Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-067

KINGS DOMINION DP 115 KV

30 MW Capacity / 50 MW Energy

January, 2020

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1 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).

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer 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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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 Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model.

The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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 project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC), has proposed a solar / storage generating facility located in Caroline County, Virginia. The installed facilities will have a total capability of 50 MW with 30 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 12/16/2022. This study does not imply a TO commitment to this in-service date.

During the Facilities Study, Dominion will review the system protection in the area and may require that the AF1-067 project rebuild the King's Dominion DP substation into a three breaker ring bus configuration.

Queue Number	AF1-067
Project Name	KINGS DOMINION DP 115 KV
State	Virginia
County	Caroline
Transmission Owner	Dominion
MFO	50
MWE	50
MWC	30
Fuel	Solar / Storage
Basecase Study Year	2023

3.1 Point of Interconnection

AF1-067 will interconnect within the Rappahannock Electric Co-op (REC) system which runs up to the Dominion's Kings Dominion 115 kV DP substation. While two separate Points of Interconnection (POI) were applied for under the AF1-067 project, both were on the REC system that is tapped from the King's Dominion DP 115kV substation. The analysis provided here reflects both requested POIs.

The IC may not install any facilities on Dominion's right-of-way without first obtaining the necessary approval from Dominion Energy.

3.2 Cost Summary

The costs associated with interconnecting the AF1-067 project to the Rappahannock Electric Co-op system will be documented in the two-party Interconnection Agreement between the IC and Rappahannock Electric Co-op.

The AF1-067 project may be responsible for a contribution to the following costs.

Description	Total Cost
System Upgrades	**$ 22,809,000**

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

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.

4 Transmission Owner Scope of Work

Dominion assessed the impact of the proposed Queue Project AF1-067 was evaluated as a 30 MW Capacity (50 MW energy) injection at the existing Kings Dominion 115 kV substation in the Dominion Transmission System, for compliance with NERC Reliability Criteria on Dominion Transmission System. The system was assessed using the summer 2023 AF1 case provided to Dominion by PJM. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: http://www.dominionenergy.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, in Planning Studies, NERC Planning Event 3 and 6 Contingency Conditions (Loss of generator, transmission circuit, transformer, shunt device, or Single Pole of a DC line followed by the loss of a generator, transmission circuit, transformer, shunt device or single pole of a DC line) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For Dominion 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 required Attachment Facilities, Direct Connection and Non-Direct Connection work for the interconnection of the AF1-067 generation project to the Dominion Transmission System is detailed in the following sections. The associated one-line with the generation project attachment facilities and primary direct and non-direct connection are shown in Attachment 1.

Note that the ITO findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in a future study phases. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. ITO herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission systems.

5 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.

During the Facilities Study, Dominion will review the system protection in the area and may require that the AF1-067 project rebuild the King's Dominion DP substation into a three breaker ring bus configuration.

6 Schedule

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimate elapsed time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

7 Transmission Owner Analysis

7.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2023 summer peak load flow model and the results were verified by Dominion. Additionally, Dominion performed an analysis of its transmission system and no further deficiencies were identified.

7.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by Dominion. The connection of AF1-031 project to the system does not result in any newly overdutied circuit breakers on the Dominion transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers

7.3 Stability Analysis

PJM will complete a dynamic stability analysis, if necessary, as part of the System Impact Study. The results of this analysis will be reviewed by Dominion. Should stability concerns be identified in PJM's study, Dominion will develop appropriate system reinforcement(s) and included the estimated cost of any reinforcement(s) in Dominion's System Impact Study report.

8 Interconnection Customer Requirements

8.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in Dominion's "Dominion Energy Electric Transmission Generator Interconnection Requirements" documented in Dominion's Facility Interconnection Requirements "Exhibit C" located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

8.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with Dominion's "Dominion's Facility Interconnection Requirements" document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated protection device (circuit breaker, circuit switcher, fuse) to protect the IC's GSU transformer(s).

2. The purchase and installation of the minimum required Dominion generation interconnection relaying and control facilities as described in the System Protection noted above. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the Dominion Transmission System Control Center.

