Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-068

Everetts – Greenville 230kV
33 MW Capacity / 50 MW Energy

Revised September / 2018

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 Greenville (Pitt County, NC). The installed facilities will have a total capability of 50 MW with 33 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2020. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AD2-068 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Everetts – Greenville (Duke) 230kV line # 218.

Cost Summary

The AD2-068 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,800,000
Direct Connection Network Upgrades	$6,300,000
Non Direct Connection Network Upgrades	$1,000,000
Total Costs	**$9,1,00,000**

In addition, the AD2-068 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$0
Previously Identified Upgrades	$88,950,000
Total Costs	**$88,950,000**

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

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. For New System Upgrades, the allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

The Feasibility Study is used to make a preliminary determination of the type and scope of Attachment Facilities, Local Upgrades, and Network Upgrades that will be necessary to accommodate the Interconnection Request and to provide the Interconnection Customer a preliminary estimate of the time that will be required to construct any necessary facilities and upgrades and the Interconnection Customer's cost responsibility. The System Impact Study provides refined and comprehensive estimates of cost responsibility and construction lead times for new facilities and system upgrades. Facilities Studies will include, commensurate with the degree of engineering specificity as provided in the Facilities Study Agreement, good faith estimates of the cost, determined in accordance with Section 217 of the Tariff,

(a) to be charged to each affected New Service Customer for the Facilities and System Upgrades that are necessary to accommodate this queue project;
(b) the time required to complete detailed design and construction of the facilities and upgrades; and
(c) a description of any site-specific environmental issues or requirements that could reasonably be anticipated to affect the cost or time required to complete construction of such facilities and upgrades.

Attachment Facilities

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

Transmission: Construct approximately one span of 230 kV Attachment line between the generation substation and a new AD2-068 Switching Station. The estimated cost for this work is $1,200,000.

The estimated total cost of the Attachment Facilities is $1,800,000. It is estimated to take 18-24 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: Establish the new 230 kV AD2-068 Switching Substation (interconnection substation). The estimated cost of this work scope is $6,300,000. 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 $1,000,000 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.

System Reinforcement

Violation #	Upgrade Description	Upgrade Cost
# 1 – 4	Replace wave trap at Clubhouse Substation to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 12-16 months to engineer and construct.	**$150,000**
# 5, 6	Wreck and rebuild the Earleys – Nucor 230kV line #246 of 14 miles to increase its line rating to 1047 MVA (normal), 1047 MVA (emergency), and 1204 MVA (load dump). It is estimated to take 30-36 months to engineer, permit, and construct. A SCC and a VA CPCN is required.	**$37,800,000**
# 7 – 9	Wreck and rebuild the Lakeview – AB2-100 tap 230kV line of 16 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 44-48 months to engineer, permit, and construct. A VA CPCN is required. A certificate from the NC PUC will most likely be required.	**$40,000,000**
# 10 – 12	Wreck and rebuild the AB2-100 TAP-Clubhouse 230kV line of 2 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 24-28 months to engineer, permit and construct. A VA CPCN is required.	**$5,000,000**
# 13, 14	Wreck and rebuild the AD2-068 tap – Greenville 230kV tie line #218 of 3 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to cost $6,000,000 and 44-48 months to engineer, permit, and construct. A certificate from the NC PUC will most likely be required. An affected systems study will need to be completed with Duke/Progress to determine upgrades required on the Duke/Progress system.	**$6,000,000**
	Total Network Upgrades	**$88,950,000**

Interconnection Customer Requirements

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

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

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

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

Revenue Metering and SCADA Requirements

PJM Requirements

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

Meteorological Data Reporting Requirement

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

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

Network Impacts

The Queue Project AD2-068 was evaluated as a 50.0 MW (Capacity 33.0 MW) injection at the tap of the Everetts – Greenville 230kV line in the VAP area. Project AD2-068 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-068 was studied with a commercial probability of 53%. Potential network impacts were as follows:

PJM assessed the impact of the proposed Queue Project as an injection into the ITO, for compliance with NERC Reliability Criteria. The system was assessed using the summer 2021 RTEP case. When performing analysis, ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under single contingency (normal and stressed system conditions). A full listing of the 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 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. The results of these studies are discussed in more detail below.

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
DVP_P1-2: LN 130-A	CONTINGENCY 'DVP_P1-2: LN 130-A' OPEN BRANCH FROM BUS 314562 TO BUS 314570 CKT 1 /* 3CLUBHSE 115.00 - 3METCATP 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314572 CKT 1 /* 3METCATP 115.00 - 3EMPORIA 115.00 OPEN BRANCH FROM BUS 314570 TO BUS 314588 CKT 1 /* 3METCATP 115.00 - 3METCALF 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 925170 CKT 1 /* 3EMPORIA 115.00 - AB2-174 TAP 115.00 OPEN BRANCH FROM BUS 314572 TO BUS 314863 CKT 1 /* 3EMPORIA 115.00 - 3EMPOR_1 115.00 OPEN BUS 314570 /* ISLAND OPEN BUS 314572 /* ISLAND OPEN BUS 314588 /* ISLAND END

