Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-301

LOUISA-SOUTH ANNA 230 KV

89 MW Capacity / 149 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.

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

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 generating facility located in Louisa County, Virginia. The installed facilities will have a total capability of 149 MW with 89 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 12/31/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-301**
Project Name	LOUISA-SOUTH ANNA 230 KV
State	Virginia
County	Louisa
Transmission Owner	Dominion
MFO	149
MWE	149
MWC	89
Fuel	Solar
Basecase Study Year	2023

3.1 Point of Interconnection

AF1-301 will interconnect with the Dominion transmission system at a new 230kV three breaker ring bus substation tapping the Louisa to South Anna 230 kV line. The IC is responsible for securing right-of-way, permits and constructing the proposed attachment line from the solar facility site to the proposed new substation. Attachment 1 shows a one-line diagram of the proposed interconnection facilities. The IC may not install any facilities on Dominion's right-of-way without first obtaining the necessary approval from Dominion Energy.

There is was no secondary point of interconnection specified for AF1-301.

3.2 Cost Summary

The AF1-301 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 2,100,000
Direct Connection Network Upgrade	$ 6,500,000
Non Direct Connection Network Upgrades	$ 1,800,000
Total Costs	**$10,400,000**

In addition, the AF1-301 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	**$ 146,630,000**

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 AF1-301. The project was evaluated as an 89 MW Capacity (149 MW Energy) injection at a single line tap between Louisa 230 kV substation and South Anna 230 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 AF1-301 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 Attachment Facilities

To accommodate the proposed AF1-301 Project, Dominion Energy will install one span of overhead 230 kV line to the point of interconnection ("POI") including 230 kV interconnection metering.

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Substation (Metering)	$ 600,000
Transmission (One span)	$ 1,500,000
	$
Total Attachment Facility Costs	**$ 2,100,000**

It is estimated to take 18-24 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). 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. See Attachment 1.

6 Direct Connection Cost Estimate

To accommodate the proposed AF1-301 Project, Dominion Energy will build a new three breaker 230 kV Switching Station.

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Substation	$ 6,500,000
Total Direct Connection Facility Costs	**$ 6,500,000**

It is estimated to take 24-30 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). 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. See Attachment 1.

7 Non-Direct Connection Cost Estimate

To accommodate the proposed AF1-301 Project, Dominion Energy will re-arrange the existing section of the line between Louisa and South Anna 230 kV Substations.

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Transmission (one span)	$ 1,800,000
Total Direct Connection Facility Costs	**$ 1,800,000**

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.

8 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.

9 Transmission Owner Analysis

9.1 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.

9.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by Dominion. The connection of AF1-301 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

9.3 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.

10 Interconnection Customer Requirements

10.1 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.

10.2 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.

10.3 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.1.1 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

11.2 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.

12 Network Impacts

The Queue Project AF1-301 was evaluated as a 149.0 MW (Capacity 89.0 MW) injection tapping the Louisa to South Anna 230 kV line in the Dominion area. Project AF1-301 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-301 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

12.1 Generation Deliverability

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

None

12.2 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
4296237	31491	8NO	500.	DVP	31493	8SPOTSY	500.	DVP	1	DVP_P4	breake	3938.	99.61	100.04	DC	46.23
4	8	ANNA	0		4	L	0			-2: 57502	r	0				