4. Compliance with the Dominion and PJM generator power factor and voltage control requirements.

The GSU(s) associated with the IC queue request shall meet the grounding requirements as noted in Dominion's "Dominion's Facility Interconnection Requirements" document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access.

The IC will also be required to meet all PJM, SERC, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and SERC audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the Dominion system.

8.3 Power Factor Requirements

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the Dominion transmission system.

9 Revenue Metering and SCADA Requirements

9.1 PJM Requirements

The Interconnection Customer 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 Section 8 of Attachment O.

9.1.1 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

9.2 Dominion Requirements

See Section 3.4.6 “Metering and telecommunications” of Dominion’s “Dominion’s Facility Interconnection Requirements” document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access.

10 Network Impacts

The Queue Project AF1-067 was evaluated as a 50.0 MW (Capacity 30.0 MW) injection at the Kings Dominion DP 115 kV substation in the Dominion area. Project AF1-067 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-067 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

10.1 Generation Deliverability

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4303814 0	31415 1	3SLABTW N	115. 0	DVP	31413 6	3FREDBR G	115. 0	DVP	1	DVP_P1 -2: LN 73	singl e	331.8 2	99.63	108.66	DC	29.97

10.2 Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4303758 2	31421 7	3ELMON T	115. 0	DVP	31423 7	3NRTHWS T	115. 0	DVP	1	DVP_P2- 2: FREDERIC K B1	bus	270.0	99.31	106.45	DC	19.27
4303782 6	31421 7	3ELMON T	115. 0	DVP	31423 7	3NRTHWS T	115. 0	DVP	1	DVP_P4- 4: SC242	breake r	270.0	99.31	106.45	DC	19.27
4303782 7	31421 7	3ELMON T	115. 0	DVP	31423 7	3NRTHWS T	115. 0	DVP	1	DVP_P4- 2: 2942	breake r	270.0	99.31	106.45	DC	19.27
4303782 8	31421 7	3ELMON T	115. 0	DVP	31423 7	3NRTHWS T	115. 0	DVP	1	DVP_P4- 5: FREDERI L742	breake r	270.0	99.31	106.45	DC	19.27

10.3 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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4303813 8	31415 3	3WOODPCK	115. 0	DVP	31415 1	3SLABTW N	115. 0	DVP	1	DVP_P1- 2: LN 73	single	331.8 2	101.5	110.53	DC	29.97
4303749 8	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P2- 2: FREDERIC K B1	bus	229.0	201.27	223.08	DC	49.95
4303768 4	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P4- 4: SC242	breake r	229.0	201.27	223.08	DC	49.95
4303768 5	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P4- 5: FREDERI L742	breake r	229.0	201.27	223.08	DC	49.95
4303768 6	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P4- 2: 2942	breake r	229.0	201.27	223.08	DC	49.95
4303801 6	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P1- 2: LN 47	single	187.0 6	143.73	159.75	DC	29.97
4303801 7	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	DVP_P1- 2: LN 2032-A	single	187.0 6	119.02	130.55	DC	21.56
4303802 1	31422 0	3FOURRIVE RS	115. 0	DVP	31422 1	3HANOVE R	115. 0	DVP	1	Base Case	single	187.0 6	106.43	117.99	DC	21.62

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
46027889	314220	3FOURRIVERS	115.0	DVP	314221	3HANOVER	115.0	DVP	1	3142226HANOVER 230 939750 AE1-206 TAP 230 1	single	187.06	119.02	130.55	DC	21.56
43037503	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P2-2: FREDERICK B1	bus	229.0	201.14	222.95	DC	49.95
43037689	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P4-5: FREDERIL742	breaker	229.0	201.14	222.95	DC	49.95
43037690	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P4-2: 2942	breaker	229.0	201.14	222.95	DC	49.95
43037691	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P4-4: SC242	breaker	229.0	201.14	222.95	DC	49.95
43038028	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P1-2: LN 47	single	187.06	143.57	159.59	DC	29.97
43038029	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P1-2: LN 2032-A	single	187.06	118.86	130.39	DC	21.56
43038033	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	Base Case	single	187.06	106.27	117.83	DC	21.62
46027901	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	3142226HANOVER 230 939750 AE1-206 TAP 230 1	single	187.06	118.86	130.39	DC	21.56

