



Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-209

GRETNA 12.5 KV

2.8 MW Capacity / 7 MW Energy

January 2021

Table of Contents

1	Introduction.....	4
2	Preface.....	4
3	General.....	5
4	Point of Interconnection.....	6
5	Cost Summary.....	6
6	Transmission Owner Scope of Work.....	7
7	Schedule.....	7
8	Transmission Owner Analysis.....	7
8.1	Power Flow Analysis.....	8
9	Interconnection Customer Requirements.....	8
9.1	System Protection.....	8
9.2	Compliance Issues and Interconnection Customer Requirements.....	8
9.3	Power Factor Requirements.....	9
10	Revenue Metering and SCADA Requirements.....	9
10.1	PJM Requirements.....	9
10.2	Interconnected Transmission Owner Requirements.....	9
11	Summer Peak - Load Flow Analysis.....	10
11.1	Generation Deliverability.....	10
11.2	Multiple Facility Contingency.....	10
11.3	Contribution to Previously Identified Overloads.....	10
11.4	Potential Congestion due to Local Energy Deliverability.....	11
11.5	System Reinforcements - Summer Peak Load Flow - Primary POI.....	12
11.6	Flow Gate Details.....	13
11.6.1	Index 1.....	14
11.6.2	Index 2.....	16
11.6.3	Index 3.....	18
11.6.4	Index 4.....	19
11.7	Queue Dependencies.....	20
11.8	Contingency Descriptions.....	21
12	Short Circuit Analysis.....	23
12.1	System Reinforcements - Short Circuit.....	23

13 Affected Systems24

 13.1 TVA.....24

 13.2 Duke Energy Progress.....24

14 Attachment 1: One Line Diagram25

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 Dominion.

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 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 Pittsylvania County, Virginia. The installed facilities will have a total capability of 7 MW with 2.8 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 30, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-209
Project Name	GRETNA 12.5 KV
State	Virginia
County	Pittsylvania
Transmission Owner	Dominion
MFO	7
MWE	7
MWC	2.8
Fuel	Storage
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AG1-209 will interconnect with the Dominion distribution system at the Gretna 69 kV substation.

5 Cost Summary

The AG1-209 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$ To be determined in two way Interconnection Agreement with Dominion
Total System Network Upgrade Costs	\$51,002,000 ¹
Total Costs	\$ 51,002,000 + Costs in two way IA

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

¹ This project currently causes and/or contributes to overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcements listed in the report. This will be re-evaluated in the System Impact phase. The results may vary with queue customers withdrawing from the queue and other generators deactivating over time. If a customer is the first to cause the need for a project (causes loading to exceed 100% of rating), then the customer is responsible. If a customer contributes to a facility that is already overloaded by a prior queue, then they may receive cost allocation.

6 Transmission Owner Scope of Work

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.

7 Schedule

If the customer is ultimately responsible for network upgrades, then the schedule for those upgrades will be refined in future study phases. The customer would need to wait for those upgrades to be completed prior to commercial operation unless determined deliverable by an interim deliverability study. The elapsed time to complete any network upgrades is provided in the System Reinforcements table of this report.

8 Transmission Owner Analysis

Dominion assessed the impact of the proposed AG1-209 for compliance with NERC Reliability Criteria on the Dominion Transmission System. The system was assessed using the summer 2024 AG1 case provided to Dominion by PJM.

When performing a generation analysis, Dominion's main analysis includes load flow study results following a single contingency event for 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.

8.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2024 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 Interconnection Customer Requirements

9.1 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.

9.2 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 section 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.

9.3 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.

10 Revenue Metering and SCADA Requirements

10.1 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.