12.3 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
4296235	31491	8NO	500.	DVP	31491	8LADYSMIT	500.	DVP	1	DVP_P4	breake	3938.0	104.88	105.24	DC	61.9
3	8	ANNA	0		1	H	0			-2: SPOTS H1T594	r					
4296235	31491	8NO	500.	DVP	31491	8LADYSMIT	500.	DVP	1	DVP_P4	breake	3938.0	100.06	101.04	DC	62.68
4	8	ANNA	0		1	H	0			-2: H1T594	r					
4296237	31491	8NO	500.	DVP	31493	8SPOTSYL	500.	DVP	1	DVP_P4	breake	3938.0	100.67	100.85	DC	52.51
5	8	ANNA	0		4		0			-2: 568T575	r					
4296258	31491	8NO	500.	DVP	31491	8LADYSMIT	500.	DVP	1	DVP_P1	single	3218.56	112.4	113.57	DC	36.88
8	8	ANNA	0		1	H	0			-2: LN 573						
4296258	31491	8NO	500.	DVP	31491	8LADYSMIT	500.	DVP	1	DVP_P1	single	3218.56	108.07	109.24	DC	37.07
9	8	ANNA	0		1	H	0			-2: LN 594						
4296233	31493	8SPOTSY	500.	DVP	31491	8MORRSVL	500.	DVP	1	DVP_P4	breake	3938.0	109.35	109.56	DC	53.17
8	4	L	0		6		0			-2: 568T575	r					
4296233	31493	8SPOTSY	500.	DVP	31491	8MORRSVL	500.	DVP	1	DVP_P4	breake	3938.0	104.1	104.27	DC	47.42
9	4	L	0		6		0			-2: 57502	r					
4296234	31493	8SPOTSY	500.	DVP	31491	8MORRSVL	500.	DVP	1	DVP_P4	breake	3938.0	103.9	104.13	DC	52.54
0	4	L	0		6		0			-2: H1T575	r					

12.4 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
4296258 6	314918	8NO ANNA	500.0	DVP	314911	8LADYSMITH	500.0	DVP	1	DVP_P1-2: LN 594	operation	3218.56	122.1	123.04	DC	62.06
4296261 9	314918	8NO ANNA	500.0	DVP	314934	8SPOTSYL	500.0	DVP	1	DVP_P1-2: LN 575	operation	3218.56	117.61	117.87	DC	51.97
4296255 0	314934	8SPOTSYL	500.0	DVP	314916	8MORRSVL	500.0	DVP	1	DVP_P1-2: LN 575	operation	3218.56	126.98	127.27	DC	52.55

12.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
42962588,42962354, 42962353,42962589	2	**8NO ANNA 500.0 kV - 8LADYSMITH 500.0 kV Ckt 1**	**dom-044 (577) : Rebuild 14.53 miles of 500 kV Line 575 from North Anna to Ladysmith with 3-1351.5 113C ACSR.** **Project Type : FAC** **Cost : $45,043,000** **Time Estimate : 48-60 Months**	$45,043,000
42962339,42962338, 42962340	3	**8SPOTSYL 500.0 kV - 8MORRSVL 500.0 kV Ckt 1**	**n6160 (777) : Rebuild 18.75 miles of 500 kV Line 594 from Spotsylvania to Morrisvile with 3-1351.5 113C ACSR.** **Project Type : FAC** **Cost : $58,125,000** **Time Estimate : 48-60 Months**	$58,125,000
42962375,42962374	1	**8NO ANNA 500.0 kV - 8SPOTSYL 500.0 kV Ckt 1**	**n6132 (759) : Rebuild 14.02 miles of 500 kV Line 573 from North Anna to Spotsylvania with 3-1351.5 113C ACSR.** **Project Type : FAC** **Cost : $43,462,000** **Time Estimate : 48-60 Months**	$43,462,000
			TOTAL COST	**$146,630,000**

12.6 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.

12.6.1 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 594	CONTINGENCY 'DVP_P1-2: LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END
DVP_P1-2: LN 573	CONTINGENCY 'DVP_P1-2: LN 573' OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00 END
DVP_P1-2: LN 575	CONTINGENCY 'DVP_P1-2: LN 575' OPEN BRANCH FROM BUS 314911 TO BUS 314918 CKT 1 /* 8LADYSMITH 500.00 - 8NO ANNA 500.00 END
DVP_P4-2: H1T594	CONTINGENCY 'DVP_P4-2: H1T594' /* MORRISVILLE 500 KV OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 OPEN BRANCH FROM BUS 314063 TO BUS 314916 CKT 1 /* 6MORRSVL 230.00 - 8MORRSVL 500.00 OPEN BUS 314897 /* 8MORRS_1 500.00 KV END
DVP_P4-2: 568T575	CONTINGENCY 'DVP_P4-2: 568T575' /* LADYSMITH 500 KV OPEN BRANCH FROM BUS 314911 TO BUS 314922 CKT 1 /* 8LADYSMITH 500.00 - 8POSSUM 500.00 OPEN BRANCH FROM BUS 314911 TO BUS 314918 CKT 1 /* 8LADYSMITH 500.00 - 8NO ANNA 500.00 END

