Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-266

CLUBHOUSE-SAPONY 230 KV

74.5 MW Capacity / 74.5 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.

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.

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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 storage generating facility located in Sussex County, Virginia. The installed facilities will have a capability of 74.5 MW with 74.5 MW of this output being recognized by PJM as Capacity. Note that this project is an increase to the Interconnection Customer's AE2-033 project and will share the same property and connection point.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

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	AF1-266
Project Name	CLUBHOUSE-SAPONY 230 KV
State	Virginia
County	Sussex
Transmission Owner	Dominion
MFO	223.5
MWE	74.5
MWC	74.5
Fuel	Storage
Basecase Study Year	2023

3.1 Point of Interconnection

AF1-266 will interconnect with the Dominion transmission system connected with a line tap between Clubhouse substation and Sapony substation. The POI is 14.28 miles away from Clubhouse substation while 2.47 miles away from the Sapony substation.

3.2 Cost Summary

The AF1-266 project will utilize the Interconnection Facilities being built under the AE2-033 project.

The AF1-266 project may be responsible for a contribution to the following costs

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Description	Total Cost
System Upgrades	**$ 63,618,000**

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 AF1-266. The project was evaluated as a 74.5 MW Capacity (74.5 MW Energy) injection at the existing AE2-033 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,

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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 AF1-266 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.

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.

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7.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by Dominion. The connection of AF1-266 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.

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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.

9.2 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 AF1-266 was evaluated as a 74.5 MW (Capacity 74.5 MW) injection as an uprate to AE2-033 tapping the Clubhouse to Sapony 230 kV line in the Dominion area. Project AF1-266 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-266 was studied with a commercial probability of 53%. Potential network impacts were as follows:

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Summer Peak Load Flow

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10.1 Generation Deliverability

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

None

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
4294651 4	314918	8NO ANNA	500.0	DVP	314911	8LADYSMITH	500.0	DVP	1	DVP_P4-2: H1T594	breaker	3938.0	99.93	100.0	DC	10.35

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
4294665 2	313845	6HATHAWAY	230.0	DVP	304222	6ROCKYMT230T	230.0	CPLE	1	DVP_P1-2: LN 2181	single	478.0	116.87	118.13	DC	6.01
4294664 7	314591	6NASH	230.0	DVP	304226	6PA-RMOUNT#4	230.0	CPLE	1	DVP_P1-2: LN 2058	single	478.0	116.18	117.46	DC	6.11

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
4294665 1	313845	6HATHAWAY	230.0	DVP	304222	6ROCKYMT230T	230.0	CPLE	1	DVP_P1-2: LN 2181	operation	478.0	146.95	147.52	DC	6.01
4294664 4	314591	6NASH	230.0	DVP	304226	6PA-RMOUNT#4	230.0	CPLE	1	DVP_P1-2: LN 2058	operation	478.0	147.6	148.18	DC	6.11

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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
46386248	314615	3SKIPPERS	115.0	DVP	925170	AB2-174 TAP	115.0	DVP	1	DVP_P1-2: LN 5254	operation	269.78	107.97	110.34	DC	6.42

10.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
42946514	1	8NO ANNA 500.0 kV - 8LADYSMITH 500.0 kV Ckt 1	DVP dom-044 : 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
42946652	2	6HATHAWAY 230.0 kV - 6ROCKYMT230T 230.0 kV Ckt 1	DVP dom-003 : For DEV portion, rebuild 4.13 miles of 230 kV Line 2058 from Hathaway to Rocky Mountain with 2-636 ACSR. Project Type : FAC Cost : $10,325,000 Time Estimate : 30-36 Months	$10,325,000
42946647	3	6NASH 230.0 kV - 6PA-RMOUNT#4 230.0 kV Ckt 1	dom-005 : For DEV portion, rebuild 3.3 miles of 230 kV Line 2181 from Nash to Parmount with 2-636 ACSR. Project Type : FAC Cost : $8,250,000 Time Estimate : 30-36 Months	$8,250,000
			TOTAL COST	**$63,618,000**

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.