10.2 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/>

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-209 was evaluated as a 7.0 MW (Capacity 2.8 MW) injection at the Gretna 69 kV substation in the Dominion area. Project AG1-209 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-209 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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/D C	MW IMPACT
161587862	242687	05JOHNMT	138.0	AEP	242734	05NEWL DN	138.0	AEP	1	AEP_P2-2_#13260_05SKI MMR 69.0_1	bus	240.0	137.87	138.96	DC	2.63
161587863	242687	05JOHNMT	138.0	AEP	242734	05NEWL DN	138.0	AEP	1	AEP_P2-2_#10163_05EDAN 2 138_2	bus	240.0	137.73	138.77	DC	2.49
161588229	242687	05JOHNMT	138.0	AEP	242734	05NEWL DN	138.0	AEP	1	AEP_P7-1_#10778	tower	240.0	137.73	138.77	DC	2.49
161588230	242687	05JOHNMT	138.0	AEP	242734	05NEWL DN	138.0	AEP	1	AEP_P7-1_#10830	tower	240.0	133.42	134.44	DC	2.45
161587857	242741	05OTTER	138.0	AEP	242687	05JOHNMT	138.0	AEP	1	AEP_P2-2_#13260_05SKI MMR 69.0_1	bus	245.0	140.85	141.93	DC	2.63
161587858	242741	05OTTER	138.0	AEP	242687	05JOHNMT	138.0	AEP	1	AEP_P2-2_#10163_05EDAN 2 138_2	bus	245.0	137.57	138.59	DC	2.49
161588239	242741	05OTTER	138.0	AEP	242687	05JOHNMT	138.0	AEP	1	AEP_P7-1_#10778	tower	245.0	137.57	138.59	DC	2.49
161588240	242741	05OTTER	138.0	AEP	242687	05JOHNMT	138.0	AEP	1	AEP_P7-1_#10830	tower	245.0	135.56	136.56	DC	2.45
169159378	314670	2ALTVSTA	69.0	DVP	314667	4ALTVSTA	138.0	DVP	1	Base Case	single	128.779998779	101.64	103.81	DC	2.8
169159379	314670	2ALTVSTA	69.0	DVP	314667	4ALTVSTA	138.0	DVP	1	DVP_P1-2: LN 173-A	single	134.044006348	102.8	104.88	DC	2.8
169159335	314730	2STONE MIL	69.0	DVP	314670	2ALTVSTA	69.0	DVP	1	DVP_P1-2: LN 173-A	single	101.519996643	135.73	138.49	DC	2.8
169159336	314730	2STONE MIL	69.0	DVP	314670	2ALTVSTA	69.0	DVP	1	Base Case	single	101.519996643	128.93	131.69	DC	2.8

11.4 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 PROJE CT LOADI NG %	POST PROJE CT LOADI NG %	AC D C	MW IMPA CT
168144865	242687	05JOHNMT	138.0	AEP	242734	05NEWLDN	138.0	AEP	1	Base Case	operati on	167.0	166.5	167.92	DC	2.38
163625538	242701	05LEESVI	138.0	AEP	314667	4ALTVSTA	138.0	DVP	1	Base Case	operati on	205.0	125.69	126.97	DC	2.63
168144857	242741	05OTTER	138.0	AEP	242687	05JOHNMT	138.0	AEP	1	Base Case	operati on	167.0	177.74	179.17	DC	2.38
168145025	242802	05SMITHM TN	138.0	AEP	242701	05LEESVI	138.0	AEP	1	Base Case	operati on	205.0	105.63	106.91	DC	2.63
169159550	314666	3ALTVSTA	115.0	DVP	314667	4ALTVSTA	138.0	DVP	1	DVP_P1-3: 4ALTVST A-TX#4	operati on	126.524002075	106.33	107.75	DC	1.8
163625361	314667	4ALTVSTA	138.0	DVP	242741	05OTTER	138.0	AEP	1	Base Case	operati on	167.0	179.66	181.08	DC	2.38
163625362	314667	4ALTVSTA	138.0	DVP	242741	05OTTER	138.0	AEP	1	DVP_P1-2: LN 1016-A	operati on	245.0	154.38	155.6	DC	2.97
169159569	314667	4ALTVSTA	138.0	DVP	314666	3ALTVSTA	115.0	DVP	2	AEP_P2-1_242687 05JOHN MT 138 242734 05NEWL DN 138 1	operati on	130.472000122	102.65	104.08	DC	1.87
169159376	314670	2ALTVSTA	69.0	DVP	314667	4ALTVSTA	138.0	DVP	1	Base Case	operati on	128.779998779	192.3	197.74	DC	7.0
169159377	314670	2ALTVSTA	69.0	DVP	314667	4ALTVSTA	138.0	DVP	1	DVP_P1-2: LN 173-A	operati on	134.044006348	189.9	195.12	DC	7.0
169159333	314730	2STONE MIL	69.0	DVP	314670	2ALTVSTA	69.0	DVP	1	DVP_P1-2: LN 173-A	operati on	101.519996643	250.74	257.63	DC	7.0
169159334	314730	2STONE MIL	69.0	DVP	314670	2ALTVSTA	69.0	DVP	1	Base Case	operati on	101.519996643	243.94	250.83	DC	7.0
169159424	314735	2ALTAVIST ADP	69.0	DVP	314730	2STONE MIL	69.0	DVP	1	DVP_P1-2: LN 173-A	operati on	85.5400009155	163.27	171.45	DC	7.0
169159425	314735	2ALTAVIST ADP	69.0	DVP	314730	2STONE MIL	69.0	DVP	1	Base Case	operati on	85.5400009155	155.09	163.27	DC	7.0
169377433	314739	2MT A TP	69.0	DVP	314735	2ALTAVIST ADP	69.0	DVP	1	DVP_P1-2: LN 173-A	operati on	123.13999939	117.64	123.32	DC	7.0
169377434	314739	2MT A TP	69.0	DVP	314735	2ALTAVIST ADP	69.0	DVP	1	Base Case	operati on	123.13999939	111.95	117.64	DC	7.0

