER	399	6.14
6	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314287	314228	1	DC	96.55	97.23	ER	399	6.09
7	BF	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314287	314228	1	DC	96.23	96.91	ER	399	6.11
8	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	107.42	108.16	ER	399	6.56
9	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	120.96	121.7	ER	399	6.56
10	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	121.11	121.85	ER	399	6.56
11	LFFB	259T2003	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	100.08	100.69	ER	399	5.38

PJM baseline project (b2745) will eliminate the identified overloads. The scheduled in service date for b2745 is 06/01/2020.

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.)

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

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

None

Contribution to Previously Identified Overloads

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
12	LFFB	562T563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	102.64	103.38	ER	470	7.73

Note:

- For item #12 please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

Steady-State Voltage Requirements

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

To be determined during Impact Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined during Impact Study.

New System Reinforcements

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

None

Contribution to Previously Identified System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1 – 4, 9	6MESSER-6CHARCTY 230 kV line	rebuild 21.32 miles of the Chesterfield – Lakeside 230kV line	b2745	**$**
#5 – 7, 10, 11	6CHSTF B-6MESSER 230 kV line	rebuild 21.32 miles of the Chesterfield – Lakeside 230kV line	b2745	**$**
#8	6CHARCTY-6LAKESD 230 kV line	rebuild 21.32 miles of the Chesterfield – Lakeside 230kV line	b2745	**$**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#12	6CHSTF B-6BASIN 230 kV line	Rebuild of the Chesterfield-Basin 230kV line	Pending	**$18,615,000**
			Total New Network Upgrades	**$18,615,000**

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
13	N-1	LN 140_B	DVP - DVP	3UNCAMP-3HOLLAND 115 kV line	314539	314527	1	DC	58.67	103.43	ER	239	106.97
14	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	97.02	97.77	ER	470	7.83
15	N-1	LN 140_B	DVP - DVP	3HOLLAND-3SUFFOLK 115 kV line	314527	314536	1	DC	50.22	94.98	ER	239	106.97
16	N-1	LN 68	DVP - DVP	3BOYKINS-3MURPHYS 115 kV line	314558	314589	1	DC	100.69	131.06	ER	124	37.65
17	N-1	LN 68	DVP - DVP	3MAPLETN-3TUNIS 115 kV line	314580	314617	1	DC	85.74	116.1	ER	124	37.65
18	N-1	LN 68	DVP - DVP	3MURPHYS-3MAPLETN 115 kV line	314589	314580	1	DC	89.94	120.3	ER	124	37.65

#	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
19	N-1	LN 68	DVP - DVP	AA2-088 TAP-3BOYKINS 115 kV line	921981	314558	1	DC	58.67	103.43	ER	239	106.97

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 #AB2-105 interconnection of a 107 MW Energy (62 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, 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 AB2-015	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-015	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

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 not 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).

Option Two

Network Impacts

The Queue Project AB2-015 was evaluated as a 107.0 MW (Capacity 62.0 MW) injection at the Watkins Corner 115kV substation in the DVP area. Project AB2-015 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-015 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 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
DVP_P1-2:2056	CONTINGENCY 'DVP_P1-2:2056' OPEN BRANCH FROM BUS 313845 TO BUS 314579 CKT 1 /* 6HATHAWAY 230.00 - 6HORNRTN 230.00 END
5632	CONTINGENCY '5632' /* BOYKINS OPEN BUS 314558 /* BOYKINS 115KV BUS OPEN BUS 314587 /* LINE 56 OPEN BUS 314604 /* LINE 56 END
10832	CONTINGENCY '10832' /* BOYKINS OPEN BUS 314558 /* BOYKINS 115KV BUS OPEN BUS 314589 /* LINE 108 OPEN BUS 314580 /* LINE 108 END
5402_A	CONTINGENCY '5402_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD

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 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
LN 56_A	CONTINGENCY 'LN 56_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 OPEN BUS 314259 /* ISLAND 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	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
1	N-1	LN 2012	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	71.41	72.49	ER	399	4.31
2	N-1	DVP_P1-2:2056	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	63.0	64.47	ER	399	5.86