Contingency Name	Description
DVP_P1-2: LN 2126	CONTINGENCY 'DVP_P1-2: LN 2126' OPEN BRANCH FROM BUS 314203 TO BUS 314594 CKT 1 /* 6MACKEYS 230.00 - 6PLYMOTH 230.00 OPEN BRANCH FROM BUS 314594 TO BUS 314616 CKT 1 /* 6PLYMOTH 230.00 - 6TRWBRDG 230.00 OPEN BUS 314594 /* ISLAND END
DVP_P1-2: LN 2131_FSA	CONTINGENCY 'DVP_P1-2: LN 2131_FSA' OPEN BRANCH FROM BUS 314203 TO BUS 314637 CKT 1 /* 6MACKEYS 230.00 - 6EDENTON 230.00 OPEN BRANCH FROM BUS 314637 TO BUS 916040 CKT 1 /* 6EDENTON 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* ADDED BY JT FOR FULL FSA TAP REMOVAL OPEN BUS 314637 /* ISLAND END
DVP_P1-2: LN 2131A	CONTINGENCY 'DVP_P1-2: LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END
DVP_P1-2: LN 218-A	CONTINGENCY 'DVP_P1-2: LN 218-A' OPEN BRANCH FROM BUS 304451 TO BUS 936530 CKT 1 /* 6GREENVILE 230.00 - AD2-068 TAP 230.00 END
DVP_P1-2: LN 246	CONTINGENCY 'DVP_P1-2: LN 246' OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND OPEN BUS 314590 /* ISLAND END
DVP_P4-2: 2020T2144	CONTINGENCY 'DVP_P4-2: 2020T2144' /* WINFALL 230 KV 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: 6ECITYDP2 230.00 OPEN BUS 314639 /* ISLAND: 6TANGLEW 230.00 OPEN BUS 913391 /* ISLAND: Y1-086 C 230.00 OPEN BUS 913392 /* ISLAND: Y1-086 E 230.00 OPEN BUS 917121 /* ISLAND: Z2-027 C 230.00 OPEN BUS 917122 /* ISLAND: Z2-027 E 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 901080 CKT 1 /* 6WINFALL 230.00 - W1-029 230.00 END

Contingency Name	Description
DVP_P4-2: 24662	CONTINGENCY 'DVP_P4-2: 24662' /* EARLEYS OPEN BRANCH FROM BUS 314568 TO BUS 314569 CKT 1 /* TX. #3 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 314537 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 246 - NUCOR END
DVP_P4-2: 24682	CONTINGENCY 'DVP_P4-2: 24682' /* 24682 @ SUFFOLK OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* SUFFOLK - NUCOR TAP OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* NUCOR TAP - EARLEYS OPEN BRANCH FROM BUS 314536 TO BUS 314537 CKT 2 /* SUFFOLK 230-115 TX#5 OPEN BRANCH FROM BUS 314928 TO BUS 314537 CKT 2 /* SUFFOLK 500-230 TX#8 END
DVP_P4-2: 246T2034	CONTINGENCY 'DVP_P4-2: 246T2034' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 314537 CKT 1 /* 246 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 933990 CKT 1 /* 2034 END
DVP_P4-2: 246T247	CONTINGENCY 'DVP_P4-2: 246T247' /* SUFFOLK 230 KV OPEN BRANCH FROM BUS 314537 TO BUS 314575 CKT 1 /* 6SUFFOLK 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00 OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00 OPEN BUS 314575 /* ISLAND: 6NUCO TP 230.00 OPEN BUS 314590 /* ISLAND: 6NUCOR 230.00 OPEN BRANCH FROM BUS 314537 TO BUS 314648 CKT 1 /* 6SUFFOLK 230.00 - 6SUNBURY 230.00 OPEN BRANCH FROM BUS 314648 TO BUS 901080 CKT 1 /* 6SUNBURY 230.00 - W1-029 230.00 OPEN BUS 314648 /* ISLAND: 6SUNBURY 230.00 END
DVP_P7-1: LN 2058-2181	CONTINGENCY 'DVP_P7-1: LN 2058-2181' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 END

Summer Peak Analysis - 2021

Generator Deliverability

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

None

Multiple Facility Contingency

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

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	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	LFFB	DVP_P4-2: 246T247	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	132.72	133.25	LDR	637	7.45	1

#	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	DVP_P4-2: 246T2034	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	127.39	128.01	LDR	637	7.92	
3	LFFB	DVP_P4-2: 24662	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	126.03	126.53	LDR	637	7.15	
4	LFFB	DVP_P4-2: 24682	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	125.93	126.44	LDR	637	7.18	
5	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	101.64	102.84	ER	572	6.81	2
6	N-1	DVP_P1-2: LN 2131_FSA	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	101.39	102.58	ER	572	6.82	
7	LFFB	DVP_P4-2: 246T247	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	127.19	127.88	LDR	459	7.06	3
8	N-1	DVP_P1-2: LN 246	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	106.5	107.7	ER	375	4.47	
9	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	101.32	102.37	ER	375	3.95	
10	LFFB	DVP_P4-2: 246T247	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	140.99	141.69	LDR	459	7.06	4
11	N-1	DVP_P1-2: LN 246	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	117.84	119.03	ER	375	4.47	
12	N-1	DVP_P1-2: LN 2126	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	110.93	111.99	ER	375	3.95	
13	DCTL	DVP_P7-1: LN 2058-2181	DVP - CPLE	AD2-068 TAP-6GREENVILE T 230 kV line	936530	304451	1	DC	129.79	135.19	ER	478	25.79	5

#	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
14	LFFB	DVP_P4-2: 2020T2144	DVP - CPLE	AD2-068 TAP-6GREENVILE T 230 kV line	936530	304451	1	DC	111.39	115.32	ER	478	26.06	