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
161587857,161588239,161588240,161587858	2	05OTTER 138.0 kV - 05JOHNMT 138.0 kV Ckt 1	<p><u>AEP</u> AEPA0019a (91) : 2) Rebuild/reconductor John Mt - Otter Line, ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor Section 1, 7 Miles. \$10.5M Project Type : FAC Cost : \$10,500,000 Time Estimate : 24-36 Months</p> <p>AEPA0019b (92) : Replace 795 AAC station conductors at Otter Project Type : FAC Cost : \$10,670,000 Time Estimate : 18-24 Months</p>	\$21,170,000
169159378,169159379	3	2ALTVSTA 69.0 kV - 4ALTVSTA 138.0 kV Ckt 1	<p><u>DVP</u> dom-121 (1314) : Add additional 138/69 kV transformer at Altavista substation Project Type : CON Cost : \$6,000,000 Time Estimate : 16-18 Months</p>	\$6,000,000
169159335,169159336	4	2STONE MIL 69.0 kV - 2ALTVSTA 69.0 kV Ckt 1	<p><u>DVP</u> dom-111 (1304) : Rebuild 1.64 miles of 69 kV Line 35 from Stone Mill to Altavista with 768 ACSS. Project Type : FAC Cost : \$2,132,000 Time Estimate : 30-36 Months</p>	\$2,132,000
161587863,161587862,161588230,161588229	1	05JOHNMT 138.0 kV - 05NEWLDN 138.0 kV Ckt 1	<p><u>AEP</u> AEPA0020a (94) : Current Station Rating: S/N: 167, S/E: 240 1) Rebuild/reconductor ACSR ~ 397.5 ~ 30/7 ~ LARK ~ Fe Clamps 9 d, Conductor Section 1, 14.43 miles Project Type : FAC Cost : \$21,650,000 Time Estimate : 12-18 Months</p> <p>AEPA0020b (95) : Replace 1200 A Wavetrap at New London Project Type : FAC Cost : \$50,000 Time Estimate : 24-36 Months</p>	\$21,700,000
			TOTAL COST	\$51,002,000

11.6 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

11.6.1 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
161588229	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	AEP_P7-1_#10778	tower	240.0	137.73	138.77	DC	2.49

