Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-202

Clover – Sedge Hill 230kV
13.6 MW Capacity / 20 MW Energy

Revised October / 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 Halifax County, VA. The installed facilities will have a total capability of 91 MW with 61.9 MW of this output being recognized by PJM as capacity. This queue request is for an additional 20 MW with 13.6 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 9/02/2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AD2-202 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 on the Clover – Sedge Hill 230kV line #2068.

Option 2 will connect via a new three breaker ring bus switching station that connects at the Barnes Junction – Mt Laurel 115kV line #33.

Cost Summary

The AD2-202 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$0
Total Costs	**$0**

In addition, the AD2-202 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$0
Previously Identified Upgrades	$0
Total Costs	**$0**

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

The existing AD1-087 scope of work is sufficient to accommodate this queue request from an Attachment Facilities and substation expansion perspective. 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.

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

Option One

Network Impacts

The Queue Project AD2-202 was evaluated as a 20.0 MW (Capacity 13.3 MW) uprate to AD1-087 which is an injection tapping the Clover to Sedge Hill (Halifax) 230kV line in the ITO area. Project AD2-202 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-202 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 556	CONTINGENCY 'DVP_P1-2: LN 556' OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 1 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 2 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 3 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314906 TO BUS 314936 CKT 1 /* 8CLOVER 500.00 - 8RAWLINGS 500.00 OPEN BUS 314906 /* ISLAND END

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	N-1	DVP_P1-2: LN 556	DVP - DVP	6HALIFAX-AC1-221 TAP 230 kV line	314697	927250	1	DC	102.29	103.34	ER	675	7.4	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	N-1	DVP_P1-2: LN 556	DVP - CPLE	AC1-221 TAP-6PERSON230 T 230 kV line	927250	304070	1	DC	105.71	106.68	ER	718	7.4	2

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	6HALIFAX-AC1-221 TAP 230 kV line	No criteria violation. The latest update indicates that the line's ratings are 933 MVA (normal), 994 MVA (emergency), and 1143 MVA (load dump).		**$0**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 2	AC1-221 TAP-6PERSON230 T 230 kV line	The AC1-221 Tap – Person 230kV line is a joint tie line between the PJM ITO and Duke/Progress transmission systems. The VEPCO portion of this tie line is rated at 904MVA (normal), 904MVA (Emergency) and 1105 MVA (normal). The Dominion portion of this line is not overloaded. An affected systems study will need to be completed with Duke/Progress to determine upgrades required to resolve this violation.		**$0**
			Total New Network Upgrades	**$17,550,000**

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
3	N-1	DVP_P1-2: LN 556	DVP - DVP	6HALIFAX-AC1-221 TAP 230 kV line	314697	927250	1	DC	122.73	124.23	ER	675	11.13
4	N-1	DVP_P1-2: LN 556	DVP - CPLE	AC1-221 TAP-6PERSON230 T 230 kV line	927250	304070	1	DC	129.65	131.08	ER	718	11.13

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).

The Feasibility Study identified issues on joint 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:

- AC1-221 Tap – Person 230kV line

Option Two

Network Impacts

The Queue Project AD2-202 was evaluated as a 20.0 MW (Capacity 13.3 MW) injection tapping the Barns Junction to Mount Laurel 115kV line in the ITO area. Project AD2-202 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-202 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 151	CONTINGENCY 'DVP_P1-2: LN 151' OPEN BRANCH FROM BUS 313825 TO BUS 314696 CKT 1 /* 3PLYWOOD 115.00 - 3HALIFAX 115.00 END
DVP_P1-3: 3ALTVSTA-4ALTVSTA	CONTINGENCY 'DVP_P1-3: 3ALTVSTA-4ALTVSTA' OPEN BRANCH FROM BUS 314666 TO BUS 314667 CKT 1 END
DVP_P1-3: 3ALTVSTA-4ALTVSTAA	CONTINGENCY 'DVP_P1-3: 3ALTVSTA-4ALTVSTAA' OPEN BRANCH FROM BUS 314666 TO BUS 314667 CKT 2 END
DVP_P1-3: 3CAROLNA-6CAROLNA	CONTINGENCY 'DVP_P1-3: 3CAROLNA-6CAROLNA' OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 END