Note:

- For item #1 please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

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	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
3	LFFB	5632	DVP - DVP	3FRNKLN-3UNCAMP 115 kV line	314524	314539	1	DC	48.76	93.52	ER	239	106.97
4	LFFB	10832	DVP - DVP	3FRNKLN-3UNCAMP 115 kV line	314524	314539	1	DC	48.76	93.52	ER	239	106.97
5	LFFB	5402_A	DVP - DVP	3FRNKLN-3UNCAMP 115 kV line	314524	314539	1	DC	59.11	90.82	ER	239	75.79
6	LFFB	5632	DVP - DVP	3HOLLAND-3SUFFOLK 115 kV line	314527	314536	1	DC	50.22	94.98	ER	239	106.97

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
7	LFFB	10832	DVP - DVP	3HOLLAND-3SUFFOLK 115 kV line	314527	314536	1	DC	50.22	94.98	ER	239	106.97
8	LFFB	5402_A	DVP - DVP	3HOLLAND-3SUFFOLK 115 kV line	314527	314536	1	DC	59.83	91.55	ER	239	75.79
9	LFFB	10832	DVP - DVP	3UNCAMP-3HOLLAND 115 kV line	314539	314527	1	DC	58.67	103.43	ER	239	106.97
10	LFFB	5632	DVP - DVP	3UNCAMP-3HOLLAND 115 kV line	314539	314527	1	DC	58.67	103.43	ER	239	106.97
11	LFFB	5402_A	DVP - DVP	3UNCAMP-3HOLLAND 115 kV line	314539	314527	1	DC	68.33	100.04	ER	239	75.79
12	LFFB	5632	DVP - DVP	3WATKINS-3FRNKLN 115 kV line	314541	314524	1	DC	48.59	85.86	ER	287	106.97
13	LFFB	10832	DVP - DVP	3WATKINS-3FRNKLN 115 kV line	314541	314524	1	DC	48.59	85.86	ER	287	106.97
14	LFFB	5402_A	DVP - DVP	3WATKINS-3FRNKLN 115 kV line	314541	314524	1	DC	57.2	83.61	ER	287	75.79

Note:

- For item #3 please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.
- For item #6 please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.
- For item #9 please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.
- For item #12 please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

No

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

No

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	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
15	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	84.98	86.89	ER	164	6.95

Steady-State Voltage Requirements

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

To be determined during Impact Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined during Impact Study.

Potential Congestion due to Local Energy Deliverability

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

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
16	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	97.28	98.03	ER	470	7.84
17	N-1	LN 56_A	DVP - DVP	3UNCAMP-3HOLLAND 115 kV line	314539	314527	1	DC	68.07	99.63	ER	239	75.44
18	N-1	LN 68	DVP - DVP	3BOYKINS-3MURPHYS 115 kV line	314558	314589	1	DC	100.69	131.06	ER	124	37.65
19	N-1	LN 68	DVP - DVP	3MAPLETN-3TUNIS 115 kV line	314580	314617	1	DC	85.82	116.19	ER	124	37.65
20	N-1	LN 68	DVP - DVP	3MURPHYS-3MAPLETN 115 kV line	314589	314580	1	DC	89.94	120.3	ER	124	37.65
21	N-1	LN 68	DVP - DVP	AA2-088 TAP-3BOYKINS 115 kV line	921981	314558	1	DC	58.67	103.43	ER	124	106.97

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 #AB2-015 interconnection of a 107 MW Energy (62 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 2019 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, 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):
System Normal – No deficiencies identified
Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Analysis)
Bus Fault - No deficiencies identified
Line Stuck Breaker - No deficiencies identified
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 AB2-015	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None

CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-015	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

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 not impact ITO's import or export capability.