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
246843	05SMG1	1.3737	50/50	1.3737
246844	05SMG2	3.7340	50/50	3.7340
246845	05SMG3	2.3410	50/50	2.3410
246846	05SMG4	3.6760	50/50	3.6760
246847	05SMG5	1.4317	50/50	1.4317
247284	05LEESVG	1.8517	50/50	1.8517
315156	1HALLBR1	2.6456	50/50	2.6456
316123	AC1-075 C	1.1014	50/50	1.1014
925661	AC1-042 C	5.6661	50/50	5.6661
925662	AC1-042 E	9.2447	50/50	9.2447
925997	AC1-075 E	3.9555	50/50	3.9555
926023	AC1-080 C	0.3681	50/50	0.3681
926024	AC1-080 E	1.3124	50/50	1.3124
926051	AC1-083 C O1	4.6599	50/50	4.6599
926052	AC1-083 E O1	7.6031	50/50	7.6031
926645	AC1-145 C	1.0642	50/50	1.0642
926646	AC1-145 E	6.0531	50/50	6.0531
927261	AC1-222 C	1.6931	Adder	1.99
927262	AC1-222 E	1.6117	Adder	1.9
933941	AD1-017 C	0.9320	50/50	0.9320
933942	AD1-017 E	1.5206	50/50	1.5206
934311	AD1-055 C	1.1755	Adder	1.38
934312	AD1-055 E	0.3031	Adder	0.36
938451	AE1-064 C	5.6827	Adder	6.69
938452	AE1-064 E	2.9385	Adder	3.46
939941	AE1-230 C	2.5561	50/50	2.5561
939942	AE1-230 E	4.5443	50/50	4.5443
940081	AE1-250 C	11.0367	50/50	11.0367
940082	AE1-250 E	7.3578	50/50	7.3578
941801	AE2-185 C	12.7807	50/50	12.7807
941802	AE2-185 E	8.5205	50/50	8.5205
941821	AE2-187 C	12.7807	50/50	12.7807
941822	AE2-187 E	5.6803	50/50	5.6803
942671	AE2-283 C	14.0588	50/50	14.0588
942672	AE2-283 E	7.3844	50/50	7.3844
942751	AE2-291 C	13.6868	50/50	13.6868
942752	AE2-291 E	9.1245	50/50	9.1245
942761	AE2-292 C O1	17.0414	50/50	17.0414
942762	AE2-292 E O1	11.3609	50/50	11.3609
943901	AF1-058 C	0.6149	Adder	0.72
943902	AF1-058 E	0.4099	Adder	0.48
945081	AF1-173	4.9525	50/50	4.9525

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
960061	AF2-297 C	2.4594	Adder	2.89
960062	AF2-297 E	1.6396	Adder	1.93
961121	AF2-403	2.8402	50/50	2.8402
963601	AG1-209 C	0.9941	50/50	0.9941
963602	AG1-209 E	1.4911	50/50	1.4911
964141	AG1-275 C	4.2602	50/50	4.2602
964142	AG1-275 E	2.8402	50/50	2.8402
964151	AG1-276 C	4.2602	50/50	4.2602
964152	AG1-276 E	2.8402	50/50	2.8402
964251	AG1-286 C	3.3059	50/50	3.3059
964252	AG1-286 E	2.2039	50/50	2.2039
964261	AG1-287 C	0.2444	Adder	0.54
964262	AG1-287 E	0.1629	Adder	0.36
964471	AG1-310 C	0.5908	Adder	1.31
964472	AG1-310 E	0.2910	Adder	0.65
966253	AG1-494 BAT	2.0832	Merchant Transmission	2.0832
966691	AG1-539 C	7.1565	50/50	7.1565
966692	AG1-539 E	9.6165	50/50	9.6165
966761	AG1-547 C	11.5524	50/50	11.5524
966762	AG1-547 E	6.1986	50/50	6.1986
CPL	CPL	0.5719	Confirmed LTF	0.5719
CALDERWOOD	CALDERWOOD	0.0179	Confirmed LTF	0.0179
NY	NY	0.0232	Confirmed LTF	0.0232
PRAIRIE	PRAIRIE	0.4598	Confirmed LTF	0.4598
O-066	O-066	0.1346	Confirmed LTF	0.1346
CBM-S2	CBM-S2	4.7398	Confirmed LTF	4.7398
CHEOAH	CHEOAH	0.0120	Confirmed LTF	0.0120
COTTONWOOD	COTTONWOOD	0.1533	Confirmed LTF	0.1533
G-007	G-007	0.0189	Confirmed LTF	0.0189
GIBSON	GIBSON	0.1283	Confirmed LTF	0.1283
BLUEG	BLUEG	0.4375	Confirmed LTF	0.4375
TRIMBLE	TRIMBLE	0.1419	Confirmed LTF	0.1419