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	6CLUBHSE-6SAPONY 230 kV line	Replace wave trap at Clubhouse Substation to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 12-16 months to engineer and construct.	Pending	**$150,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 5, 6	6EARLEYS-6NUCO TP 230 kV line	Wreck and rebuild the Earleys – Nucor 230kV line #246 of 14 miles to increase its line rating to 1047 MVA (normal), 1047 MVA (emergency), and 1204 MVA (load dump). It is estimated to take 30-36 months to engineer, permit, and construct. A SCC and a VA CPCN is required.	Pending	**$37,800,000**
# 7 – 9	6LAKEVEW-AB2-100 TAP 230 kV line	Wreck and rebuild the Lakeview – AB2-100 tap 230kV line of 16 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 44-48 months to engineer, permit, and construct. A VA CPCN is required. A certificate from the NC PUC will most likely be required.	Pending	**$40,000,000**
# 10 – 12	AB2-100 TAP-6CLUBHSE 230 kV line	Wreck and rebuild the AB2-100 TAP-Clubhouse 230kV line of 2 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to take 24-28 months to engineer, permit and construct. A VA CPCN is required.	Pending	**$5,000,000**
# 13, 14	AD2-068 TAP-6GREENVILE T 230 kV line	Wreck and rebuild the AD2-068 tap – Greenville 230kV tie line #218 of 3 miles to increase its line rating to 722 MVA (normal), 722 MVA (emergency), and 830 MVA (load dump). It is estimated to cost $6,000,000 and 44-48 months to engineer, permit, and construct. A certificate from the NC PUC will most likely be required. An affected systems study will need to be completed with Duke/Progress to determine upgrades required on the Duke/Progress system.	Pending	**$6,000,000**
			Total New Network Upgrades	**$88,950,000**

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
15	N-1	DVP_P1-2: LN 218-A	DVP - CPLE	6MORNSTR-6ROCKYMT230T 230 kV line	313845	304222	1	DC	98.36	100.18	ER	374	6.82
16	N-1	DVP_P1-2: LN 246	DVP - DVP	6MACKEYS-6EDENTON 230 kV line	314203	314637	1	DC	106.44	107.51	ER	731	7.82
17	N-1	DVP_P1-2: LN 246	DVP - DVP	6SAPONY-6CARSON 230 kV line	314435	314282	1	DC	117.57	118.05	ER	679	7.15
18	N-1	DVP_P1-2: LN 246	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	133.95	134.49	ER	599	7.16
19	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	DC	163.95	165.63	ER	572	10.32
20	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6NUCO TP-6SUFFOLK 230 kV line	314575	314537	1	DC	157.93	159.61	ER	572	10.32
21	N-1	DVP_P1-2: LN 2131A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	155.39	156.11	ER	375	5.99
22	Non	Non	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	DC	118.37	119.76	NR	375	5.19
23	N-1	DVP_P1-2: LN 246	DVP - DVP	6EDENTON-Z1-036 TAP 230 kV line	314637	916040	1	DC	102.02	103.09	ER	733	7.82
24	N-1	DVP_P1-2: LN 246	DVP - DVP	6S HERTFORD-6WINFALL 230 kV line	314662	314651	1	DC	130.01	131.08	ER	733	7.81
25	N-1	DVP_P1-2: LN 246	DVP - DVP	Z1-036 TAP-6S HERTFORD 230 kV line	916040	314662	1	DC	131.66	132.72	ER	733	7.81
26	N-1	DVP_P1-2: LN 130-A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	166.22	167.71	ER	375	5.58

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
27	Non	Non	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	DC	133.85	135.24	NR	375	5.19
28	N-1	DVP_P1-2: LN 2131A	DVP - CPLE	AD2-068 TAP-6GREENVILE T 230 kV line	936530	304451	1	DC	112.1	115.71	ER	478	26.05

Light Load Analysis

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

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

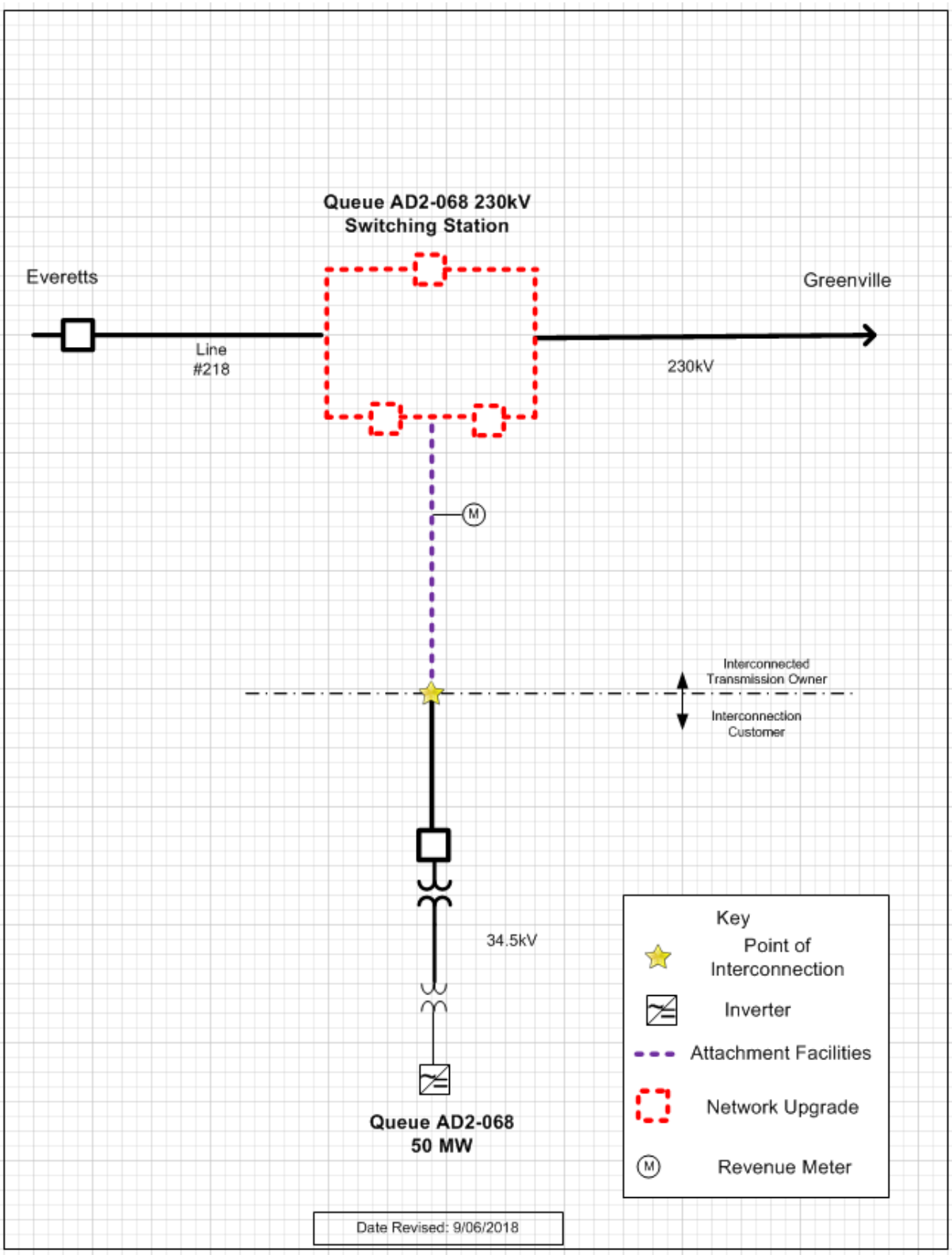
Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