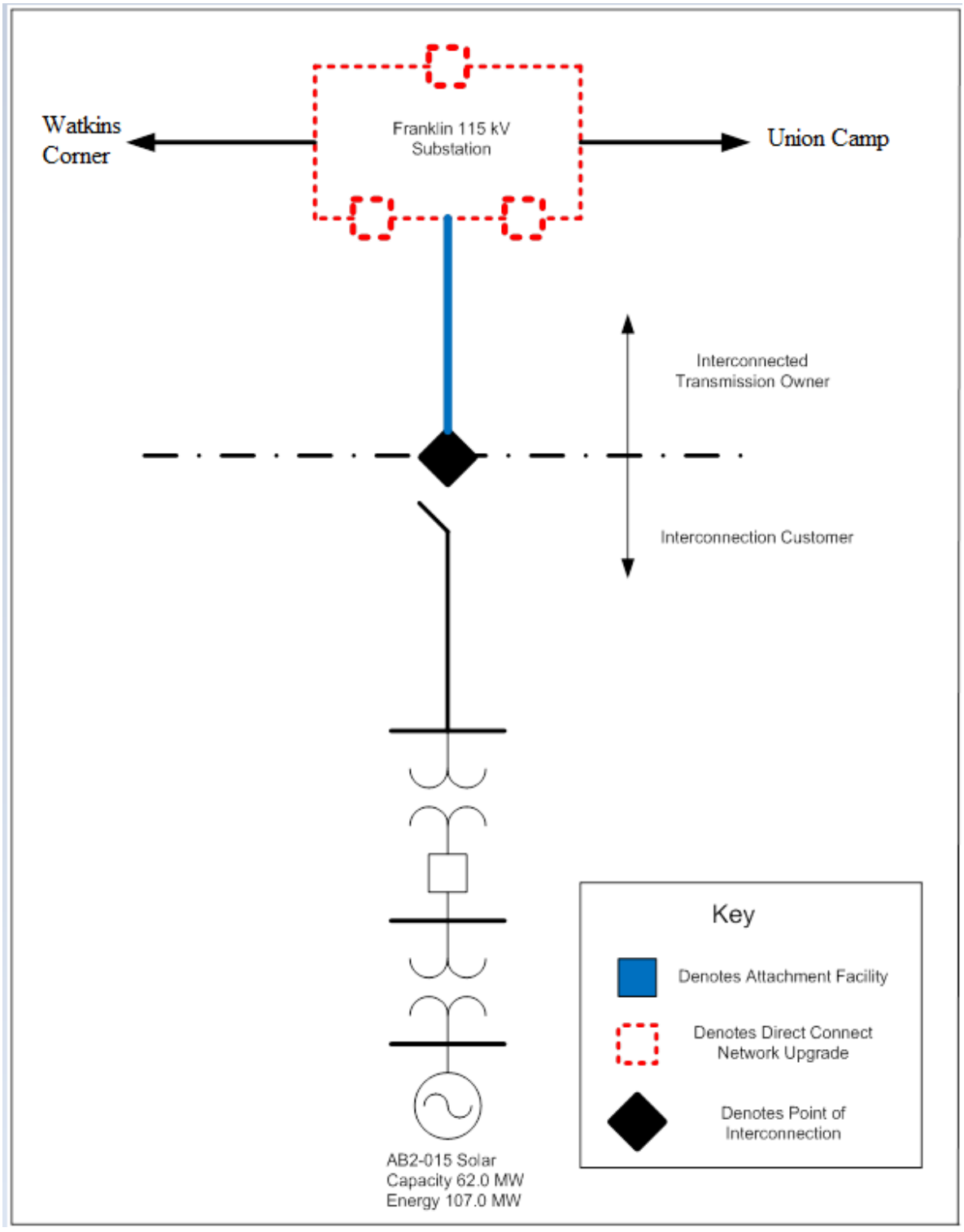
Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

Attachment 1.