Contingency Name	Contingency Definition
DVP_P4-2: SPOTS H1T594	CONTINGENCY 'DVP_P4-2: SPOTS H1T594' /* SPOTSYLVANIA 500 KV OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 OPEN BRANCH FROM BUS 314755 TO BUS 314934 CKT 1 /* 3SPOTSYL 115.00 - 8SPOTSYL 500.00 END
DVP_P4-2: H1T575	CONTINGENCY 'DVP_P4-2: H1T575' /* LADYSMITH 500 KV OPEN BRANCH FROM BUS 314911 TO BUS 314918 CKT 1 /* 8LADYSMITH 500.00 - 8NO ANNA 500.00 OPEN BRANCH FROM BUS 314196 TO BUS 314911 CKT 1 /* 6LADYSMITH 230.00 - 8LADYSMITH 500.00 END
DVP_P4-2: 57502	CONTINGENCY 'DVP_P4-2: 57502' /* NORTH ANNA 500 KV OPEN BRANCH FROM BUS 314911 TO BUS 314918 CKT 1 /* 8LADYSMITH 500.00 - 8NO ANNA 500.00 OPEN BRANCH FROM BUS 314232 TO BUS 314918 CKT 1 /* 6NO ANNA 230.00 - 8NO ANNA 500.00 END

12.6.2 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
42962375	314918	8NO ANNA	DVP	314934	8SPOTSYL	DVP	1	DVP_P4-2: 568T575	breaker	3938.0	100.67	100.85	DC	52.51

Bus #	Bus	MW Impact
314333	6POWHATN	0.3798
314435	6SAPONY	0.3501
314947	8GREENSVILLE	48.1025
315102	1BRUNSWICKG1	7.8991
315103	1BRUNSWICKG2	7.8991
315104	1BRUNSWICKG3	7.8991
315105	1BRUNSWICKS1	16.4102
315153	1CLOVER1	11.2535
315154	1CLOVER2	11.1414
315177	1S ANNAG1	1.4409
315178	1S ANNAS1	0.7405
315179	1S ANNAG2	1.4409
315180	1S ANNAS2	0.7405
315225	1N ANNA1	80.0074
315226	1N ANNA2	80.0410
901082	W1-029 E	38.8237
913392	Y1-086 E	1.8586
916192	Z1-068 E	1.5924
917122	Z2-027 E	0.8964
919152	AA1-139 E	5.4407
923831	AB2-022 C	1.9486
923832	AB2-022 E	1.0492
923852	AB2-025 E	1.1267
923862	AB2-026 E	1.2224
925021	AB2-158 C	21.1530
925022	AB2-158 E	9.4321
925522	AC1-027 E	0.9703
926661	AC1-147 C	1.9075
926662	AC1-147 E	1.1202
926731	AC1-158 C	-82.8527
926732	AC1-158 E	-36.3598