11.6.2 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
161587857	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	AEP_P2-2_#13260_05SKIMMR69.0_1	bus	245.0	140.85	141.93	DC	2.63

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
246843	05SMG1	1.1693	50/50	1.1693
246844	05SMG2	3.1786	50/50	3.1786
246845	05SMG3	1.9928	50/50	1.9928
246846	05SMG4	3.1292	50/50	3.1292
246847	05SMG5	1.2187	50/50	1.2187
247284	05LEESVG	1.8564	50/50	1.8564
315156	1HALLBR1	2.9223	50/50	2.9223
316118	AC1-105 C	1.8331	Adder	2.16
316123	AC1-075 C	1.2269	50/50	1.2269
925661	AC1-042 C	5.9959	50/50	5.9959
925662	AC1-042 E	9.7827	50/50	9.7827
925997	AC1-075 E	4.4060	50/50	4.4060
926023	AC1-080 C	0.4100	50/50	0.4100
926024	AC1-080 E	1.4619	50/50	1.4619
926051	AC1-083 C O1	2.5478	Adder	3.0
926052	AC1-083 E O1	4.1570	Adder	4.89
926274	AC1-105 E	0.9006	Adder	1.06
926645	AC1-145 C	1.1261	50/50	1.1261
926646	AC1-145 E	6.4053	50/50	6.4053
927261	AC1-222 C	1.9259	Adder	2.27
927262	AC1-222 E	1.8334	Adder	2.16
933941	AD1-017 C	0.5096	Adder	0.6
933942	AD1-017 E	0.8314	Adder	0.98
934311	AD1-055 C	1.3372	Adder	1.57
934312	AD1-055 E	0.3448	Adder	0.41
938451	AE1-064 C	4.7778	Adder	5.62
938452	AE1-064 E	2.4705	Adder	2.91
939941	AE1-230 C	2.7049	50/50	2.7049
939942	AE1-230 E	4.8087	50/50	4.8087
940081	AE1-250 C	4.5831	Adder	5.39
940082	AE1-250 E	3.0554	Adder	3.59
941801	AE2-185 C	13.5245	50/50	13.5245
941802	AE2-185 E	9.0163	50/50	9.0163
941821	AE2-187 C	13.5245	50/50	13.5245
941822	AE2-187 E	6.0109	50/50	6.0109
942671	AE2-283 C	14.8769	50/50	14.8769
942672	AE2-283 E	7.8141	50/50	7.8141
942751	AE2-291 C	15.1898	50/50	15.1898
942752	AE2-291 E	10.1266	50/50	10.1266
942761	AE2-292 C O1	18.9128	50/50	18.9128
942762	AE2-292 E O1	12.6086	50/50	12.6086