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10.6.1 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 2181	CONTINGENCY 'DVP_P1-2: LN 2181' OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 END
DVP_P1-2: LN 5254	CONTINGENCY 'DVP_P1-2: LN 5254' OPEN BRANCH FROM BUS 314563 TO BUS 924510 CKT 1 /* 6CLUBHSE 230.00 - AB2-100 TAP 230.00 END
DVP_P1-2: LN 2058	CONTINGENCY 'DVP_P1-2: LN 2058' OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 OPEN BRANCH FROM BUS 313844 TO BUS 313845 CKT 2 /* 3HATHAWAY 115.00 - 6HATHAWAY 230.00 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

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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
42946514	314918	8NO ANNA	DVP	314911	8LADYSMITH	DVP	1	DVP_P4-2: H1T594	breaker	3938.0	99.93	100.0	DC	10.35

Bus #	Bus	MW Impact
315172	1LOISA A	2.6932
315173	1LOISA B	2.7071
315174	1LOISA C	2.7071
315175	1LOISA D	2.7071
315176	1LOISA E	5.5190
315177	1S ANNAG1	1.9512
315178	1S ANNAS1	1.0027
315179	1S ANNAG2	1.9512
315180	1S ANNAS2	1.0027
315225	1N ANNA1	88.8990
315226	1N ANNA2	88.9364
901082	W1-029 E	28.6342
913392	Y1-086 E	1.3672
916192	Z1-068 E	1.1617
917122	Z2-027 E	0.6602
919152	AA1-139 E	3.9893
923572	AB1-173 C OP	1.4849
923573	AB1-173 E OP	0.6929
923582	AB1-173AC OP	1.4849
923583	AB1-173AE OP	0.6929
923831	AB2-022 C	1.4334
923832	AB2-022 E	0.7718
923852	AB2-025 E	0.7367
923862	AB2-026 E	0.9027
923911	AB2-031 C O1	1.4739
923912	AB2-031 E O1	0.7259
923991	AB2-040 C O1	4.8396
923992	AB2-040 E O1	3.9596
924032	AB2-045 E	0.7254
924511	AB2-100 C	7.6051
924512	AB2-100 E	3.7458

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Bus #	Bus	MW Impact
925021	AB2-158 C	25.3174
925022	AB2-158 E	11.2891
925171	AB2-174 C O1	4.6403
925172	AB2-174 E O1	4.1984
925522	AC1-027 E	0.7076
925611	AC1-036 C	0.6317
925612	AC1-036 E	1.0307
925671	AC1-043 C	5.5456
925672	AC1-043 E	9.0481
926001	AC1-076 C	6.5878
926002	AC1-076 E	10.7122
926481	AC1-120 C O1	8.0432
926482	AC1-120 E O1	4.1434
926501	AC1-121 C O1	2.7623
926502	AC1-121 E O1	1.2999
926661	AC1-147 C	1.3864
926662	AC1-147 E	0.8142
926731	AC1-158 C	226.9557
926732	AC1-158 E	99.5993
926751	AC1-161 C O1	18.8277
926752	AC1-161 E O1	8.0370
932041	AC2-012 C	6.2719
932042	AC2-012 E	10.2330
932511	AC2-071 C	1.5315
932512	AC2-071 E	0.7715
932781	AC2-102 C	5.0406
932782	AC2-102 E	9.6755
933291	AC2-141 C	18.8277
933292	AC2-141 E	8.0370
933501	AC2-165 C	7.9618
933502	AC2-165 E	5.9923
933731	AC2-196 C	1.1116
933732	AC2-196 E	0.7403
934061	AD1-033 C	4.6656
934062	AD1-033 E	3.1104
934201	AD1-047 C	5.2795
934202	AD1-047 E	3.5197
934611	AD1-087 C O1	5.9583
934612	AD1-087 E O1	2.8003
934621	AD1-088 C	8.7928

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Bus #	Bus	MW Impact
934622	AD1-088 E	4.1378
934861	AD1-115 C	2.7728
934862	AD1-115 E	4.5240
935171	AD1-152 C O1	5.9213
935172	AD1-152 E O1	3.9475
935221	AD1-157 C	1.0229
935222	AD1-157 E	0.6819
935231	AD1-160 C	0.7501
935232	AD1-160 E	1.0342
936261	AD2-033 C	8.6104
936262	AD2-033 E	5.7403
936481	AD2-063 C O1	0.6197
936482	AD2-063 E O1	0.4097
937221	AD2-160 C O1	3.6381
937222	AD2-160 E O1	1.9078
937481	AD2-202 C O1	1.5790
937482	AD2-202 E O1	0.8882
937571	AD2-169 C	6.5673
937572	AD2-169 E	4.3782
938181	AE1-027 C	1.4550
938182	AE1-027 E	0.7664
938191	AE1-028 C	0.8441
938192	AE1-028 E	0.4887
938371	AE1-056 C	4.4098
938372	AE1-056 E	2.4095
938491	AE1-068 C O1	50.5188
938492	AE1-068 E O1	27.9022
938501	AE1-069 C O1	39.5269
938502	AE1-069 E O1	22.5979
938531	AE1-072 C O1	10.9154
938532	AE1-072 E O1	5.6902
938551	AE1-074 C	1.6462
938552	AE1-074 E	0.8293
938561	AE1-075 C	1.7617
938562	AE1-075 E	0.8590
939221	AE1-153 C O1	11.1933
939222	AE1-153 E O1	7.4622
939231	AE1-154 C	4.1504
939232	AE1-154 E	2.9053
939371	AE1-168 C	10.0995