Bus #	Bus	MW Impact
926751	AC1-161 C O1	25.8332
926752	AC1-161 E O1	11.0275
932041	AC2-012 C	8.6289
932042	AC2-012 E	14.0788
932591	AC2-079 C O1	4.7862
932592	AC2-079 E O1	7.8091
933291	AC2-141 C	25.8332
933292	AC2-141 E	11.0275
933501	AC2-165 C	10.7263
933502	AC2-165 E	8.0729
933731	AC2-196 C	1.5192
933732	AC2-196 E	1.0118
934061	AD1-033 C	6.3792
934062	AD1-033 E	4.2528
934571	AD1-082 C	4.7685
934572	AD1-082 E	2.7202
935111	AD1-144 C	1.4333
935112	AD1-144 E	0.7831
935211	AD1-156 C	1.7630
935212	AD1-156 E	1.1753
936661	AD2-085 C	2.8709
936662	AD2-085 E	4.6841
937221	AD2-160 C O1	4.9646
937222	AD2-160 E O1	2.6034
937541	AD2-215 C	1.4481
937542	AD2-215 E	0.7684
938181	AE1-027 C	1.9876
938182	AE1-027 E	1.0469
938191	AE1-028 C	1.1531
938192	AE1-028 E	0.6676
938491	AE1-068 C O1	68.7329
938492	AE1-068 E O1	37.9621
938501	AE1-069 C O1	53.8064
938502	AE1-069 E O1	30.7616
938531	AE1-072 C O1	14.8788
938532	AE1-072 E O1	7.7563
938551	AE1-074 C	2.5775
938552	AE1-074 E	1.2985
938561	AE1-075 C	2.3856
938562	AE1-075 E	1.1632

Bus #	Bus	MW Impact
939231	AE1-154 C	3.4677
939232	AE1-154 E	2.4274
939411	AE1-173 C	99.5904
939412	AE1-173 E	66.3936
940061	AE2-000BC O1	13.2574
940062	AE2-000BE O1	8.8383
940251	AE2-007 O1	146.6940
940471	AE2-031 C	37.5301
940472	AE2-031 E	25.0200
940481	AE2-033 C	13.6556
940482	AE2-033 E	9.2060
940541	AE2-040 O1	3.2057
940641	AE2-051 C O1	19.5300
940642	AE2-051 E O1	13.0200
941031	AE2-094 C	44.9810
941032	AE2-094 E	20.1460
941101	AE2-104 C O1	2.9414
941102	AE2-104 E O1	4.6734
941281	AE2-122 C O1	12.7735
941282	AE2-122 E O1	51.5443
941291	AE2-123 C O1	13.1272
941292	AE2-123 E O1	51.1906
941301	AE2-124 C O1	11.9395
941302	AE2-124 E O1	52.3891
941501	AE2-147 C	13.3875
941502	AE2-147 E	8.9250
941591	AE2-156 O1	15.1487
942131	AE2-225 C	1.8054
942132	AE2-225 E	1.2036
942171	AE2-229 C	1.8054
942172	AE2-229 E	1.2036
942341	AE2-247 C	0.6594
942342	AE2-247 E	0.9106
942401	AE2-253 C	5.2219
942402	AE2-253 E	2.3461
942471	AE2-260 C O1	12.1920
942472	AE2-260 E O1	17.2928
942851	AE2-304 C	0.5324
942852	AE2-304 E	0.2070
942931	AE2-313 C	40.6360

Bus #	Bus	MW Impact
942932	AE2-313 E	27.0907
943451	AF1-016 C O1	0.6109
943452	AF1-016 E O1	0.9718
943461	AF1-017 C	0.5966
943462	AF1-017 E	0.9735
943611	AF1-032 C	0.7814
943612	AF1-032 E	0.4146
944011	AF1-069 C	14.6970
944012	AF1-069 E	5.7095
944111	AF1-079 C	6.5886
944112	AF1-079 E	8.9467
944581	AF1-123 C O1	19.7684
944582	AF1-123 E O1	51.6740
944591	AF1-124 C O1	19.7684
944592	AF1-124 E O1	51.6740
944601	AF1-125 C O1	19.7684
944602	AF1-125 E O1	51.6740
944871	AF1-152 C	2.3651
944872	AF1-152 E	1.5767
945811	AF1-246 C O1	8.0690
945812	AF1-246 E O1	11.1430
946011	AF1-266	6.0583
946371	AF1-301 C	31.3672
946372	AF1-301 E	21.1464
946461	**AF1-310 C O1 (Withdrawn : 11/05/2019)**	**20.8175**
946462	**AF1-310 E O1 (Withdrawn : 11/05/2019)**	**33.9655**
LGEE	LGEE	1.3030
CPLE	CPLE	8.0690
WEC	WEC	0.6533
CBM-W2	CBM-W2	29.6069
NY	NY	2.6456
CBM-W1	CBM-W1	23.1685
TVA	TVA	6.5450
O-066	O-066	35.6765
CBM-S2	CBM-S2	55.6787
CBM-S1	CBM-S1	36.0481
G-007	G-007	5.5682
MADISON	MADISON	2.0039
MEC	MEC	4.2124
AA2-074	AA2-074	5.4981