Contingency Name	Description
DVP_P4-2: 101002	CONTINGENCY 'DVP_P4-2: 101002' /* CAROLINA 115 KV OPEN BRANCH FROM BUS 313723 TO BUS 314259 CKT 1 /* 3PECAN 115.00 - 3CAROL56_1 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 314559 CKT Z1 /* 3CAROL56_1 115.00 - 3CAROLNA 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 314835 CKT 1 /* 3CAROL56_1 115.00 - 3CAROL_1 115.00 OPEN BUS 314259 /* ISLAND: 3CAROL56_1 115.00 OPEN BUS 314835 /* ISLAND: 3CAROL_1 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* 3CAROLNA 115.00 - 3EATON F 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 919690 CKT 1 /* 3CAROLNA 115.00 - AA2-053 TAP 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* 3CAROLNA 115.00 - 3PLHITP 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* 3CAROLNA 115.00 - 6CAROLNA 230.00 END
DVP_P4-2: 2202	CONTINGENCY 'DVP_P4-2: 2202' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314571 TO BUS 925780 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 919690 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END
DVP_P4-2: 5402	CONTINGENCY 'DVP_P4-2: 5402' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 919690 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Contingency Name	Description
DVP_P4-2: 5602	CONTINGENCY 'DVP_P4-2: 5602' /* CAROLINA 115 KV OPEN BRANCH FROM BUS 313723 TO BUS 314604 CKT 1 /* 3PECAN 115.00 - 3SEABORD 115.00 OPEN BRANCH FROM BUS 314558 TO BUS 314587 CKT 1 /* 3BOYKINS 115.00 - 3MARGTSV 115.00 OPEN BRANCH FROM BUS 314587 TO BUS 314604 CKT 1 /* 3MARGTSV 115.00 - 3SEABORD 115.00 OPEN BUS 314587 /* ISLAND: 3MARGTSV 115.00 OPEN BUS 314604 /* ISLAND: 3SEABORD 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* 3CAROLNA 115.00 - 3EATON F 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 919690 CKT 1 /* 3CAROLNA 115.00 - AA2-053 TAP 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* 3CAROLNA 115.00 - 3PLHITP 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* 3CAROLNA 115.00 - 6CAROLNA 230.00 END
DVP_P4-5: T122C	CONTINGENCY 'DVP_P4-5: T122C' /* CAROLINA OPEN BUS 314559 /* CAROLINA 115KV BUS OPEN BUS 315126 /* ROANOKE RAPIDS GEN 1 AND 2 OPEN BUS 315128 /* ROANOKE RAPIDS GEN 3 AND 4 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 END
DVP_P7-1: LN 22-90_A	CONTINGENCY 'DVP_P7-1: LN 22-90_A' OPEN BRANCH FROM BUS 925780 TO BUS 314702 CKT 1 /* AC1-054 TAP 115.00 - 3KERR 115.00 OPEN BRANCH FROM BUS 314265 TO BUS 314584 CKT 1 /* 3FIVEFORKSDP115.00 - 3LITTLTN 115.00 OPEN BRANCH FROM BUS 314265 TO BUS 314673 CKT 1 /* 3FIVEFORKSDP115.00 - 3BCHWD90 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314585 CKT 1 /* 3CAROLNA 115.00 - 3L GASTN 115.00 OPEN BRANCH FROM BUS 314584 TO BUS 314585 CKT 1 /* 3LITTLTN 115.00 - 3L GASTN 115.00 OPEN BRANCH FROM BUS 314672 TO BUS 314673 CKT 1 /* 3BEECHWD 115.00 - 3BCHWD90 115.00 OPEN BRANCH FROM BUS 314673 TO BUS 314702 CKT 1 /* 3BCHWD90 115.00 - 3KERR 115.00 OPEN BUS 314265 /* ISLAND OPEN BUS 314584 /* ISLAND OPEN BUS 314585 /* ISLAND OPEN BUS 314672 /* ISLAND OPEN BUS 314673 /* ISLAND END