An affected system study will need to be completed with Duke since this interconnection has been requested on a tie line. The Feasibility Study identified issues on a tie lines between the VEPCO and Duke/Progress transmission systems. It is expected that an Affected System Study will be required with Duke / Progress to determine the upgrade necessary to the:

- Everetts - AD2-068 - Greenville 230kV line

Attachment 1.

System Configuration



Attachment 2.

Flowgate Appendices

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 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 132.72% to 133.25% (**DC power flow**) of its load dump rating (637 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 7.45 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	8.64
315151	1BUGGS 2	8.64
315131	1EDGECMA	10.81
315132	1EDGECMB	10.81
315139	1GASTONA	7.18
315141	1GASTONB	7.18
315126	1ROARAP2	2.57
315128	1ROARAP4	2.47
315136	1ROSEMG1	4.85
315138	1ROSEMG2	2.27
315137	1ROSEMS1	3.01
314557	3BETHELC	0.9
314554	3BTLEBRO	0.91
314566	3CRESWEL	1.69
314572	3EMPORIA	1.04
314578	3HORNRTN	5.4
314582	3KELFORD	1.09
314704	3LAWRENC	0.78
314603	3SCOT NK	4.39

314617	3TUNIS	1.
314541	3WATKINS	0.48
314620	6CASHIE	0.87
314574	6EVERETS	2.55
314594	6PLYMOTH	0.72
932631	AC2-084 C	11.81
932632	AC2-084 E	5.82
933991	AD1-023 C	12.48
933992	AD1-023 E	6.8
934201	AD1-047 C	17.56
934202	AD1-047 E	11.71
934231	AD1-050 C	5.08
934232	AD1-050 E	2.78
934331	AD1-057 C O1	15.84
934332	AD1-057 E O1	8.45
934521	AD1-076 C O1	47.19
934522	AD1-076 E O1	24.03
LTF	AD1-120	4.44
LTF	AD1-121	4.42
936261	AD2-033 C	9.73
936262	AD2-033 E	6.49
936361	AD2-046 C O1	8.38
936362	AD2-046 E O1	3.85
936401	AD2-051 C O1	11.34
936402	AD2-051 E O1	4.87
936481	AD2-063 C O1	11.53
936482	AD2-063 E O1	7.68
936531	AD2-068 C	4.92
936532	AD2-068 E	2.53
936701	AD2-089 C	8.13
936702	AD2-089 E	5.42
936711	AD2-090 C O1	5.56
936712	AD2-090 E O1	3.71
LTF	AD2-099	3.35
937441	AD2-195 C	8.63
937442	AD2-195 E	3.72
LTF	CARR	0.12
LTF	CBM-S1	5.43
LTF	CBM-S2	10.9
LTF	CBM-W1	12.02
LTF	CBM-W2	29.4
LTF	CIN	2.7
LTF	CPLE	3.68
LTF	G-007	0.77
LTF	IPL	1.72

LTF	LGEE	0.58
LTF	MEC	6.07
LTF	MECS	2.72
LTF	O-066	4.92
LTF	RENSSELAER	0.09
LTF	ROSETON	0.68
900671	V4-068 C	0.11
900672	V4-068 E	0.33
LTF	WEC	0.74
917331	Z2-043 C	0.57
917332	Z2-043 E	1.31
917341	Z2-044 C	0.3
917342	Z2-044 E	0.7
917511	Z2-088 C OP1	1.01
917512	Z2-088 E OP1	4.28
918411	AA1-050	0.85
918491	AA1-063AC OP	2.23
918492	AA1-063AE OP	5.65
918511	AA1-065 C OP	2.12
918512	AA1-065 E OP	5.62
918531	AA1-067 C	0.33
918532	AA1-067 E	0.76
918561	AA1-072 C	0.09
918562	AA1-072 E	0.22
919691	AA2-053 C	2.58
919692	AA2-053 E	5.95
919701	AA2-057 C	1.68
919702	AA2-057 E	4.51
LTF	AA2-074	2.5
920041	AA2-088 C	1.17
920042	AA2-088 E	10.3
920591	AA2-165 C	0.23
920592	AA2-165 E	0.6
920671	AA2-174 C	0.12
920672	AA2-174 E	0.69
920691	AA2-178 C	6.77
920692	AA2-178 E	2.9
930051	AB1-013 C	2.04
930052	AB1-013 E	13.67
930401	AB1-081 C	10.25
930402	AB1-081 E	4.39
930861	AB1-132 C	29.52
930862	AB1-132 E	12.65
931231	AB1-173 C	4.94
931232	AB1-173 E	2.31