System Configuration



Flowgate Appendices – Option 1

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 6CHSTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 102.64% to 103.38% (**DC power flow**) of its emergency rating (470 MVA) for the line fault with failed breaker contingency outage of '562T563'. This project contributes approximately 7.73 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*	*37.56*
315077	*1HOPHCF1*	*1.99*
315078	*1HOPHCF2*	*1.99*
315079	*1HOPHCF3*	*1.99*
315080	*1HOPHCF4*	*3.02*
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*	*15.91*
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*	*16.18*
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*	*3.18*
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*	*1.66*
918512	*AA1-065 E OP*	*1.81*
921182	*AA1-067 C*	*0.67*
921183	*AA1-067 E*	*0.29*
918562	*AA1-072 E*	*0.07*
921552	*AA1-134 C*	*3.41*
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*	*4.55*
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*	*6.05*
922523	*AA2-177 E*	*2.59*
922532	*AA2-178 C*	*3.58*
922533	*AA2-178 E*	*1.53*
922602	*AB1-013 C*	*1.08*
922603	*AB1-013 E*	*7.22*
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*	*7.95*

922922	*AB1-081 C OP*	*3.64*
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.*
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*	*4.29*
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*	*7.76*
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*	*2.78*
924951	*AB2-150 C OP*	*1.41*
924952	*AB2-150 E OP*	*2.3*
924961	*AB2-152*	*14.64*
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*	*3.44*
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*	*3.37*
925171	*AB2-174 C OP*	*3.8*
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*

Appendix 2

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 71.41% to 72.49% (**DC power flow**) of its emergency rating (399 MVA) for the single line contingency outage of 'LN 2012'. This project contributes approximately 4.31 MW to the thermal violation.

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

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*1.9*
315132	*1EDGECMB*	*1.9*
315139	*1GASTONA*	*9.*
315141	*1GASTONB*	*9.*
315159	*1KERR 2*	*0.6*
315161	*1KERR 4*	*0.59*
315162	*1KERR 5*	*0.59*
315163	*1KERR 6*	*0.59*
315164	*1KERR 7*	*0.59*
315126	*1ROARAP2*	*1.72*
315128	*1ROARAP4*	*1.65*
315134	*1ROAVALA*	*13.15*
315135	*1ROAVALB*	*3.51*
315136	*1ROSEMG1*	*5.97*
315138	*1ROSEMG2*	*2.8*
315137	*1ROSEMS1*	*3.7*
315115	*1SHAMPT1*	*0.89*
900671	*V4-068 C*	*0.06*
902241	*W2-022 C OP1*	*0.59*
917331	*Z2-043 C*	*0.28*
917341	*Z2-044 C*	*0.25*
917511	*Z2-088 C OP1*	*0.67*
917591	*Z2-099 C*	*0.11*
918411	*AA1-050*	*0.56*
LTF	*AA1-058*	*0.36*
921162	*AA1-063AC*	*7.41*
921182	*AA1-067 C*	*0.9*
918561	*AA1-072 C*	*0.04*

921562	*AA1-135 C*	*4.*
921752	*AA2-053 C*	*8.07*
921762	*AA2-057 C*	*6.56*
921862	*AA2-068 C*	*2.02*
920021	*AA2-086 C*	*0.06*
921982	*AA2-088 C*	*3.59*
922032	*AA2-105 C*	*2.34*
922072	*AA2-113 C*	*2.34*
922442	*AA2-165 C*	*0.89*
922472	*AA2-169 C*	*1.45*
922512	*AA2-174 C*	*0.37*
922722	*AB1-053 C*	*2.47*
922732	*AB1-054 C*	*3.89*
922922	*AB1-081 C OP*	*8.71*
923262	*AB1-132 C OP*	*35.07*
923801	*AB2-015 C OP*	*4.31*
923911	*AB2-031 C OP*	*7.48*
923941	*AB2-035 C*	*0.29*
923991	*AB2-040 C OP*	*25.45*
924151	*AB2-059 C OP*	*11.03*
924381	*AB2-087 C*	*0.27*
924391	*AB2-088 C*	*0.38*
924401	*AB2-089 C*	*1.01*
924491	*AB2-098 C*	*0.3*
924501	*AB2-099 C*	*0.29*
924511	*AB2-100 C*	*37.39*
924761	*AB2-128 C*	*32.03*
925121	*AB2-169 C OP*	*2.49*
925141	*AB2-171 C OP*	*2.15*
925171	*AB2-174 C OP*	*23.44*

Appendix 3

(DVP - DVP) The 3FRNKLN-3UNCAMP 115 kV line (from bus 314524 to bus 314539 ckt 1) loads from 48.76% to 93.52% (**DC power flow**) of its emergency rating (239 MVA) for the line fault with failed breaker contingency outage of '5632'. This project contributes approximately 106.97 MW to the thermal violation.