Contingency Name	Description
DVP_P7-1: LN 22-90_B	CONTINGENCY 'DVP_P7-1: LN 22-90_B' OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* 3CAROLNA 115.00 - 3EATON F 115.00 OPEN BRANCH FROM BUS 314571 TO BUS 925780 CKT 1 /* 3EATON F 115.00 - AC1-054 TAP 115.00 OPEN BUS 314571 /* ISLAND OPEN BRANCH FROM BUS 314265 TO BUS 314584 CKT 1 /* 3FIVEFORKSDP115.00 - 3LITTLTN 115.00 OPEN BRANCH FROM BUS 314265 TO BUS 314673 CKT 1 /* 3FIVEFORKSDP115.00 - 3BCHWD90 115.00 OPEN BRANCH FROM BUS 314559 TO BUS 314585 CKT 1 /* 3CAROLNA 115.00 - 3L GASTN 115.00 OPEN BRANCH FROM BUS 314584 TO BUS 314585 CKT 1 /* 3LITTLTN 115.00 - 3L GASTN 115.00 OPEN BRANCH FROM BUS 314672 TO BUS 314673 CKT 1 /* 3BEECHWD 115.00 - 3BCHWD90 115.00 OPEN BRANCH FROM BUS 314673 TO BUS 314702 CKT 1 /* 3BCHWD90 115.00 - 3KERR 115.00 OPEN BUS 314265 /* ISLAND OPEN BUS 314584 /* ISLAND OPEN BUS 314585 /* ISLAND OPEN BUS 314672 /* ISLAND OPEN BUS 314673 /* ISLAND END

Summer Peak Analysis - 2021

Generator Deliverability

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

Contingency			Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	N-1	DVP_P1-3: 3ALTVSTA - 4ALTVSTA	DVP - DVP	4ALTVSTA 138/115 kV transformer	314666	314667	2	DC	99.81	100.63	ER	130	1.07	1

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 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_P4-5: T122C	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	146.97	147.46	LDR	209	2.29	2
3	LFFB	DVP_P4-2: 2202	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	141.29	142.53	LDR	209	2.16	
4	LFFB	DVP_P4-2: 5602	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	140.74	141.98	LDR	209	2.16	
5	LFFB	DVP_P4-2: 5402	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	140.48	141.71	LDR	209	2.16	
6	LFFB	DVP_P4-2: 101002	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	139.71	140.95	LDR	209	2.16	
7	LFFB	DVP_P4-5: T122C	DVP - CPLE	3KERR-3GW KING TAP 115 kV line	314702	304102	1	DC	115.64	116.24	ER	199	2.7	3
8	DCTL	DVP_P7-1: LN 22-90_B	DVP - CPLE	3KERR-3GW KING TAP 115 kV line	314702	304102	1	DC	112.01	112.61	ER	199	2.67	
9	LFFB	DVP_P4-2: 2202	DVP - CPLE	3KERR-3GW KING TAP 115 kV line	314702	304102	1	DC	108.67	109.2	ER	199	2.36	
10	DCTL	DVP_P7-1: LN 22-90_A	DVP - CPLE	3KERR-3GW KING TAP 115 kV line	314702	304102	1	DC	102.27	102.87	ER	199	2.67	

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
11	N-1	DVP_P1-3: 3CAROLNA-6CAROLNA	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	141.98	142.5	ER	183	2.11
12	Non	Non	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	109.85	110.31	NR	177	1.78
13	N-1	DVP_P1-3: 3ALTVSTA-4ALTVSTAA	DVP - DVP	4ALTVSTA 138/115 kV transformer	314666	314667	1	DC	111.64	112.18	ER	127	1.52
14	N-1	DVP_P1-3: 3ALTVSTA-4ALTVSTA	DVP - DVP	4ALTVSTA 138/115 kV transformer	314666	314667	2	DC	116.11	116.67	ER	130	1.61
15	N-1	DVP_P1-2: LN 151	DVP - CPLE	3KERR-3GW KING TAP 115 kV line	314702	304102	1	DC	102.02	102.48	ER	199	2.03