12.6.3 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
42962588	314918	8NO ANNA	DVP	314911	8LADYSMITH	DVP	1	DVP_P1-2: LN 573	single	3218.56	112.4	113.57	DC	36.88

Bus #	Bus	MW Impact
314295	6BIRDNECK	0.0288
314333	6POWHATN	0.3398
314435	6SAPONY	0.2829
314947	8GREENSVILLE	43.3131
315102	1BRUNSWICKG1	7.1073
315103	1BRUNSWICKG2	7.1073
315104	1BRUNSWICKG3	7.1073
315105	1BRUNSWICKS1	14.7654
315131	**1EDGECMA (Deativation : 04/22/19)**	**6.1260**
315132	**1EDGECMB (Deativation : 04/22/19)**	**6.1260**
315153	1CLOVER1	10.0481
315154	1CLOVER2	9.9480
315172	1LOISA A	2.4389
315173	1LOISA B	2.4515
315174	1LOISA C	2.4515
315175	1LOISA D	2.4515
315176	1LOISA E	4.9979
315177	1S ANNAG1	1.7863
315178	1S ANNAS1	0.9180
315179	1S ANNAG2	1.7863
315180	1S ANNAS2	0.9180
315225	1N ANNA1	91.4291
315226	1N ANNA2	91.4675
315294	1DOMTR10	7.2270
315603	6AA1-139SOLA	1.6132
922922	AB1-081 C OP	5.9157
923262	AB1-132 C OP	9.5583
923263	AB1-132 E OP	4.0964
923572	AB1-173 C OP	1.5552
923582	AB1-173AC OP	1.5552
923801	AB2-015 C OP	5.7044
923831	AB2-022 C	1.5122

Bus #	Bus	MW Impact
923911	AB2-031 C O1	1.5437
923991	AB2-040 C O1	5.0688
924021	AB2-043 C O1	2.1240
924151	AB2-059 C OP	6.9721
924161	AB2-060 C OP	6.1199
924301	AB2-077 C O1	1.3464
924311	AB2-078 C O1	1.3464
924321	AB2-079 C O1	1.3464
924501	AB2-099 C	0.3930
924511	AB2-100 C	9.3880
925021	AB2-158 C	24.8965
925061	AB2-161 C O1	2.1136
925121	AB2-169 C	4.2972
925171	AB2-174 C O1	4.8598
925591	AC1-034 C	4.5160
925611	AC1-036 C	0.6519
925781	AC1-054 C O1	4.9120
926071	AC1-086 C	14.0758
926201	AC1-098 C	4.1289
926211	AC1-099 C	1.3836
926271	AC1-105 C O1	3.7753
926661	AC1-147 C	1.4645
926751	AC1-161 C O1	23.3949
927021	AC1-189 C	5.6996
927141	AC1-208 C	6.0727
927261	AC1-222 C	2.4104
932041	AC2-012 C	6.6251
932511	AC2-071 C	1.5504
932581	AC2-078 C O1	2.4496
932591	AC2-079 C O1	3.6482
932631	AC2-084 C	5.8859
933291	AC2-141 C	23.3949
933501	AC2-165 C	9.6131
933731	AC2-196 C	1.3806
933991	AD1-023 C	8.7483
934061	AD1-033 C	5.7952
934201	AD1-047 C	5.5296
934311	AD1-055 C	1.6736
934331	AD1-057 C O1	6.6934
934521	AD1-076 C	36.1597