CONTINGENCY '5632' /* BOYKINS
OPEN BUS 314558 /* BOYKINS 115KV BUS
OPEN BUS 314587 /* LINE 56
OPEN BUS 314604 /* LINE 56
END

Bus Number	*Bus Name*	*Full Contribution*
315115	*1SHAMPT1*	*12.38*
314541	*3WATKINS*	*4.*
921982	*AA2-088 C*	*37.99*
921983	*AA2-088 E*	*61.98*
923801	*AB2-015 C OP*	*61.98*
923802	*AB2-015 E OP*	*44.99*
925141	*AB2-171 C OP*	*28.49*
925142	*AB2-171 E OP*	*46.49*

Appendix 4

(DVP - DVP) The 3HOLLAND-3SUFFOLK 115 kV line (from bus 314527 to bus 314536 ckt 1) loads from 50.22% to 94.98% (**DC power flow**) of its emergency rating (239 MVA) for the line fault with failed breaker contingency outage of '5632'. This project contributes approximately 106.97 MW to the thermal violation.

CONTINGENCY '5632' /* BOYKINS
OPEN BUS 314558 /* BOYKINS 115KV BUS
OPEN BUS 314587 /* LINE 56
OPEN BUS 314604 /* LINE 56
END

Bus Number	*Bus Name*	*Full Contribution*
315115	*1SHAMPT1*	*12.38*
314539	*3UNCAMP*	*14.*
314541	*3WATKINS*	*4.*
907092	*X1-038 E*	*34.99*
921982	*AA2-088 C*	*37.99*
921983	*AA2-088 E*	*61.98*
923801	*AB2-015 C OP*	*61.98*
923802	*AB2-015 E OP*	*44.99*
925141	*AB2-171 C OP*	*28.49*
925142	*AB2-171 E OP*	*46.49*

Appendix 5

(DVP - DVP) The 3UNCAMP-3HOLLAND 115 kV line (from bus 314539 to bus 314527 ckt 1) loads from 58.67% to 103.43% (**DC power flow**) of its emergency rating (239 MVA) for the line fault with failed breaker contingency outage of '10832'. This project contributes approximately 106.97 MW to the thermal violation.

```
CONTINGENCY '10832'                    /* BOYKINS
  OPEN BUS 314558                      /* BOYKINS 115KV BUS
  OPEN BUS 314589                      /* LINE 108
  OPEN BUS 314580                      /* LINE 108
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315115	*1SHAMPT1*	*12.38*
314539	*3UNCAMP*	*14.*
314541	*3WATKINS*	*4.*
907092	*X1-038 E*	*34.99*
921982	*AA2-088 C*	*37.99*
921983	*AA2-088 E*	*61.98*
923801	*AB2-015 C OP*	*61.98*
923802	*AB2-015 E OP*	*44.99*
925141	*AB2-171 C OP*	*28.49*
925142	*AB2-171 E OP*	*46.49*

Appendix 6

(DVP - DVP) The 3WATKINS-3FRNKLN 115 kV line (from bus 314541 to bus 314524 ckt 1) loads from 48.59% to 85.86% (**DC power flow**) of its emergency rating (287 MVA) for the line fault with failed breaker contingency outage of '5632'. This project contributes approximately 106.97 MW to the thermal violation.

```
CONTINGENCY '5632'                    /* BOYKINS
  OPEN BUS 314558                     /* BOYKINS 115KV BUS
  OPEN BUS 314587                     /* LINE 56
  OPEN BUS 314604                     /* LINE 56
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315115	*1SHAMPT1*	*12.38*
314541	*3WATKINS*	*4.*
921982	*AA2-088 C*	*37.99*
921983	*AA2-088 E*	*61.98*
923801	*AB2-015 C OP*	*61.98*
923802	*AB2-015 E OP*	*44.99*
925141	*AB2-171 C OP*	*28.49*
925142	*AB2-171 E OP*	*46.49*