Light Load Analysis

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

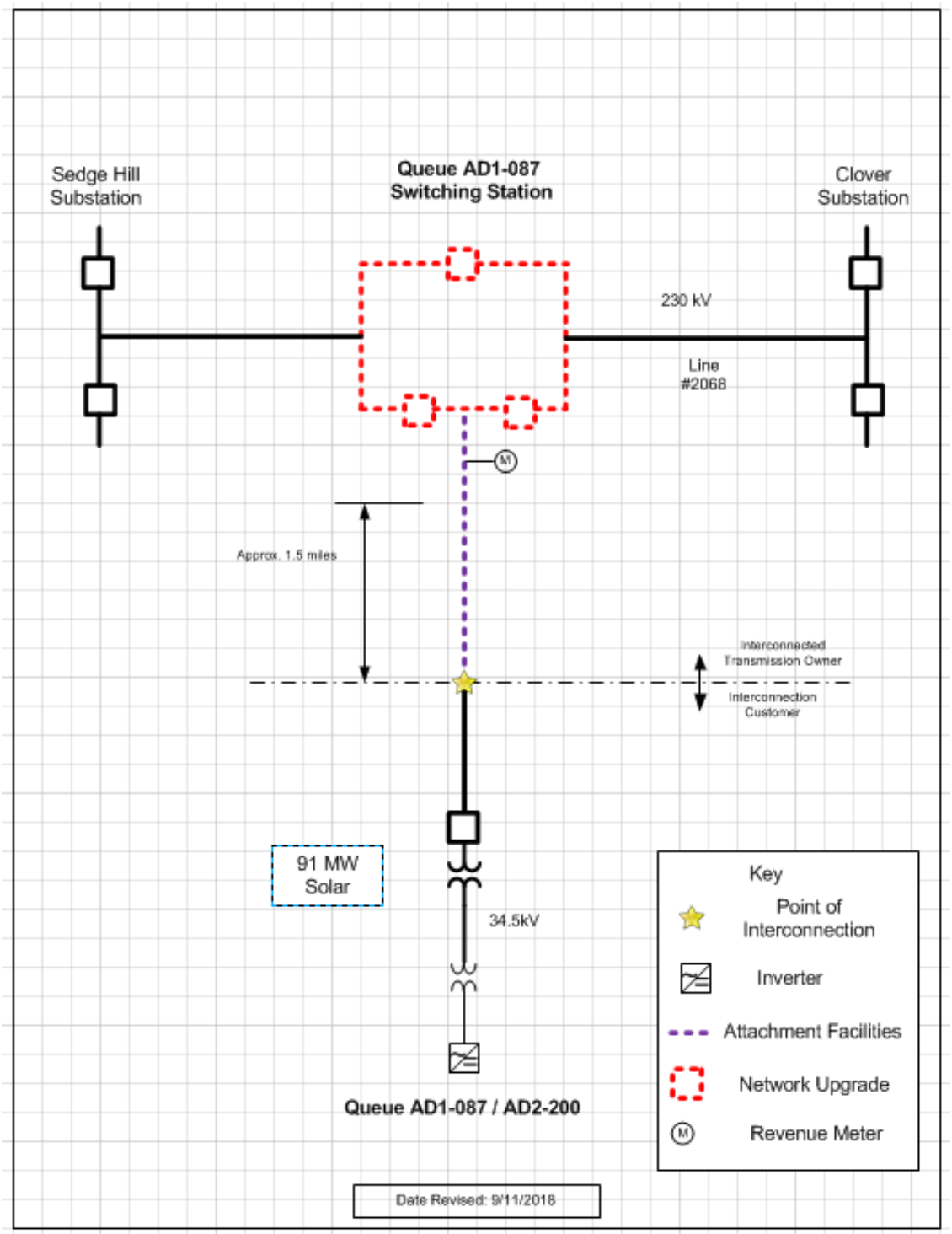
Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

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 6HALIFAX-AC1-221 TAP 230 kV line (from bus 314697 to bus 927250 ckt 1) loads from 102.29% to 103.34% (**DC power flow**) of its emergency rating (675 MVA) for the single line contingency outage of 'DVP_P1-2: LN 556'. This project contributes approximately 7.4 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 556'
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 1 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 2 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 3 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314906 TO BUS 314936 CKT 1 /* 8CLOVER 500.00 - 8RAWLINGS 500.00
OPEN BUS 314906 /* ISLAND
END