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
943901	AF1-058 C	0.7117	Adder	0.84
943902	AF1-058 E	0.4744	Adder	0.56
945081	AF1-173	5.2407	50/50	5.2407
960061	AF2-297 C	2.8466	Adder	3.35
960062	AF2-297 E	1.8977	Adder	2.23
961121	AF2-403	3.0054	50/50	3.0054
962441	AG1-093 C O1	2.5908	Adder	5.75
962442	AG1-093 E O1	0.7885	Adder	1.75
963601	AG1-209 C	1.0519	50/50	1.0519
963602	AG1-209 E	1.5779	50/50	1.5779
964141	AG1-275 C	4.5082	50/50	4.5082
964142	AG1-275 E	3.0054	50/50	3.0054
964151	AG1-276 C	4.5082	50/50	4.5082
964152	AG1-276 E	3.0054	50/50	3.0054
964261	AG1-287 C	0.2829	Adder	0.63
964262	AG1-287 E	0.1886	Adder	0.42
964471	AG1-310 C	1.4850	50/50	1.4850
964472	AG1-310 E	0.7314	50/50	0.7314
964533	AG1-316 BAT	1.6207	Merchant Transmission	1.6207
966253	AG1-494 BAT	2.5943	Merchant Transmission	2.5943
966691	AG1-539 C	7.9424	50/50	7.9424
966692	AG1-539 E	10.6726	50/50	10.6726
966761	AG1-547 C	12.2246	50/50	12.2246
966762	AG1-547 E	6.5594	50/50	6.5594
CPLE	CPLE	0.9111	Confirmed LTF	0.9111
NY	NY	0.0210	Confirmed LTF	0.0210
PRAIRIE	PRAIRIE	0.4288	Confirmed LTF	0.4288
O-066	O-066	0.0673	Confirmed LTF	0.0673
CBM-S2	CBM-S2	8.1014	Confirmed LTF	8.1014
COTTONWOOD	COTTONWOOD	0.0105	Confirmed LTF	0.0105
G-007	G-007	0.0084	Confirmed LTF	0.0084
GIBSON	GIBSON	0.1381	Confirmed LTF	0.1381
BLUEG	BLUEG	0.4826	Confirmed LTF	0.4826
TRIMBLE	TRIMBLE	0.1564	Confirmed LTF	0.1564

11.6.3 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
169159379	314670	2ALTVSTA	DVP	314667	4ALTVSTA	DVP	1	DVP_P1-2: LN 173-A	single	134.04	102.8	104.88	DC	2.8

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
925661	AC1-042 C	15.9584	80/20	15.9584
926645	AC1-145 C	2.9973	80/20	2.9973
939941	AE1-230 C	7.1993	80/20	7.1993
941801	AE2-185 C	35.9964	80/20	35.9964
941821	AE2-187 C	35.9964	80/20	35.9964
942671	AE2-283 C	39.5960	80/20	39.5960
945081	AF1-173	13.9486	80/20	13.9486
961121	AF2-403	7.9992	80/20	7.9992
963601	AG1-209 C	2.7997	80/20	2.7997
964141	AG1-275 C	11.9988	80/20	11.9988
964151	AG1-276 C	11.9988	80/20	11.9988
966761	AG1-547 C	32.5367	80/20	32.5367
CALDERWOOD	CALDERWOOD	0.0050	Confirmed LTF	0.0050
NY	NY	0.0055	Confirmed LTF	0.0055
PRAIRIE	PRAIRIE	0.0258	Confirmed LTF	0.0258
CHEOAH	CHEOAH	0.0050	Confirmed LTF	0.0050
COTTONWOOD	COTTONWOOD	0.0210	Confirmed LTF	0.0210
HAMLET	HAMLET	0.0058	Confirmed LTF	0.0058
GIBSON	GIBSON	0.0055	Confirmed LTF	0.0055
BLUEG	BLUEG	0.0174	Confirmed LTF	0.0174
TRIMBLE	TRIMBLE	0.0056	Confirmed LTF	0.0056
CATAWBA	CATAWBA	0.0035	Confirmed LTF	0.0035

11.6.4 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
169159335	314730	2STONE MIL	DVP	314670	2ALTVSTA	DVP	1	DVP_P1-2: LN 173-A	single	101.52	135.73	138.49	DC	2.8

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
925661	AC1-042 C	15.9584	80/20	15.9584
926645	AC1-145 C	2.9973	80/20	2.9973
939941	AE1-230 C	7.1993	80/20	7.1993
941801	AE2-185 C	35.9964	80/20	35.9964
941821	AE2-187 C	35.9964	80/20	35.9964
942671	AE2-283 C	39.5960	80/20	39.5960
945081	AF1-173	13.9486	80/20	13.9486
961121	AF2-403	7.9992	80/20	7.9992
963601	AG1-209 C	2.7997	80/20	2.7997
964141	AG1-275 C	11.9988	80/20	11.9988
964151	AG1-276 C	11.9988	80/20	11.9988
966761	AG1-547 C	32.5367	80/20	32.5367
CALDERWOOD	CALDERWOOD	0.0050	Confirmed LTF	0.0050
NY	NY	0.0055	Confirmed LTF	0.0055
PRAIRIE	PRAIRIE	0.0258	Confirmed LTF	0.0258
CHEOAH	CHEOAH	0.0050	Confirmed LTF	0.0050
COTTONWOOD	COTTONWOOD	0.0210	Confirmed LTF	0.0210
HAMLET	HAMLET	0.0058	Confirmed LTF	0.0058
GIBSON	GIBSON	0.0055	Confirmed LTF	0.0055
BLUEG	BLUEG	0.0174	Confirmed LTF	0.0174
TRIMBLE	TRIMBLE	0.0056	Confirmed LTF	0.0056
CATAWBA	CATAWBA	0.0035	Confirmed LTF	0.0035