10.4 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 developer 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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43038139	314151	3SLABTWN	115.0	DVP	314136	3FREDBRG	115.0	DVP	1	DVP_P1-2: LN 73	operation	331.82	138.9	153.96	DC	49.95
43038244	314152	3S JOHNS	115.0	DVP	314153	3WOODPCK	115.0	DVP	1	DVP_P1-2: LN 73	operation	331.82	104.97	120.03	DC	49.95
43038137	314153	3WOODPCK	115.0	DVP	314151	3SLABTWN	115.0	DVP	1	DVP_P1-2: LN 73	operation	331.82	140.77	155.83	DC	49.95

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43038232	314216	3PINEWOOD	115.0	DVP	314152	3S JOHNS	115.0	DVP	1	DVP_P1-2: LN 73	operation	331.82	106.87	121.93	DC	49.95
43038290	314217	3ELMONT	115.0	DVP	314237	3NRTHWST	115.0	DVP	1	DVP_P1-2: LN 47	operation	220.9	102.8	111.53	DC	19.27
43038010	314220	3FOURRIVERS	115.0	DVP	314221	3HANOVER	115.0	DVP	1	DVP_P1-2: LN 47	operation	187.06	189.58	216.28	DC	49.95
43038015	314220	3FOURRIVERS	115.0	DVP	314221	3HANOVER	115.0	DVP	1	Base Case	operation	187.06	148.49	167.75	DC	36.04
43038022	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	DVP_P1-2: LN 47	operation	187.06	189.41	216.12	DC	49.95
43038027	314221	3HANOVER	115.0	DVP	314217	3ELMONT	115.0	DVP	1	Base Case	operation	187.06	148.33	167.59	DC	36.04
43038240	314223	3KNGS DOM DP	115.0	DVP	314216	3PINEWOOD	115.0	DVP	1	DVP_P1-2: LN 73	operation	331.82	106.24	121.29	DC	49.95

10.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43037828,43037827, 43037826,43037582	2	3ELMONT 115.0 kV - 3NRTHWST 115.0 kV Ckt 1	dom-144 : Uprate 0.86 miles of 115 kV Line 142 from Elmont to Northwest to operate at 150 degrees F and replace Wave Trap at Elmont. Project Type : FAC Cost : $408,000 Time Estimate : 30-36 Months	$408,000
43038138	3	3WOODPCK 115.0 kV - 3SLABTWN 115.0 kV Ckt 1	dom-154 : Reconductor 9.19 miles of 115 kV Line 47 from Slabtown DP to Woodpecker with 768 ACSS Project Type : FAC Cost : $5,514,000 Time Estimate : 30-36 Months	$5,514,000
46027901,43037503, 43038028,43038029, 43037689,43037690, 43037691,43038033	5	3HANOVER 115.0 kV - 3ELMONT 115.0 kV Ckt 1	n6164 : Rebuild 3.3 miles of 115 kV Line 73 from Hanover to Elmont with 768 ACSS. Project Type : FAC Cost : $4,290,000 Time Estimate : 30-36 Months	$4,950,000
43038017,43038016, 43038021,43037498, 46027889,43037686, 43037685,43037684	4	3FOURRIVERS 115.0 kV - 3HANOVER 115.0 kV Ckt 1	n6163 : Rebuild 5.67 miles of 115 kV Line 73 from Four Rivers to Hanover with 768 ACSS. Project Type : FAC Cost : $7,371,000 Time Estimate : 30-36 Months	$8,505,000
43038140	1	3SLABTWN 115.0 kV - 3FREDBRG 115.0 kV Ckt 1	dom-153 : Reconductor 5.72 miles of 115 kV Line 47 from Fredericksburg to Slabtown DP with 768 ACSS Project Type : FAC Cost : $3,432,000 Time Estimate : 30-36 Months	$3,432,000
			TOTAL COST	**$22,809,000**