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	17.66
315151	1BUGGS 2	17.66
315153	1CLOVER1	39.26
315154	1CLOVER2	38.75
315159	1KERR 2	1.31
315164	1KERR 7	1.29
315266	1PLYWOOD A	3.44
314429	3JTRSVLE	0.57
932511	AC2-071 C	2.43
932821	AC2-107 C	21.11
934231	AD1-050 C	3.64
934311	AD1-055 C	6.99
934611	AD1-087 C O1	26.89
934621	AD1-088 C	31.79
934911	AD1-123 C	3.15
935171	AD1-152 C O1	26.72
935221	AD1-157 C	2.12
935231	AD1-160 C	1.56
936261	AD2-033 C	17.89
936331	AD2-043 C	13.04
936361	AD2-046 C O1	8.55
936481	AD2-063 C O1	20.59
936651	AD2-082 C	2.38
937461	AD2-200 C	4.02

937481	AD2-202 C O1	7.4
LTF	AMIL	0.46
LTF	BAYOU	2.63
LTF	BIG_CAJUN1	4.16
LTF	BIG_CAJUN2	8.37
LTF	BLUEG	2.32
LTF	CALDERWOOD	1.58
LTF	CANNELTON	0.45
LTF	CARR	0.04
LTF	CATAWBA	1.7
LTF	CELEVELAND	4.83
LTF	CHEOAH	1.48
LTF	CHILHOWEE	0.51
LTF	CHOCTAW	2.84
LTF	CLIFTY	8.17
LTF	COTTONWOOD	10.27
LTF	DEARBORN	0.83
LTF	EDWARDS	0.74
LTF	ELMERSMITH	1.34
LTF	FARMERCITY	0.6
LTF	G-007A	0.38
LTF	GIBSON	0.82
LTF	HAMLET	6.4
LTF	MORGAN	4.57
LTF	NEWTON	2.04
LTF	PRAIRIE	4.53
LTF	RENSSELAER	0.03
LTF	ROSETON	0.24
LTF	ROWAN	3.76
LTF	SANTEETLA	0.44
LTF	SMITHLAND	0.41
LTF	TATANKA	1.
LTF	TILTON	0.86
LTF	TRIMBLE	0.44
LTF	TVA	1.91
LTF	UNIONPOWER	3.
LTF	VFT	0.99
924021	AB2-043 C O1	4.29
924031	AB2-045 C	0.42
924161	AB2-060 C O1	12.36
924301	AB2-077 C O1	2.76
924311	AB2-078 C O1	2.76
924321	AB2-079 C O1	2.76
924401	AB2-089 C	1.65
924411	AB2-090 C	5.4

925221	AB2-176 C	2.22
925611	AC1-036 C	1.32
925781	AC1-054 C	5.09
925831	AC1-062	0.08
925991	AC1-075 C	11.87
926021	AC1-080 C	3.97
926271	AC1-105 C	14.48
926761	AC1-162 C	56.69
927261	AC1-222 C	10.07

Appendix 2

(DVP - CPLE) The AC1-221 TAP-6PERSON230 T 230 kV line (from bus 927250 to bus 304070 ckt 1) loads from 105.71% to 106.68% (**DC power flow**) of its emergency rating (718 MVA) for the single line contingency outage of 'DVP_P1-2: LN 556'. This project contributes approximately 7.4 MW to the thermal violation.