Bus #	Bus	MW Impact
934571	AD1-082 C	4.8167
934611	AD1-087 C O1	7.2788
934621	AD1-088 C	10.6136
935111	AD1-144 C	1.0854
935171	AD1-152 C O1	7.2336
935211	AD1-156 C	1.3235
935221	AD1-157 C	1.0500
935231	AD1-160 C	0.7700
936261	AD2-033 C	8.8928
936331	**AD2-043 C (Withdrawn : 12/20/2019)**	**3.1370**
936361	AD2-046 C O1	6.0284
936401	AD2-051 C O1	5.8775
936481	AD2-063 C O1	10.1829
936661	AD2-085 C	2.1874
936701	**AD2-089 C (Withdrawn : 12/09/2019)**	**4.7809**
936711	AD2-090 C O1	4.7781
937221	AD2-160 C O1	4.5175
937481	AD2-202 C O1	1.9290
937541	AD2-215 C	1.0966
937571	AD2-169 C	6.8784
938171	AE1-026 C O1	21.3617
938181	AE1-027 C	1.8070
938191	AE1-028 C	1.0483
938221	AE1-035 C	1.5023
938371	AE1-056 C	4.5268
938491	AE1-068 C O1	61.9269
938501	AE1-069 C O1	48.4492
938531	AE1-072 C O1	13.5526
938551	AE1-074 C	2.0377
938561	AE1-075 C	2.1347
938631	AE1-085 C O1	5.3996
938661	AE1-088	2.2037
938771	AE1-103 C O1	2.3989
939181	AE1-148 C O1	5.9468
939191	AE1-149 C O1	6.4051
939231	AE1-154 C	4.0814
939311	AE1-162 C	1.2822
939371	AE1-168 C	10.3948
939411	AE1-173 C	85.6032
940061	AE2-000BC O1	10.0116

Bus #	Bus	MW Impact
940241	AE2-006	0.3317
940251	AE2-007 O1	112.7510
940471	AE2-031 C	33.8378
940481	AE2-033 C	12.9940
940491	AE2-034 C	2.9496
940521	AE2-037 C	5.3773
940541	AE2-040 O1	2.5910
940571	AE2-044 C	1.5677
940641	AE2-051 C O1	17.2521
940651	AE2-052	1.1316
940661	AE2-053 O1	2.2025
941031	AE2-094 C	40.5698
941101	AE2-104 C O1	2.2691
941281	AE2-122 C O1	21.8472
941291	AE2-123 C O1	22.4521
941301	AE2-124 C O1	20.4277
941501	AE2-147 C	10.4132
941541	AE2-151 C	0.7284
941591	AE2-156 O1	11.6348
941601	AE2-157 C	6.5836
941791	AE2-182 C	2.0216
942131	AE2-225 C	1.3950
942171	AE2-229 C	1.3950
942341	AE2-247 C	0.5024
942401	AE2-253 C	4.7517
942451	AE2-258	1.5845
942461	AE2-259 C O1	8.3514
942471	AE2-260 C O1	11.6533
942851	AE2-304 C	0.4153
942931	AE2-313 C	36.6381
943171	AE2-346 C	0.4999
943451	AF1-016 C O1	0.4713
943461	AF1-017 C	0.4545
943611	AF1-032 C	0.6038
943901	AF1-058 C	0.7027
943911	AF1-059	6.0673
944011	AF1-069 C	13.2557
944051	AF1-073 C O1	7.1711
944061	AF1-074 C O1	2.3595
944111	AF1-079 C	7.7547