10.6 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

10.6.1 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 73	CONTINGENCY 'DVP_P1-2: LN 73' OPEN BRANCH FROM BUS 314217 TO BUS 314221 CKT 1 /* 3ELMONT 115.00 - 3HANOVER 115.00 OPEN BRANCH FROM BUS 314220 TO BUS 314221 CKT 1 /* 3FOURRIVERS 115.00 - 3HANOVER 115.00 OPEN BRANCH FROM BUS 314221 TO BUS 314405 CKT 1 /* 3HANOVER 115.00 - 3HANOV_1 115.00 OPEN BUS 314221 /* ISLAND: 3HANOVER 115.00 OPEN BUS 314405 /* ISLAND: 3HANOV_1 115.00 END
DVP_P2-2: FREDERICK B1	CONTINGENCY 'DVP_P2-2: FREDERICK B1' /* FREDERICKSBURG 115 KV OPEN BRANCH FROM BUS 314076 TO BUS 314136 CKT 1 /* 3QUANTCO 115.00 - 3FREDBRG 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314151 CKT 1 /* 3FREDBRG 115.00 - 3SLABTWN 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314137 CKT 1 /* 3FREDBRG 115.00 - 6FREDBRG 230.00 OPEN BUS 314368 /* 3FREDB_1 115.00 KV END
DVP_P4-5: FREDERI L742	CONTINGENCY 'DVP_P4-5: FREDERI L742' /* FREDERICKSBURG 115 KV OPEN BRANCH FROM BUS 314076 TO BUS 314136 CKT 1 /* 3QUANTCO 115.00 - 3FREDBRG 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314151 CKT 1 /* 3FREDBRG 115.00 - 3SLABTWN 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314137 CKT 1 /* 3FREDBRG 115.00 - 6FREDBRG 230.00 OPEN BUS 314368 /* 3FREDB_1 115.00 KV OPEN BUS 314380 /* 6FREDB_1 230.00 KV END

Contingency Name	Contingency Definition
DVP_P1-2: LN 47	CONTINGENCY 'DVP_P1-2: LN 47' OPEN BRANCH FROM BUS 314136 TO BUS 314151 CKT 1 /* 3FREDBRG 115.00 - 3SLABTWN 115.00 OPEN BRANCH FROM BUS 314151 TO BUS 314153 CKT 1 /* 3SLABTWN 115.00 - 3WOODPCK 115.00 OPEN BRANCH FROM BUS 314152 TO BUS 314153 CKT 1 /* 3S JOHNS 115.00 - 3WOODPCK 115.00 OPEN BRANCH FROM BUS 314152 TO BUS 314216 CKT 1 /* 3S JOHNS 115.00 - 3PINEWOOD 115.00 OPEN BUS 314151 /* ISLAND: 3SLABTWN 115.00 OPEN BUS 314152 /* ISLAND: 3S JOHNS 115.00 OPEN BUS 314153 /* ISLAND: 3WOODPCK 115.00 END
DVP_P1-2: LN 2032-A	CONTINGENCY 'DVP_P1-2: LN 2032-A' OPEN BRANCH FROM BUS 314212 TO BUS 939750 CKT 1 /* 6FOUR RIVERS230.00 - AE1-206 TAP 230.00 END
Base Case	
DVP_P4-2: 2942	CONTINGENCY 'DVP_P4-2: 2942' /* FREDERICKSBURG 115 KV OPEN BRANCH FROM BUS 314073 TO BUS 314076 CKT 1 /* 3POSSUM 115.00 - 3QUANTCO 115.00 OPEN BRANCH FROM BUS 314076 TO BUS 314136 CKT 1 /* 3QUANTCO 115.00 - 3FREDBRG 115.00 OPEN BUS 314076 /* ISLAND: 3QUANTCO 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314151 CKT 1 /* 3FREDBRG 115.00 - 3SLABTWN 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314137 CKT 1 /* 3FREDBRG 115.00 - 6FREDBRG 230.00 OPEN BUS 314368 /* 3FREDB_1 115.00 KV END
314222 6HANOVER 230 939750 AE1-206 TAP 230 1	CONTINGENCY '314222 6HANOVER 230 939750 AE1-206 TAP 230 1' OPEN BRANCH FROM BUS 314222 TO BUS 939750 CKT 1 END
DVP_P4-4: SC242	CONTINGENCY 'DVP_P4-4: SC242' /* FREDERICKSBURG 115 KV OPEN BRANCH FROM BUS 314076 TO BUS 314136 CKT 1 /* 3QUANTCO 115.00 - 3FREDBRG 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314151 CKT 1 /* 3FREDBRG 115.00 - 3SLABTWN 115.00 OPEN BRANCH FROM BUS 314136 TO BUS 314137 CKT 1 /* 3FREDBRG 115.00 - 6FREDBRG 230.00 OPEN BUS 314368 /* 3FREDB_1 115.00 KV END