CONTINGENCY 'DVP_P1-2: LN 556'
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 1 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 2 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 3 /* 6CLOVER 230.00 - 8CLOVER 500.00
OPEN BRANCH FROM BUS 314906 TO BUS 314936 CKT 1 /* 8CLOVER 500.00 - 8RAWLINGS 500.00
OPEN BUS 314906 /* ISLAND
END

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	17.66
315151	1BUGGS 2	17.66
315153	1CLOVER1	39.26
315154	1CLOVER2	38.75
315159	1KERR 2	1.31
315164	1KERR 7	1.29
315266	1PLYWOOD A	3.44
314429	3JTRSVLE	0.57
932511	AC2-071 C	2.43
932761	AC2-100 C	26.97
932821	AC2-107 C	21.11
934311	AD1-055 C	6.99
934341	AD1-058 C	29.37
934611	AD1-087 C O1	26.89
934621	AD1-088 C	31.79
934911	AD1-123 C	3.15
934991	AD1-131 C	9.63
935171	AD1-152 C O1	26.72
935221	AD1-157 C	2.12
935231	AD1-160 C	1.56
936261	AD2-033 C	17.89
936331	AD2-043 C	13.04

936361	AD2-046 C O1	8.55
936481	AD2-063 C O1	20.59
936651	AD2-082 C	2.38
937461	AD2-200 C	4.02
937481	AD2-202 C O1	7.4
LTF	AMIL	0.46
LTF	BAYOU	2.63
LTF	BIG_CAJUN1	4.16
LTF	BIG_CAJUN2	8.37
LTF	BLUEG	2.32
LTF	CALDERWOOD	1.58
LTF	CANNELTON	0.45
LTF	CARR	0.04
LTF	CATAWBA	1.7
LTF	CELEVELAND	4.83
LTF	CHEOAH	1.48
LTF	CHILHOWEE	0.51
LTF	CHOCTAW	2.84
LTF	CLIFTY	8.17
LTF	COTTONWOOD	10.27
LTF	DEARBORN	0.83
LTF	EDWARDS	0.74
LTF	ELMERSMITH	1.34
LTF	FARMERCITY	0.6
LTF	G-007A	0.38
LTF	GIBSON	0.82
LTF	HAMLET	6.4
LTF	MORGAN	4.57
LTF	NEWTON	2.04
LTF	PRAIRIE	4.53
LTF	RENSSELAER	0.03
LTF	ROSETON	0.24
LTF	ROWAN	3.76
LTF	SANTEETLA	0.44
LTF	SMITHLAND	0.41
LTF	TATANKA	1.
LTF	TILTON	0.86
LTF	TRIMBLE	0.44
LTF	TVA	1.91
LTF	UNIONPOWER	3.
LTF	VFT	0.99
924021	AB2-043 C O1	4.29
924031	AB2-045 C	0.42
924161	AB2-060 C O1	12.36
924301	AB2-077 C O1	2.76

924311	AB2-078 C O1	2.76
924321	AB2-079 C O1	2.76
924411	AB2-090 C	5.4
925221	AB2-176 C	2.22
925611	AC1-036 C	1.32
925831	AC1-062	0.08
925991	AC1-075 C	11.87
926021	AC1-080 C	3.97
926271	AC1-105 C	14.48
926761	AC1-162 C	56.69
927251	AC1-221 C	11.72
927261	AC1-222 C	10.07

Appendix 3

(DVP - DVP) The 4ALTVSTA 138/115 kV transformer (from bus 314666 to bus 314667 ckt 2) loads from 99.81% to 100.63% (**DC power flow**) of its emergency rating (130 MVA) for the single line contingency outage of 'DVP_P1-3: 3ALTVSTA-4ALTVSTA'. This project contributes approximately 1.07 MW to the thermal violation.

CONTINGENCY 'DVP_P1-3: 3ALTVSTA-4ALTVSTA'
OPEN BRANCH FROM BUS 314666 TO BUS 314667 CKT 1
END

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	4.5
315151	1BUGGS 2	4.5
315156	1HALLBR1	6.46
315165	1HURT 1	4.47
315166	1HURT 2	4.47
315266	1PLYWOOD A	0.83
932821	AC2-107 C	24.25
934311	AD1-055 C	2.67
934911	AD1-123 C	0.75
936261	AD2-033 C	3.92
936331	AD2-043 C	5.25
937481	AD2-202 C O2	1.07
LTF	AMIL	0.1
LTF	BAYOU	0.19
LTF	BIG_CAJUN1	0.27
LTF	BIG_CAJUN2	0.54
LTF	BLUEG	0.76
LTF	CALDERWOOD	0.08
LTF	CANNELTON	0.12
LTF	CARR	0.02
LTF	CBM-S2	1.4
LTF	CHEOAH	0.06
LTF	CHILHOWEE	0.03
LTF	CHOCTAW	0.17
LTF	CLIFTY	3.39
LTF	COTTONWOOD	0.78
LTF	CPLE	0.67
LTF	DEARBORN	0.33
LTF	EDWARDS	0.2
LTF	ELMERSMITH	0.34
LTF	FARMERCITY	0.11
LTF	G-007A	0.22
LTF	GIBSON	0.24