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Bus #	Bus	MW Impact
939372	AE1-168 E	6.7330
939411	AE1-173 C	69.5436
939412	AE1-173 E	46.3624
940241	AE2-006	0.3214
940251	AE2-007 O1	106.7471
940471	AE2-031 C	27.6070
940472	AE2-031 E	18.4047
940481	AE2-033 C	10.5131
940482	AE2-033 E	7.0875
940541	AE2-040 O1	1.1109
940641	AE2-051 C O1	14.0446
940642	AE2-051 E O1	9.3631
941031	AE2-094 C	33.0912
941032	AE2-094 E	14.8208
941281	AE2-122 C O1	9.3203
941282	AE2-122 E O1	37.6096
941291	AE2-123 C O1	9.5784
941292	AE2-123 E O1	37.3516
941301	AE2-124 C O1	8.7156
941302	AE2-124 E O1	38.2431
941381	AE2-134	4.5395
941501	AE2-147 C	9.8739
941502	AE2-147 E	6.5826
941591	AE2-156 O1	11.0152
941791	AE2-182 C	1.6748
941792	AE2-182 E	0.7881
941831	AE2-188	6.6324
942131	AE2-225 C	1.3216
942132	AE2-225 E	0.8811
942171	AE2-229 C	1.3216
942172	AE2-229 E	0.8811
942401	AE2-253 C	3.8266
942402	AE2-253 E	1.7192
942461	AE2-259 C O1	6.9396
942462	AE2-259 E O1	4.6264
942471	AE2-260 C O1	9.4385
942472	AE2-260 E O1	13.3874
942851	AE2-304 C	0.3939
942852	AE2-304 E	0.1532
942931	AE2-313 C	29.8917

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Bus #	Bus	MW Impact
942932	AE2-313 E	19.9278
943611	AF1-032 C	0.5720
943612	AF1-032 E	0.3035
943911	AF1-059	5.8254
944011	AF1-069 C	5.7304
944012	AF1-069 E	2.2261
944111	AF1-079 C	7.8858
944112	AF1-079 E	10.7080
944581	AF1-123 C O1	14.5151
944582	AF1-123 E O1	37.9419
944591	AF1-124 C O1	14.5151
944592	AF1-124 E O1	37.9419
944601	AF1-125 C O1	14.5151
944602	AF1-125 E O1	37.9419
944871	AF1-152 C	1.7444
944872	AF1-152 E	1.1629
945811	AF1-246 C O1	3.1324
945812	AF1-246 E O1	4.3257
946011	AF1-266	4.6641
946281	AF1-292 C	0.5273
946282	AF1-292 E	0.3555
946301	AF1-294 C	1.7956
946302	AF1-294 E	1.1971
946371	AF1-301 C	37.4414
946372	AF1-301 E	25.2414
946461	**AF1-310 C O1 (Withdrawn : 11/05/2019)**	**8.0661**
946462	**AF1-310 E O1 (Withdrawn : 11/05/2019)**	**13.1605**
LGEE	LGEE	1.0343
CPLE	CPLE	6.6501
WEC	WEC	0.5223
CBM-W2	CBM-W2	23.8329
NY	NY	2.1584
CBM-W1	CBM-W1	18.5773
TVA	TVA	5.2710
O-066	O-066	29.2723
CBM-S2	CBM-S2	45.6678
CBM-S1	CBM-S1	28.9936
G-007	G-007	4.5698
MADISON	MADISON	1.6451
MEC	MEC	3.3782

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Bus #	Bus	MW Impact
AA2-074	AA2-074	4.5306

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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
42946652	313845	6HATHAWAY	DVP	304222	6ROCKYMT230T	CPLE	1	DVP_P1-2: LN 2181	single	478.0	116.87	118.13	DC	6.01