931241	AB1-173AC	4.94
931242	AB1-173AE	2.31
923801	AB2-015 C O1	5.47
923802	AB2-015 E O1	4.49
923911	AB2-031 C O1	4.9
923912	AB2-031 E O1	2.41
923941	AB2-035 C	0.38
923942	AB2-035 E	0.16
923991	AB2-040 C O1	16.1
923992	AB2-040 E O1	13.17
924021	AB2-043 C O1	2.67
924022	AB2-043 E O1	4.39
924151	AB2-059 C O1	12.08
924152	AB2-059 E O1	6.22
924161	AB2-060 C O1	7.59
924162	AB2-060 E O1	3.57
924301	AB2-077 C O1	1.68
924302	AB2-077 E O1	1.12
924311	AB2-078 C O1	1.68
924312	AB2-078 E O1	1.12
924321	AB2-079 C O1	1.68
924322	AB2-079 E O1	1.12
924391	AB2-088 C	0.49
924392	AB2-088 E	0.23
924401	AB2-089 C	2.3
924402	AB2-089 E	1.19
924411	AB2-090 C	3.37
924412	AB2-090 E	1.73
924491	AB2-098 C	0.59
924492	AB2-098 E	0.25
924501	AB2-099 C	0.73
924502	AB2-099 E	0.31
924511	AB2-100 C	35.9
924512	AB2-100 E	17.68
925121	AB2-169 C	6.14
925122	AB2-169 E	5.51
925171	AB2-174 C O1	16.16
925172	AB2-174 E O1	14.62
925221	AB2-176 C	1.39
925222	AB2-176 E	0.59
925291	AB2-188 C O1	1.67
925292	AB2-188 E O1	0.75
925591	AC1-034 C	7.83
925592	AC1-034 E	5.9
925611	AC1-036 C	0.64

925612	AC1-036 E	1.04
925781	AC1-054 C	8.28
925782	AC1-054 E	3.81
926071	AC1-086 C	43.47
926072	AC1-086 E	19.78
926201	AC1-098 C	8.28
926202	AC1-098 E	4.94
926211	AC1-099 C	2.78
926212	AC1-099 E	1.63
926771	AC1-163 C	2.41
926772	AC1-163 E	1.13
927021	AC1-189 C	9.38
927022	AC1-189 E	4.67
927141	AC1-208 C	13.11
927142	AC1-208 E	5.82

Appendix 2

(DVP - DVP) The 6EARLEYS-6NUCO TP 230 kV line (from bus 314569 to bus 314575 ckt 1) loads from 101.64% to 102.84% (**DC power flow**) of its emergency rating (572 MVA) for the single line contingency outage of 'DVP_P1-2: LN 2131A'. This project contributes approximately 6.81 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 2131A'
OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00
OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00
OPEN BUS 314662 /* ISLAND
END

Bus Number	Bus Name	Full Contribution
315294	1DOMTR10	4.52
315292	1DOMTR78	3.05
315293	1DOMTR9	2.49
315131	1EDGECMA	9.02
315132	1EDGECMB	9.02
315139	1GASTONA	3.69
315141	1GASTONB	3.69
315159	1KERR 2	0.81
315163	1KERR 6	0.79
315164	1KERR 7	0.79
315126	1ROARAP2	1.5
315128	1ROARAP4	1.44
315136	1ROSEMG1	2.6
315138	1ROSEMG2	1.22
315137	1ROSEMS1	1.61
314704	3LAWRENC	0.21
932631	AC2-084 C	11.32
933991	AD1-023 C	27.83
934201	AD1-047 C	6.39
934231	AD1-050 C	2.75
934331	AD1-057 C O1	10.19
934521	AD1-076 C O1	112.88
LTF	AD1-120	4.28
LTF	AD1-121	4.24
936401	AD2-051 C O1	16.62
936531	AD2-068 C	6.81

936701	AD2-089 C	8.51
LTF	AD2-099	3.34
937441	AD2-195 C	17.93
LTF	CARR	0.08
LTF	CBM-S1	5.28
LTF	CBM-S2	10.69
LTF	CBM-W1	11.81
LTF	CBM-W2	28.66
LTF	CIN	2.64
LTF	CPLE	3.68
LTF	IPL	1.69
LTF	LGEE	0.57
LTF	MEC	5.93
LTF	MECS	2.71
LTF	RENSSELAER	0.07
LTF	ROSETON	0.48
900671	V4-068 C	0.11
LTF	WEC	0.73
916041	Z1-036 C	2.55
917331	Z2-043 C	0.72
917341	Z2-044 C	0.26
917511	Z2-088 C OP1	1.14
918411	AA1-050	0.96
918491	AA1-063AC OP	1.36
918511	AA1-065 C OP	3.8
918531	AA1-067 C	0.49
918561	AA1-072 C	0.11
919691	AA2-053 C	1.91
919701	AA2-057 C	1.42
LTF	AA2-074	2.51
920041	AA2-088 C	0.79
920591	AA2-165 C	0.19
920671	AA2-174 C	0.09
920691	AA2-178 C	19.71
930051	AB1-013 C	5.95
930401	AB1-081 C	8.64
930861	AB1-132 C	15.15
931231	AB1-173 C	1.8
931241	AB1-173AC	1.8
923911	AB2-031 C O1	1.78
923941	AB2-035 C	0.4
923991	AB2-040 C O1	5.86
924151	AB2-059 C O1	10.18
924391	AB2-088 C	0.51
924401	AB2-089 C	1.25