LTF	MORGAN	0.3
LTF	NEWTON	0.5
LTF	PRAIRIE	0.85
LTF	RENSSELAER	0.02
LTF	ROSETON	0.13
LTF	SANTEETLA	0.02
LTF	SMITHLAND	0.06
LTF	TATANKA	0.22
LTF	TILTON	0.25
LTF	TRIMBLE	0.15
LTF	TVA	0.17
LTF	VFT	0.59
924021	AB2-043 C O1	1.03
924161	AB2-060 C O1	2.95
924301	AB2-077 C O1	0.67
924311	AB2-078 C O1	0.67
924321	AB2-079 C O1	0.67
924411	AB2-090 C	1.3
925221	AB2-176 C	0.54
925991	AC1-075 C	13.64
926021	AC1-080 C	4.56
926271	AC1-105 C	3.45
927261	AC1-222 C	3.84

Appendix 4

(DVP - DVP) The 6CLUBHSE 230/115 kV transformer (from bus 314562 to bus 314563 ckt 1) loads from 146.97% to 147.46% (**DC power flow**) of its load dump rating (209 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-5: T122C'. This project contributes approximately 2.29 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-5: T122C'                          /* CAROLINA
  OPEN BUS 314559                                  /* CAROLINA 115KV BUS
  OPEN BUS 315126                                  /* ROANOKE RAPIDS GEN 1 AND 2
  OPEN BUS 315128                                  /* ROANOKE RAPIDS GEN 3 AND 4
  OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1          /* TX. #4
  END
```

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	8.23
315151	1BUGGS 2	8.23
315159	1KERR 2	1.11
315164	1KERR 7	1.09
314572	3EMPORIA	1.99
314704	3LAWRENC	1.26
934201	AD1-047 C	38.12
934202	AD1-047 E	25.41
934231	AD1-050 C	3.55
934232	AD1-050 E	1.94
936261	AD2-033 C	11.57
936262	AD2-033 E	7.71
936361	AD2-046 C O2	7.26
936362	AD2-046 E O2	3.34
937481	AD2-202 C O2	1.52
937482	AD2-202 E O2	0.77
LTF	CARR	0.01
LTF	CBM-S1	0.63
LTF	CBM-S2	0.84
LTF	CBM-W1	1.73
LTF	CBM-W2	3.5
LTF	CIN	0.4
LTF	CPLE	0.21
LTF	G-007	0.1
LTF	IPL	0.26
LTF	LGEE	0.09
LTF	MEC	0.8

LTF	MECS	0.44
LTF	O-066	0.65
LTF	RENSSELAER	< 0.01
LTF	ROSETON	0.06
LTF	WEC	0.11
931231	AB1-173 C	10.72
931232	AB1-173 E	5.
931241	AB1-173AC	10.72
931242	AB1-173AE	5.
923911	AB2-031 C O1	10.64
923912	AB2-031 E O1	5.24
923991	AB2-040 C O1	34.94
923992	AB2-040 E O1	28.59
924021	AB2-043 C O1	3.16
924022	AB2-043 E O1	5.18
924161	AB2-060 C O1	8.96
924162	AB2-060 E O1	4.22
924301	AB2-077 C O1	1.94
924302	AB2-077 E O1	1.29
924311	AB2-078 C O1	1.94
924312	AB2-078 E O1	1.29
924321	AB2-079 C O1	1.94
924322	AB2-079 E O1	1.29
924401	AB2-089 C	1.61
924402	AB2-089 E	0.83
924411	AB2-090 C	3.98
924412	AB2-090 E	2.04
925171	AB2-174 C O1	33.35
925172	AB2-174 E O1	30.18
925221	AB2-176 C	1.64
925222	AB2-176 E	0.7
925611	AC1-036 C	0.76
925612	AC1-036 E	1.25
925781	AC1-054 C	5.42
925782	AC1-054 E	2.5

Appendix 5

(DVP - CPLE) The 3KERR-3GW KING TAP 115 kV line (from bus 314702 to bus 304102 ckt 1) loads from 115.64% to 116.24% (**DC power flow**) of its emergency rating (199 MVA) for the line fault with failed breaker contingency outage of 'DVP_P4-5: T122C'. This project contributes approximately 2.7 MW to the thermal violation.