Bus #	Bus	MW Impact
314435	6SAPONY	0.1427
314572	3EMPORIA	0.0402
314574	6EVERETS	0.1811
314582	3KELFORD	0.3088
314589	3MURPHYS	0.0492
314623	3WITAKRS	0.2540
314704	3LAWRENC	0.1369
315115	1S HAMPT1	0.6342
315126	1ROARAP2	0.9589
315128	1ROARAP4	0.9150
315131	**1EDGECMA (Deativation : 04/22/19)**	**25.0572**
315132	**1EDGECMB (Deativation : 04/22/19)**	**25.0572**
315136	1ROSEMG1	2.3478
315137	1ROSEMS1	1.4559
315138	1ROSEMG2	1.1003
315139	1GASTONA	2.9075
315141	1GASTONB	2.9075
315292	1DOMTR78	0.6926
315294	1DOMTR10	6.4308
315601	1CONETOE2SOL	2.1801
315602	1HOLLOMANSOL	0.8466
315605	6W1-029WIND	0.2837
315606	3AA2-053SOLA	0.9775
315607	3AA1-063SOLA	0.8796
315608	3AA2-088SOLA	0.5384
315611	6Z1-036WIND	0.3395
315612	3AA2-057SOLA	1.2559
315614	AA2-178 C	0.6337
920591	AA2-165 C	0.1489
920671	AA2-174 C OP	0.0448
922922	AB1-081 C OP	15.1676
923262	AB1-132 C OP	15.9062

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Bus #	Bus	MW Impact
923263	AB1-132 E OP	6.8170
923572	AB1-173 C OP	1.6592
923582	AB1-173AC OP	1.6592
923801	AB2-015 C OP	4.0535
923911	AB2-031 C O1	1.6469
923991	AB2-040 C O1	5.4076
924151	AB2-059 C OP	17.8761
924501	AB2-099 C	0.4112
924511	AB2-100 C	8.4949
925121	AB2-169 C	4.1734
925171	AB2-174 C O1	5.0379
925591	AC1-034 C	11.5788
925781	AC1-054 C O1	2.9281
926071	AC1-086 C	23.4238
926201	AC1-098 C	6.2957
926211	AC1-099 C	2.1097
927021	AC1-189 C	12.1912
927141	AC1-208 C	9.6989
932631	AC2-084 C	8.9748
933991	AD1-023 C	7.5866
934201	AD1-047 C	5.8992
934331	AD1-057 C O1	20.1168
934521	AD1-076 C	29.5525
936401	AD2-051 C O1	6.0354
936701	**AD2-089 C (Withdrawn : 12/09/2019)**	**14.3289**
936711	AD2-090 C O1	3.8426
937571	AD2-169 C	7.5666
938171	AE1-026 C O1	19.1419
938221	AE1-035 C	1.5163
938661	AE1-088	2.1402
938771	AE1-103 C O1	1.6046
940481	AE2-033 C	7.1805
940491	AE2-034 C	3.9724
940521	AE2-037 C	5.5122
940541	AE2-040 O1	1.3064
940571	AE2-044 C	7.5838
941501	AE2-147 C	4.6899
941541	AE2-151 C	0.7816
942471	AE2-260 C O1	9.8388
942851	AE2-304 C	0.2061

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Bus #	Bus	MW Impact
943171	AE2-346 C	0.9870
943911	AF1-059	6.8860
944051	AF1-073 C O1	11.0580
944141	AF1-082	4.8753
944871	AF1-152 C	1.5633
945711	AF1-236 C O1	37.2760
946011	AF1-266	6.0107
946281	AF1-292 C	0.9984
DUCKCREEK	DUCKCREEK	1.3668
NEWTON	NEWTON	1.3485
FARMERCITY	FARMERCITY	0.0773
G-007A	G-007A	0.7576
VFT	VFT	2.0124
PRAIRIE	PRAIRIE	3.6420
COFFEEN	COFFEEN	0.6675
EDWARDS	EDWARDS	0.4067
CHEOAH	CHEOAH	1.1016
TILTON	TILTON	0.7195
GIBSON	GIBSON	0.6514
CALDERWOOD	CALDERWOOD	1.0740
BLUEG	BLUEG	2.0120
TRIMBLE	TRIMBLE	0.6383
CATAWBA	CATAWBA	1.1606

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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
42946647	314591	6NASH	DVP	304226	6PA-RMOUNT#4	CPLE	1	DVP_P1-2: LN 2058	single	478.0	116.18	117.46	DC	6.11