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AC1-042	Altavista-Mt. Airy 69kV	Engineering and Procurement
AC1-075	Perth-Hickory Grove 115kV	Engineering and Procurement
AC1-080	Perth-Hickory Grove 115kV	Engineering and Procurement
AC1-083	Smith Mountain-Bearskin 138kV	Active
AC1-105	Halifax-Mt. Laurel 115kV	Engineering and Procurement
AC1-145	Gretna DP 69 kV	Engineering and Procurement
AC1-222	Crystal Hill-Halifax 115kV	Engineering and Procurement
AD1-017	Smith Mountain-Bearskin 138 kV	Active
AD1-055	Crystal Hill-Halifax 115 kV	Engineering and Procurement
AE1-064	Rockcastle 138 kV	Active
AE1-230	Shockoe 69 kV	Active
AE1-250	Smith Mountain-E. Danville 138 kV	Active
AE2-185	Gladys DP-Stonemill Switching Station 69 kV	Active
AE2-187	Shockoe DP-Chatham 69 kV	Active
AE2-283	Gladys-Stone Mill 69 kV	Active
AE2-291	Grit DP-Perth 115 kV	Active
AE2-292	Grit DP-Perth 115 kV	Active
AF1-058	Welco 34.5 kV	Engineering and Procurement
AF1-173	Gretna DP-Shockoe DP 69 kV	Active
AF2-297	Sedge Hill 115 kV	Active
AF2-403	Shockoe DP-Chatham 69 kV	Active
AG1-093	Halifax-Chase City 115 kV	Active
AG1-209	Gretna 12.5 kV	Active
AG1-275	Gladys DP-Stone Mill 69 kV	Active
AG1-276	Gladys DP-Stone Mill 69 kV	Active
AG1-286	Johnson Mountain 138 kV	Active
AG1-287	South Boston 12.5 kV	Active
AG1-310	Crystal Hill-Perth 115 kV	Active
AG1-316	Rustburg 138 kV	Active
AG1-494	Boxwood-Riverville 138 kV	Active
AG1-539	Grit DP-Perth 115 kV	Active
AG1-547	Mount Airy-Chatham 69 kV	Active