10.6.2 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43038140	314151	3SLABTWN	DVP	314136	3FREDBRG	DVP	1	DVP_P1-2: LN 73	single	331.82	99.63	108.66	DC	29.97

Bus #	Bus	MW Impact
315050	1FOURRIVERG	23.7073
934781	AD1-105 C	45.3882
939281	**AE1-159 C O1 (Withdrawn : 12/20/2019)**	**75.3306**
941141	AE2-108 C	8.3923
941151	AE2-109 C	2.9373
943601	AF1-031 C	71.3343
943991	AF1-067 C	29.9724
DUCKCREEK	DUCKCREEK	0.1059
NEWTON	NEWTON	0.0989
FARMERCITY	FARMERCITY	0.0052
NY	NY	0.0514
PRAIRIE	PRAIRIE	0.2376
COFFEEN	COFFEEN	0.0486
EDWARDS	EDWARDS	0.0322
CHEOAH	CHEOAH	0.0460
TILTON	TILTON	0.0580
GIBSON	GIBSON	0.0502
CALDERWOOD	CALDERWOOD	0.0457
BLUEG	BLUEG	0.1597
TRIMBLE	TRIMBLE	0.0512
CATAWBA	CATAWBA	0.0322

10.6.3 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43037828	314217	3ELMONT	DVP	314237	3NRTHWST	DVP	1	DVP_P4-5: FREDERI L742	breaker	270.0	99.31	106.45	DC	19.27

Bus #	Bus	MW Impact
315050	1FOURRIVERG	9.1457
927041	AC1-191 C O1	20.5814
927042	AC1-191 E O1	10.2522
934781	AD1-105 C	17.5096
934782	AD1-105 E	12.1677
939281	**AE1-159 C O1 (Withdrawn : 12/20/2019)**	**29.0607**
939282	**AE1-159 E O1 (Withdrawn : 12/20/2019)**	**17.1897**
941141	AE2-108 C	3.2375
941142	AE2-108 E	4.4709
941151	AE2-109 C	1.1331
941152	AE2-109 E	1.5648
943601	AF1-031 C	27.5190
943602	AF1-031 E	14.8772
943991	AF1-067 C	11.5626
943992	AF1-067 E	7.7084
DUCKCREEK	DUCKCREEK	0.0829
NEWTON	NEWTON	0.0827
FARMERCITY	FARMERCITY	0.0049
G-007A	G-007A	0.1223
VFT	VFT	0.3225
PRAIRIE	PRAIRIE	0.2325
COFFEEN	COFFEEN	0.0412
EDWARDS	EDWARDS	0.0245
CHEOAH	CHEOAH	0.0761
TILTON	TILTON	0.0428
GIBSON	GIBSON	0.0399
CALDERWOOD	CALDERWOOD	0.0741
BLUEG	BLUEG	0.1215
TRIMBLE	TRIMBLE	0.0384
CATAWBA	CATAWBA	0.0837

10.6.4 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43038138	314153	3WOODPCK	DVP	314151	3SLABTWN	DVP	1	DVP_P1-2: LN 73	single	331.82	101.5	110.53	DC	29.97