```
CONTINGENCY 'DVP_P4-5: T122C'                    /* CAROLINA
  OPEN BUS 314559                                /* CAROLINA 115KV BUS
  OPEN BUS 315126                                /* ROANOKE RAPIDS GEN 1 AND 2
  OPEN BUS 315128                                /* ROANOKE RAPIDS GEN 3 AND 4
  OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1          /* TX. #4
  END
```

Bus Number	Bus Name	Full Contribution
315150	1BUGGS 1	15.37
315151	1BUGGS 2	15.37
315159	1KERR 2	3.19
315163	1KERR 6	3.14
315164	1KERR 7	3.14
934231	AD1-050 C	10.2
934232	AD1-050 E	5.57
935221	AD1-157 C	1.02
935222	AD1-157 E	0.68
935231	AD1-160 C	0.75
935232	AD1-160 E	1.03
936261	AD2-033 C	13.59
936262	AD2-033 E	9.06
936361	AD2-046 C O2	17.21
936362	AD2-046 E O2	7.91
936651	AD2-082 C	1.15
936652	AD2-082 E	0.56
937481	AD2-202 C O2	1.8
937482	AD2-202 E O2	0.91
LTF	AMIL	0.13
LTF	BAYOU	0.7
LTF	BIG_CAJUN1	1.11
LTF	BIG_CAJUN2	2.23
LTF	BLUEG	0.67
LTF	CALDERWOOD	0.42
LTF	CANNELTON	0.13
LTF	CARR	0.01

LTF	CATAWBA	0.43
LTF	CELEVELAND	1.21
LTF	CHEOAH	0.39
LTF	CHILHOWEE	0.14
LTF	CHOCTAW	0.76
LTF	CLIFTY	2.43
LTF	COTTONWOOD	2.75
LTF	DEARBORN	0.25
LTF	EDWARDS	0.21
LTF	ELMERSMITH	0.38
LTF	FARMERCITY	0.17
LTF	G-007A	0.13
LTF	GIBSON	0.24
LTF	HAMLET	1.65
LTF	MORGAN	1.22
LTF	NEWTON	0.58
LTF	PRAIRIE	1.26
LTF	RENSSELAER	< 0.01
LTF	ROSETON	0.07
LTF	ROWAN	0.92
LTF	SANTEETLA	0.12
LTF	SMITHLAND	0.11
LTF	TATANKA	0.28
LTF	TILTON	0.25
LTF	TRIMBLE	0.13
LTF	TVA	0.51
LTF	UNIONPOWER	0.77
LTF	VFT	0.35
924021	AB2-043 C O1	3.7
924022	AB2-043 E O1	6.07
924161	AB2-060 C O1	10.51
924162	AB2-060 E O1	4.95
924301	AB2-077 C O1	2.39
924302	AB2-077 E O1	1.59
924311	AB2-078 C O1	2.39
924312	AB2-078 E O1	1.59
924321	AB2-079 C O1	2.39
924322	AB2-079 E O1	1.59
924401	AB2-089 C	4.63
924402	AB2-089 E	2.38
924411	AB2-090 C	4.66
924412	AB2-090 E	2.39
925221	AB2-176 C	1.92
925222	AB2-176 E	0.82
925611	AC1-036 C	0.9

925612	AC1-036 E	1.47
925781	AC1-054 C	15.59
925782	AC1-054 E	7.18
926271	AC1-105 C	2.93
926272	AC1-105 E	1.46