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 173-A	CONTINGENCY 'DVP_P1-2: LN 173-A' OPEN BRANCH FROM BUS 314680 TO BUS 941820 CKT 1 /* 2CHATHAM 69.000 - AE2-187 TAP 69.000 OPEN BUS 314680 /* ISLAND: 2CHATHAM 69.000 END
AEP_P7-1_#10778	CONTINGENCY 'AEP_P7-1_#10778' OPEN BRANCH FROM BUS 242531 TO BUS 304094 CKT 1 / 242531 05EDANV2 230 304094 6YANCY TAP 230 1 OPEN BRANCH FROM BUS 242531 TO BUS 242632 CKT 4 / 242531 05EDANV2 230 242632 05EDAN 2 138 4 OPEN BRANCH FROM BUS 242549 TO BUS 242632 CKT 1 / 242549 05BANSTR 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242629 TO BUS 242632 CKT 1 / 242629 05E.MONU 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242629 TO BUS 242770 CKT 1 / 242629 05E.MONU 138 242770 05RIGIS 138 1 OPEN BRANCH FROM BUS 242631 TO BUS 242632 CKT Z1 / 242631 05EDAN 1 138 242632 05EDAN 2 138 Z1 OPEN BRANCH FROM BUS 242629 TO BUS 243948 CKT 1 / 242629 05E.MONU 138 243948 05BRANTLY 69.0 1 OPEN BRANCH FROM BUS 242770 TO BUS 243988 CKT 1 / 242770 05RIGIS 138 243988 05RIGIS 69.0 1 OPEN BRANCH FROM BUS 243974 TO BUS 243988 CKT 1 / 243974 05GOODYEAR 69.0 243988 05RIGIS 69.0 1 END
Base Case	
AEP_P2-2_#10163_05EDAN 2 138_2	CONTINGENCY 'AEP_P2-2_#10163_05EDAN 2 138_2' OPEN BRANCH FROM BUS 242531 TO BUS 304094 CKT 1 / 242531 05EDANV2 230 304094 6YANCY TAP 230 1 OPEN BRANCH FROM BUS 242531 TO BUS 242632 CKT 4 / 242531 05EDANV2 230 242632 05EDAN 2 138 4 OPEN BRANCH FROM BUS 242549 TO BUS 242632 CKT 1 / 242549 05BANSTR 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242629 TO BUS 242632 CKT 1 / 242629 05E.MONU 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242631 TO BUS 242632 CKT Z1 / 242631 05EDAN 1 138 242632 05EDAN 2 138 Z1 END
DVP_P1-3: 4ALTVSTA-TX#4	CONTINGENCY 'DVP_P1-3: 4ALTVSTA-TX#4' OPEN BRANCH FROM BUS 314666 TO BUS 314667 CKT 2 /* 3ALTVSTA 115.00 - 4ALTVSTA 138.00 END

Contingency Name	Contingency Definition
AEP_P2-2_#13260_05SKIMMR 69.0_1	CONTINGENCY 'AEP_P2-2_#13260_05SKIMMR 69.0_1' OPEN BRANCH FROM BUS 242886 TO BUS 314861 CKT 1 / 242886 05SKIMMR 69.0 314861 3SKIMMR 115 1 OPEN BRANCH FROM BUS 242886 TO BUS 314861 CKT 2 / 242886 05SKIMMR 69.0 314861 3SKIMMR 115 2 OPEN BRANCH FROM BUS 242860 TO BUS 242886 CKT 1 / 242860 05ABERT 69.0 242886 05SKIMMR 69.0 1 OPEN BRANCH FROM BUS 242884 TO BUS 242886 CKT 1 / 242884 05S.LYNCHB 69.0 242886 05SKIMMR 69.0 1 REMOVE SWSHUNT FROM BUS 242886 / 242886 05SKIMMR 69.0 END
DVP_P1-2: LN 1016-A	CONTINGENCY 'DVP_P1-2: LN 1016-A' OPEN BRANCH FROM BUS 314688 TO BUS 927260 CKT 1 /* 3CRSTL HILL 115.00 - AC1-222 TAP 115.00 OPEN BUS 314688 /* ISLAND: 3CRSTL HILL 115.00 END
AEP_P7-1_#10830	CONTINGENCY 'AEP_P7-1_#10830' OPEN BRANCH FROM BUS 242555 TO BUS 242843 CKT 1 / 242555 05BLAINE 138 242843 05WLAKE 138 1 OPEN BRANCH FROM BUS 242748 TO BUS 243951 CKT 1 / 242748 05PENHOK 138 243951 05REDWOOD 138 1 OPEN BRANCH FROM BUS 242748 TO BUS 242802 CKT 1 / 242748 05PENHOK 138 242802 05SMITHMTN 138 1 OPEN BRANCH FROM BUS 242843 TO BUS 243951 CKT 1 / 242843 05WLAKE 138 243951 05REDWOOD 138 1 END
AEP_P2-1_242687 05JOHNMT 138 242734 05NEWLDN 138 1	CONTINGENCY 'AEP_P2-1_242687 05JOHNMT 138 242734 05NEWLDN 138 1' OPEN BRANCH FROM BUS 242687 TO BUS 242734 CKT 1 END

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

12.1 System Reinforcements - Short Circuit

None.

13 Affected Systems

13.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

13.2 Duke Energy Progress

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

14 Attachment 1: One Line Diagram