924491	AB2-098 C	0.88
924501	AB2-099 C	0.99
924511	AB2-100 C	7.31
925121	AB2-169 C	11.96
925171	AB2-174 C O1	5.33
925291	AB2-188 C O1	4.86
925591	AC1-034 C	6.59
925781	AC1-054 C	4.54
926071	AC1-086 C	22.31
926201	AC1-098 C	7.94
926211	AC1-099 C	2.66
926771	AC1-163 C	3.28
927021	AC1-189 C	11.67
927141	AC1-208 C	9.96

Appendix 3

(DVP - DVP) The 6LAKEVEW-AB2-100 TAP 230 kV line (from bus 314583 to bus 924510 ckt 1) loads from 127.19% to 127.88% (**DC power flow**) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 7.06 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
315294	1DOMTR10	2.01
315131	1EDGECMA	10.47
315132	1EDGECMB	10.47
315139	1GASTONA	7.52
315141	1GASTONB	7.52
315126	1ROARAP2	1.54
315128	1ROARAP4	1.48
315136	1ROSEMG1	5.05
315138	1ROSEMG2	2.36
315137	1ROSEMS1	3.13
314557	3BETHELC	0.87
314554	3BTLEBRO	0.84
314566	3CRESWEL	1.63
314578	3HORNRTN	3.35
314582	3KELFORD	0.91
314603	3SCOT NK	3.54
314617	3TUNIS	0.81

314541	3WATKINS	0.32
314620	6CASHIE	0.83
314574	6EVERETS	2.43
314594	6PLYMOTH	0.69
932631	AC2-084 C	9.33
932632	AC2-084 E	4.59
933991	AD1-023 C	11.94
933992	AD1-023 E	6.5
934331	AD1-057 C O1	16.07
934332	AD1-057 E O1	8.57
934521	AD1-076 C O1	45.25
934522	AD1-076 E O1	23.04
LTF	AD1-120	3.74
LTF	AD1-121	3.71
936401	AD2-051 C O1	9.84
936402	AD2-051 E O1	4.22
936531	AD2-068 C	4.66
936532	AD2-068 E	2.4
936701	AD2-089 C	7.83
936702	AD2-089 E	5.22
936711	AD2-090 C O1	3.74
936712	AD2-090 E O1	2.49
LTF	AD2-099	2.89
937441	AD2-195 C	8.25
937442	AD2-195 E	3.56
LTF	CARR	0.09
LTF	CBM-S1	4.48
LTF	CBM-S2	9.25
LTF	CBM-W1	9.73
LTF	CBM-W2	24.21
LTF	CIN	2.18
LTF	CPLE	3.17
LTF	G-007	0.62
LTF	IPL	1.39
LTF	LGEE	0.47
LTF	MEC	4.95
LTF	MECS	2.17
LTF	O-066	3.92
LTF	RENSSELAER	0.08
LTF	ROSETON	0.55
900672	V4-068 E	0.24
LTF	WEC	0.6
916042	Z1-036 E	21.78
917331	Z2-043 C	0.48
917332	Z2-043 E	1.1

917341	Z2-044 C	0.26
917342	Z2-044 E	0.61
917511	Z2-088 C OP1	0.97
917512	Z2-088 E OP1	4.12
918411	AA1-050	0.82
918491	AA1-063AC OP	1.38
918492	AA1-063AE OP	3.51
918511	AA1-065 C OP	2.01
918512	AA1-065 E OP	5.34
918531	AA1-067 C	0.32
918532	AA1-067 E	0.73
918561	AA1-072 C	0.07
918562	AA1-072 E	0.18
919691	AA2-053 C	1.67
919692	AA2-053 E	3.86
919701	AA2-057 C	1.39
919702	AA2-057 E	3.73
LTF	AA2-074	2.16
920042	AA2-088 E	6.94
920591	AA2-165 C	0.19
920592	AA2-165 E	0.49
920671	AA2-174 C	0.08
920672	AA2-174 E	0.45
920691	AA2-178 C	6.54
920692	AA2-178 E	2.8
930051	AB1-013 C	1.97
930052	AB1-013 E	13.2
930401	AB1-081 C	9.52
930402	AB1-081 E	4.08
930861	AB1-132 C	30.89
930862	AB1-132 E	13.24
923941	AB2-035 C	0.37
923942	AB2-035 E	0.16
924151	AB2-059 C O1	11.22
924152	AB2-059 E O1	5.78
924391	AB2-088 C	0.47
924392	AB2-088 E	0.23
924491	AB2-098 C	0.57
924492	AB2-098 E	0.24
924501	AB2-099 C	0.61
924502	AB2-099 E	0.26
925121	AB2-169 C	5.87
925122	AB2-169 E	5.27
925281	AB2-186 C	0.27
925282	AB2-186 E	0.12

925291	AB2-188 C O1	1.61
925292	AB2-188 E O1	0.72
925591	AC1-034 C	7.27
925592	AC1-034 E	5.48
925781	AC1-054 C	3.7
925782	AC1-054 E	1.71
926071	AC1-086 C	45.48
926072	AC1-086 E	20.7
926201	AC1-098 C	6.54
926202	AC1-098 E	3.9
926211	AC1-099 C	2.19
926212	AC1-099 E	1.29
926771	AC1-163 C	2.03
926772	AC1-163 E	0.95
927021	AC1-189 C	8.99
927022	AC1-189 E	4.48
927141	AC1-208 C	9.4
927142	AC1-208 E	4.18