Bus #	Bus	MW Impact
315050	1FOURRIVERG	23.7073
934781	AD1-105 C	45.3882
939281	**AE1-159 C O1 (Withdrawn : 12/20/2019)**	**75.3306**
941141	AE2-108 C	8.3923
941151	AE2-109 C	2.9373
943601	AF1-031 C	71.3343
943991	AF1-067 C	29.9724
DUCKCREEK	DUCKCREEK	0.1059
NEWTON	NEWTON	0.0989
FARMERCITY	FARMERCITY	0.0052
NY	NY	0.0514
PRAIRIE	PRAIRIE	0.2376
COFFEEN	COFFEEN	0.0486
EDWARDS	EDWARDS	0.0322
CHEOAH	CHEOAH	0.0460
TILTON	TILTON	0.0580
GIBSON	GIBSON	0.0502
CALDERWOOD	CALDERWOOD	0.0457
BLUEG	BLUEG	0.1597
TRIMBLE	TRIMBLE	0.0512
CATAWBA	CATAWBA	0.0322

10.6.5 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43037686	314220	3FOURRIVERS	DVP	314221	3HANOVER	DVP	1	DVP_P4-2: 2942	breaker	229.0	201.27	223.08	DC	49.95

Bus #	Bus	MW Impact
315050	1FOURRIVERG	23.7073
934781	AD1-105 C	45.3882
934782	AD1-105 E	31.5410
939281	**AE1-159 C O1 (Withdrawn : 12/20/2019)**	**75.3306**
939282	**AE1-159 E O1 (Withdrawn : 12/20/2019)**	**44.5590**
941141	AE2-108 C	8.3923
941142	AE2-108 E	11.5893
941151	AE2-109 C	2.9373
941152	AE2-109 E	4.0563
943601	AF1-031 C	71.3343
943602	AF1-031 E	38.5645
943991	AF1-067 C	29.9724
943992	AF1-067 E	19.9816
DUCKCREEK	DUCKCREEK	0.1059
NEWTON	NEWTON	0.0989
FARMERCITY	FARMERCITY	0.0052
NY	NY	0.0514
PRAIRIE	PRAIRIE	0.2376
O-066	O-066	0.6182
COFFEEN	COFFEEN	0.0486
EDWARDS	EDWARDS	0.0322
CHEOAH	CHEOAH	0.0460
TILTON	TILTON	0.0580
G-007	G-007	0.0957
GIBSON	GIBSON	0.0502
CALDERWOOD	CALDERWOOD	0.0457
BLUEG	BLUEG	0.1597
TRIMBLE	TRIMBLE	0.0512
CATAWBA	CATAWBA	0.0322

10.6.6 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
43037691	314221	3HANOVER	DVP	314217	3ELMONT	DVP	1	DVP_P4-4: SC242	breaker	229.0	201.14	222.95	DC	49.95

Bus #	Bus	MW Impact
315050	1FOURRIVERG	23.7073
934781	AD1-105 C	45.3882
934782	AD1-105 E	31.5410
939281	**AE1-159 C O1 (Withdrawn : 12/20/2019)**	**75.3306**
939282	**AE1-159 E O1 (Withdrawn : 12/20/2019)**	**44.5590**
941141	AE2-108 C	8.3923
941142	AE2-108 E	11.5893
941151	AE2-109 C	2.9373
941152	AE2-109 E	4.0563
943601	AF1-031 C	71.3343
943602	AF1-031 E	38.5645
943991	AF1-067 C	29.9724
943992	AF1-067 E	19.9816
DUCKCREEK	DUCKCREEK	0.1059
NEWTON	NEWTON	0.0989
FARMERCITY	FARMERCITY	0.0052
NY	NY	0.0514
PRAIRIE	PRAIRIE	0.2376
O-066	O-066	0.6182
COFFEEN	COFFEEN	0.0486
EDWARDS	EDWARDS	0.0322
CHEOAH	CHEOAH	0.0460
TILTON	TILTON	0.0580
G-007	G-007	0.0957
GIBSON	GIBSON	0.0502
CALDERWOOD	CALDERWOOD	0.0457
BLUEG	BLUEG	0.1597
TRIMBLE	TRIMBLE	0.0512
CATAWBA	CATAWBA	0.0322

Short Circuit

10.7 Short Circuit

The following Breakers are overdutied:

None

Affected Systems

11 Affected Systems

11.1 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

Attachment 1

System Configuration