Bus #	Bus	MW Impact
944141	AF1-082	1.0078
944581	AF1-123 C O1	34.0072
944591	AF1-124 C O1	34.0072
944601	AF1-125 C O1	34.0072
944871	AF1-152 C	1.8397
945711	AF1-236 C O1	27.6780
945811	AF1-246 C O1	7.2269
946011	AF1-266	10.8770
946281	AF1-292 C	1.2258
946301	AF1-294 C	1.8457
946371	AF1-301 C	36.8780
946461	**AF1-310 C O1 (Withdrawn : 11/05/2019)**	**18.5877**
LGEE	LGEE	1.0697
CPLE	CPLE	6.9266
WEC	WEC	0.5405
CBM-W2	CBM-W2	24.7256
NY	NY	2.2220
CBM-W1	CBM-W1	19.2279
TVA	TVA	5.4712
CBM-S2	CBM-S2	47.5174
CBM-S1	CBM-S1	30.0841
MADISON	MADISON	1.7136
MEC	MEC	3.5006
AA2-074	AA2-074	4.7191

12.6.4 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
42962338	314934	8SPOTSYL	DVP	314916	8MORRSVL	DVP	1	DVP_P4-2: 568T575	breaker	3938.0	109.35	109.56	DC	53.17

Bus #	Bus	MW Impact
314947	8GREENSVILLE	47.4267
315102	1BRUNSWICKG1	7.7894
315103	1BRUNSWICKG2	7.7894
315104	1BRUNSWICKG3	7.7894
315105	1BRUNSWICKS1	16.1823
315174	1LOISA C	2.2057
315175	1LOISA D	2.2057
315176	1LOISA E	4.4968
315177	1S ANNAG1	1.5979
315178	1S ANNAS1	0.8211
315179	1S ANNAG2	1.5979
315180	1S ANNAS2	0.8211
315225	1N ANNA1	77.0404
315226	1N ANNA2	77.0728
901082	W1-029 E	38.6507
913392	Y1-086 E	1.8504
916192	Z1-068 E	1.5857
917122	Z2-027 E	0.8924
919152	AA1-139 E	5.4171
923831	AB2-022 C	1.9399
923832	AB2-022 E	1.0446
923852	AB2-025 E	0.9514
923862	AB2-026 E	1.0365
925021	AB2-158 C	21.4592
925022	AB2-158 E	9.5687
925061	AB2-161 C O1	2.7910
925062	AB2-161 E O1	4.5538
925522	AC1-027 E	0.9663
926001	AC1-076 C	6.8313
926002	AC1-076 E	11.1081
926481	AC1-120 C O1	6.1648

Bus #	Bus	MW Impact
926482	AC1-120 E O1	3.1758
926501	AC1-121 C O1	2.1172
926502	AC1-121 E O1	0.9963
926661	AC1-147 C	1.8998
926662	AC1-147 E	1.1158
926731	AC1-158 C	239.5526
926732	AC1-158 E	105.1274
926751	AC1-161 C O1	25.7217
926752	AC1-161 E O1	10.9799
932041	AC2-012 C	8.5945
932042	AC2-012 E	14.0227
932591	AC2-079 C O1	4.7700
932592	AC2-079 E O1	7.7827
932781	AC2-102 C	4.4667
932782	AC2-102 E	7.2878
933291	AC2-141 C	25.7217
933292	AC2-141 E	10.9799
933501	AC2-165 C	9.1236
933502	AC2-165 E	6.8667
933731	AC2-196 C	1.5127
933732	AC2-196 E	1.0074
934061	AD1-033 C	6.3517
934062	AD1-033 E	4.2345
934571	AD1-082 C	6.3606
934572	AD1-082 E	3.6284
935111	AD1-144 C	1.4289
935112	AD1-144 E	0.7808
935211	AD1-156 C	1.7587
935212	AD1-156 E	1.1724
936661	AD2-085 C	2.8614
936662	AD2-085 E	4.6685
937221	AD2-160 C O1	4.9428
937222	AD2-160 E O1	2.5920
937541	AD2-215 C	1.4437
937542	AD2-215 E	0.7660
938181	AE1-027 C	1.9789
938182	AE1-027 E	1.0423
938191	AE1-028 C	1.1481
938192	AE1-028 E	0.6647
938491	AE1-068 C O1	67.7570