Appendix 4

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 140.99% to 141.69% (**DC power flow**) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-2: 246T247'. This project contributes approximately 7.06 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
315294	1DOMTR10	2.01
315131	1EDGECMA	10.47
315132	1EDGECMB	10.47
315139	1GASTONA	7.52
315141	1GASTONB	7.52
315126	1ROARAP2	1.54
315128	1ROARAP4	1.48
315136	1ROSEMG1	5.05
315138	1ROSEMG2	2.36
315137	1ROSEMS1	3.13
314557	3BETHELC	0.87
314554	3BTLEBRO	0.84
314566	3CRESWEL	1.63
314578	3HORNRTN	3.35
314582	3KELFORD	0.91
314603	3SCOT NK	3.54
314617	3TUNIS	0.81

314541	3WATKINS	0.32
314620	6CASHIE	0.83
314574	6EVERETS	2.43
314594	6PLYMOTH	0.69
932631	AC2-084 C	9.33
932632	AC2-084 E	4.59
933991	AD1-023 C	11.94
933992	AD1-023 E	6.5
934331	AD1-057 C O1	16.07
934332	AD1-057 E O1	8.57
934521	AD1-076 C O1	45.25
934522	AD1-076 E O1	23.04
LTF	AD1-120	3.74
LTF	AD1-121	3.71
936401	AD2-051 C O1	9.84
936402	AD2-051 E O1	4.22
936531	AD2-068 C	4.66
936532	AD2-068 E	2.4
936701	AD2-089 C	7.83
936702	AD2-089 E	5.22
936711	AD2-090 C O1	3.74
936712	AD2-090 E O1	2.49
LTF	AD2-099	2.89
937441	AD2-195 C	8.25
937442	AD2-195 E	3.56
LTF	CARR	0.09
LTF	CBM-S1	4.48
LTF	CBM-S2	9.25
LTF	CBM-W1	9.73
LTF	CBM-W2	24.21
LTF	CIN	2.18
LTF	CPLE	3.17
LTF	G-007	0.62
LTF	IPL	1.39
LTF	LGEE	0.47
LTF	MEC	4.95
LTF	MECS	2.17
LTF	O-066	3.92
LTF	RENSSELAER	0.08
LTF	ROSETON	0.55
900672	V4-068 E	0.24
LTF	WEC	0.6
916042	Z1-036 E	21.78
917331	Z2-043 C	0.48
917332	Z2-043 E	1.1

917341	Z2-044 C	0.26
917342	Z2-044 E	0.61
917511	Z2-088 C OP1	0.97
917512	Z2-088 E OP1	4.12
918411	AA1-050	0.82
918491	AA1-063AC OP	1.38
918492	AA1-063AE OP	3.51
918511	AA1-065 C OP	2.01
918512	AA1-065 E OP	5.34
918531	AA1-067 C	0.32
918532	AA1-067 E	0.73
918561	AA1-072 C	0.07
918562	AA1-072 E	0.18
919691	AA2-053 C	1.67
919692	AA2-053 E	3.86
919701	AA2-057 C	1.39
919702	AA2-057 E	3.73
LTF	AA2-074	2.16
920042	AA2-088 E	6.94
920591	AA2-165 C	0.19
920592	AA2-165 E	0.49
920671	AA2-174 C	0.08
920672	AA2-174 E	0.45
920691	AA2-178 C	6.54
920692	AA2-178 E	2.8
930051	AB1-013 C	1.97
930052	AB1-013 E	13.2
930401	AB1-081 C	9.52
930402	AB1-081 E	4.08
930861	AB1-132 C	30.89
930862	AB1-132 E	13.24
923941	AB2-035 C	0.37
923942	AB2-035 E	0.16
924151	AB2-059 C O1	11.22
924152	AB2-059 E O1	5.78
924391	AB2-088 C	0.47
924392	AB2-088 E	0.23
924491	AB2-098 C	0.57
924492	AB2-098 E	0.24
924501	AB2-099 C	0.61
924502	AB2-099 E	0.26
924511	AB2-100 C	42.68
924512	AB2-100 E	21.02
925121	AB2-169 C	5.87
925122	AB2-169 E	5.27

925291	AB2-188 C O1	1.61
925292	AB2-188 E O1	0.72
925591	AC1-034 C	7.27
925592	AC1-034 E	5.48
925781	AC1-054 C	3.7
925782	AC1-054 E	1.71
926071	AC1-086 C	45.48
926072	AC1-086 E	20.7
926201	AC1-098 C	6.54
926202	AC1-098 E	3.9
926211	AC1-099 C	2.19
926212	AC1-099 E	1.29
926771	AC1-163 C	2.03
926772	AC1-163 E	0.95
927021	AC1-189 C	8.99
927022	AC1-189 E	4.48
927141	AC1-208 C	9.4
927142	AC1-208 E	4.18

Appendix 5

(DVP - CPLE) The AD2-068 TAP-6GREENVILE T 230 kV line (from bus 936530 to bus 304451 ckt 1) loads from 129.79% to 135.19% (**DC power flow**) of its emergency rating (478 MVA) for the tower line contingency outage of 'DVP_P7-1: LN 2058-2181'. This project contributes approximately 25.79 MW to the thermal violation.