Bus #	Bus	MW Impact
314435	6SAPONY	0.1449
314572	3EMPORIA	0.0400
314574	6EVERETS	0.1885
314582	3KELFORD	0.2792
314589	3MURPHYS	0.0480
314623	3WITAKRS	0.1790
314704	3LAWRENC	0.1363
315115	1S HAMPT1	0.6209
315126	1ROARAP2	0.9268
315128	1ROARAP4	0.8844
315131	**1EDGECMA (Deativation : 04/22/19)**	**26.1916**
315132	**1EDGECMB (Deativation : 04/22/19)**	**26.1916**
315136	1ROSEMG1	2.4140
315137	1ROSEMS1	1.4969
315138	1ROSEMG2	1.1313
315139	1GASTONA	2.9735
315141	1GASTONB	2.9735
315292	1DOMTR78	0.7093
315294	1DOMTR10	6.5856
315601	1CONETOE2SOL	2.2766
315602	1HOLLOMANSOL	0.8563
315605	6W1-029WIND	0.2875
315606	3AA2-053SOLA	0.9462
315607	3AA1-063SOLA	0.8523
315608	3AA2-088SOLA	0.5247
315611	6Z1-036WIND	0.3446
315612	3AA2-057SOLA	0.9239
315614	AA2-178 C	0.6444
920591	AA2-165 C	0.1095
920671	AA2-174 C OP	0.0433
922922	AB1-081 C OP	10.5437
923262	AB1-132 C OP	16.2674

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Bus #	Bus	MW Impact
923263	AB1-132 E OP	6.9718
923572	AB1-173 C OP	1.6316
923582	AB1-173AC OP	1.6316
923801	AB2-015 C OP	3.9745
923911	AB2-031 C O1	1.6195
923991	AB2-040 C O1	5.3178
924151	AB2-059 C OP	12.4265
924501	AB2-099 C	0.4009
924511	AB2-100 C	8.6450
925121	AB2-169 C	4.2994
925171	AB2-174 C O1	4.9753
925591	AC1-034 C	8.0490
925781	AC1-054 C O1	2.8120
926071	AC1-086 C	23.9557
926201	AC1-098 C	5.1350
926211	AC1-099 C	1.7208
927021	AC1-189 C	12.7226
927141	AC1-208 C	7.7881
932631	AC2-084 C	7.3202
933991	AD1-023 C	7.7055
934201	AD1-047 C	5.8013
934331	AD1-057 C O1	20.9131
934521	AD1-076 C	30.0720
936401	AD2-051 C O1	6.1067
936701	**AD2-089 C (Withdrawn : 12/09/2019)**	**14.9679**
936711	AD2-090 C O1	3.7548
937571	AD2-169 C	7.4088
938171	AE1-026 C O1	19.4249
938221	AE1-035 C	1.5336
938661	AE1-088	2.2048
938771	AE1-103 C O1	1.5765
940481	AE2-033 C	7.2962
940491	AE2-034 C	4.0396
940521	AE2-037 C	5.5951
940541	AE2-040 O1	1.3272
940571	AE2-044 C	5.2718
941501	AE2-147 C	4.7529
941541	AE2-151 C	0.7619
942471	AE2-260 C O1	10.0026
942851	AE2-304 C	0.2091

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Bus #	Bus	MW Impact
943171	AE2-346 C	0.9621
943911	AF1-059	6.8230
944051	AF1-073 C O1	11.2524
944141	AF1-082	3.3890
944871	AF1-152 C	1.5843
945711	AF1-236 C O1	37.9059
946011	AF1-266	6.1075
946281	AF1-292 C	0.9980
DUCKCREEK	DUCKCREEK	1.3783
NEWTON	NEWTON	1.3603
FARMERCITY	FARMERCITY	0.0781
G-007A	G-007A	0.7696
VFT	VFT	2.0446
PRAIRIE	PRAIRIE	3.6730
COFFEEN	COFFEEN	0.6733
EDWARDS	EDWARDS	0.4102
CHEOAH	CHEOAH	1.1116
TILTON	TILTON	0.7258
GIBSON	GIBSON	0.6574
CALDERWOOD	CALDERWOOD	1.0840
BLUEG	BLUEG	2.0294
TRIMBLE	TRIMBLE	0.6439
CATAWBA	CATAWBA	1.1715

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Short Circuit

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10.7 Short Circuit

The following Breakers are overdutied:

None

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Affected Systems

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11 Affected Systems

11.1 Duke Energy Progress

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

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Attachment 1

System Configuration

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