Bus #	Bus	MW Impact
938492	AE1-068 E O1	37.4230
938501	AE1-069 C O1	53.0505
938502	AE1-069 E O1	30.3295
938531	AE1-072 C O1	14.8134
938532	AE1-072 E O1	7.7222
938551	AE1-074 C	2.1805
938552	AE1-074 E	1.0985
938561	AE1-075 C	2.0228
938562	AE1-075 E	0.9863
939231	AE1-154 C	3.5179
939232	AE1-154 E	2.4625
939411	AE1-173 C	98.4528
939412	AE1-173 E	65.6352
940061	AE2-000BC O1	13.2207
940062	AE2-000BE O1	8.8138
940251	AE2-007 O1	146.1018
940471	AE2-031 C	36.9941
940472	AE2-031 E	24.6628
940481	AE2-033 C	13.5663
940482	AE2-033 E	9.1458
940541	AE2-040 O1	1.4347
940641	AE2-051 C O1	19.2699
940642	AE2-051 E O1	12.8466
941031	AE2-094 C	44.3304
941032	AE2-094 E	19.8546
941101	AE2-104 C O1	2.9295
941102	AE2-104 E O1	4.6545
941281	AE2-122 C O1	12.7198
941282	AE2-122 E O1	51.3276
941291	AE2-123 C O1	13.0721
941292	AE2-123 E O1	50.9754
941301	AE2-124 C O1	11.8893
941302	AE2-124 E O1	52.1690
941381	AE2-134	4.7073
941501	AE2-147 C	13.3278
941502	AE2-147 E	8.8852
941591	AE2-156 O1	15.0875
941831	AE2-188	5.8772
942131	AE2-225 C	1.7977
942132	AE2-225 E	1.1985

Bus #	Bus	MW Impact
942171	AE2-229 C	1.7977
942172	AE2-229 E	1.1985
942341	AE2-247 C	0.6572
942342	AE2-247 E	0.9076
942401	AE2-253 C	5.1990
942402	AE2-253 E	2.3358
942471	AE2-260 C O1	11.2466
942472	AE2-260 E O1	15.9519
942851	AE2-304 C	0.5300
942852	AE2-304 E	0.2061
942931	AE2-313 C	40.0557
942932	AE2-313 E	26.7038
943451	AF1-016 C O1	0.6085
943452	AF1-016 E O1	0.9678
943461	AF1-017 C	0.5946
943462	AF1-017 E	0.9702
943611	AF1-032 C	0.7781
943612	AF1-032 E	0.4129
944011	AF1-069 C	14.4844
944012	AF1-069 E	5.6269
944111	AF1-079 C	6.6840
944112	AF1-079 E	9.0762
944581	AF1-123 C O1	19.6774
944582	AF1-123 E O1	51.4360
944591	AF1-124 C O1	19.6774
944592	AF1-124 E O1	51.4360
944601	AF1-125 C O1	19.6774
944602	AF1-125 E O1	51.4360
944871	AF1-152 C	2.3546
944872	AF1-152 E	1.5697
945811	AF1-246 C O1	3.5950
945812	AF1-246 E O1	4.9645
946011	AF1-266	6.0187
946371	AF1-301 C	31.7596
946372	AF1-301 E	21.4110
946461	**AF1-310 C O1 (Withdrawn : 11/05/2019)**	**9.2905**
946462	**AF1-310 E O1 (Withdrawn : 11/05/2019)**	**15.1582**
LGEE	LGEE	1.3179
CPLE	CPLE	8.0154
WEC	WEC	0.6599

Bus #	Bus	MW Impact
CBM-W2	CBM-W2	29.7215
NY	NY	2.6572
CBM-W1	CBM-W1	23.4312
TVA	TVA	6.5590
O-066	O-066	35.8445
CBM-S2	CBM-S2	55.4244
CBM-S1	CBM-S1	36.1589
G-007	G-007	5.5942
MADISON	MADISON	1.9898
MEC	MEC	4.2426
AA2-074	AA2-074	5.4617

Short Circuit

12.7 Short Circuit

The following Breakers are overdutied:

None

Affected Systems

13 Affected Systems

13.1 Duke Energy Progress

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

Attachment 1

System Configuration