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

Bus Number	Bus Name	Full Contribution
315294	1DOMTR10	2.96
315292	1DOMTR78	2.
315293	1DOMTR9	1.63
315131	1EDGECMA	9.28
315132	1EDGECMB	9.28
315136	1ROSEMG1	1.88
315138	1ROSEMG2	0.88
315137	1ROSEMS1	1.17
314557	3BETHELC	1.15
314554	3BTLEBRO	0.43
314566	3CRESWEL	2.04
314572	3EMPORIA	0.21
314578	3HORNRTN	2.04
314582	3KELFORD	0.72
314603	3SCOT NK	2.51
314617	3TUNIS	0.7
314539	3UNCAMP	1.18
314541	3WATKINS	0.36
314620	6CASHIE	0.88
314574	6EVERETS	5.39
314594	6PLYMOTH	0.83
314648	6SUNBURY	0.4
314651	6WINFALL	0.97

932631	AC2-084 C	6.17
932632	AC2-084 E	3.04
933991	AD1-023 C	13.47
933992	AD1-023 E	7.33
934201	AD1-047 C	4.29
934202	AD1-047 E	2.86
934331	AD1-057 C O1	8.81
934332	AD1-057 E O1	4.7
934521	AD1-076 C O1	54.77
934522	AD1-076 E O1	27.89
936401	AD2-051 C O1	8.4
936402	AD2-051 E O1	3.61
936531	AD2-068 C	17.02
936532	AD2-068 E	8.77
936701	AD2-089 C	10.31
936702	AD2-089 E	6.87
936711	AD2-090 C O1	3.91
936712	AD2-090 E O1	2.61
937441	AD2-195 C	12.87
937442	AD2-195 E	5.55
LTF	AMIL	0.48
LTF	BAYOU	2.63
LTF	BIG_CAJUN1	4.15
LTF	BIG_CAJUN2	8.36
LTF	BLUEG	2.48
LTF	CALDERWOOD	1.54
LTF	CANNELTON	0.48
LTF	CATAWBA	1.5
LTF	CBM-N	< 0.01
LTF	CELEVELAND	4.26
LTF	CHEOAH	1.43
LTF	CHILHOWEE	0.5
LTF	CHOCTAW	2.83
LTF	CLIFTY	8.97
LTF	COTTONWOOD	10.28
LTF	DEARBORN	0.89
LTF	EDWARDS	0.77
LTF	ELMERSMITH	1.41
LTF	FARMERCITY	0.62
LTF	G-007A	1.06
LTF	GIBSON	0.87
LTF	HAMLET	6.46
LTF	MORGAN	4.55
LTF	NEWTON	2.14
LTF	NYISO	0.09

LTF	PRAIRIE	4.66
LTF	ROWAN	2.98
LTF	SANTEETLA	0.43
LTF	SMITHLAND	0.42
LTF	TATANKA	1.04
LTF	TILTON	0.91
LTF	TRIMBLE	0.47
LTF	TVA	1.91
LTF	UNIONPOWER	2.73
900672	V4-068 E	0.21
LTF	VFT	2.82
901082	W1-029E	23.4
907092	X1-038 E	2.96
913392	Y1-086 E	1.05
916042	Z1-036 E	29.14
917122	Z2-027 E	0.51
917331	Z2-043 C	0.37
917332	Z2-043 E	0.86
917342	Z2-044 E	0.33
917511	Z2-088 C OP1	1.44
917512	Z2-088 E OP1	6.13
918411	AA1-050	1.22
918492	AA1-063AE OP	2.44
918511	AA1-065 C OP	1.83
918512	AA1-065 E OP	4.84
918531	AA1-067 C	0.7
918532	AA1-067 E	1.62
918561	AA1-072 C	0.06
918562	AA1-072 E	0.14
919692	AA2-053 E	2.58
919702	AA2-057 E	2.12
920042	AA2-088 E	6.25
920592	AA2-165 E	0.28
920672	AA2-174 E	0.3
920691	AA2-178 C	8.16
920692	AA2-178 E	3.5
930051	AB1-013 C	2.46
930052	AB1-013 E	16.48
930401	AB1-081 C	5.64
930402	AB1-081 E	2.42
930861	AB1-132 C	10.36
930862	AB1-132 E	4.44
931231	AB1-173 C	1.21
931232	AB1-173 E	0.56
931241	AB1-173AC	1.21

931242	AB1-173AE	0.56
923801	AB2-015 C O1	4.4
923802	AB2-015 E O1	3.61
923831	AB2-022 C	1.02
923832	AB2-022 E	0.55
923911	AB2-031 C O1	1.2
923912	AB2-031 E O1	0.59
923941	AB2-035 C	0.48
923942	AB2-035 E	0.21
923991	AB2-040 C O1	3.93
923992	AB2-040 E O1	3.22
924151	AB2-059 C O1	6.65
924152	AB2-059 E O1	3.42
924391	AB2-088 C	0.62
924392	AB2-088 E	0.3
924491	AB2-098 C	1.26
924492	AB2-098 E	0.54
924501	AB2-099 C	0.53
924502	AB2-099 E	0.23
924511	AB2-100 C	5.85
924512	AB2-100 E	2.88
925121	AB2-169 C	10.02
925122	AB2-169 E	8.99
925171	AB2-174 C O1	3.64
925172	AB2-174 E O1	3.29
925281	AB2-186 C	0.37
925282	AB2-186 E	0.16
925291	AB2-188 C O1	2.01
925292	AB2-188 E O1	0.9
925591	AC1-034 C	4.3
925592	AC1-034 E	3.25
926071	AC1-086 C	15.26
926072	AC1-086 E	6.95
926201	AC1-098 C	4.33
926202	AC1-098 E	2.58
926211	AC1-099 C	1.45
926212	AC1-099 E	0.85
LTF	AC1-133	22.45
926771	AC1-163 C	1.74
926772	AC1-163 E	0.81
927021	AC1-189 C	15.46
927022	AC1-189 E	7.7
927141	AC1-208 C	5.75
927142	AC1-208 E	2.55