



# **Generation Interconnection**

## **Feasibility Study Report**

**for**

### **Queue Project AE2-188**

**MITCHELL DP-MOUNTAIN RUN 115 KV**

**40 MW Capacity / 40 MW Energy**

July, 2019

# Table of Contents

1	Preface.....	4
2	General.....	5
2.1	Point of Interconnection .....	6
2.2	Cost Summary.....	6
3	Transmission Owner Scope of Work.....	7
4	Attachment Facilities .....	8
5	Direct Connection Cost Estimate.....	8
6	Non-Direct Connection Cost Estimate.....	8
7	System Reinforcements .....	9
8	Schedule.....	10
9	Transmission Owner Analysis.....	10
9.1	Power Flow Analysis .....	10
9.2	Short Circuit Analysis .....	10
9.3	Stability Analysis.....	10
10	Interconnection Customer Requirements.....	11
10.1	System Protection.....	11
10.2	Compliance Issues and Interconnection Customer Requirements .....	11
10.3	Power Factor Requirements.....	11
11	Revenue Metering and SCADA Requirements .....	12
11.1	PJM Requirements .....	12
11.2	Dominion Requirements.....	12
12	Network Impacts.....	13
13	Generation Deliverability .....	15
14	Multiple Facility Contingency .....	15
15	Contribution to Previously Identified Overloads .....	15
16	Potential Congestion due to Local Energy Deliverability.....	16
17	System Reinforcements.....	17
18	Flow Gate Details .....	18
18.1	Index 1 .....	19
18.2	Index 2 .....	20
18.3	Index 3 .....	21

18.4	Index 4 .....	22
18.5	Index 5 .....	23
18.6	Index 6 .....	24
18.7	Index 7 .....	25
19	Affected Systems .....	27
19.1	LG&E .....	27
19.2	MISO .....	27
19.3	TVA .....	27
19.4	Duke Energy Progress .....	27
19.5	NYISO .....	27
20	Contingency Descriptions .....	28
21	Short Circuit .....	31
22	Attachment 1: One Line Diagram .....	32

## 1 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.

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.

## 2 General

The Interconnection Customer (IC) has proposed a new Storage generating facility located in Culpeper County, Virginia. The installed facilities will have a total capability of 40 MW with 40 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2020. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AE2-188</b>
<b>Project Name</b>	MITCHELL DP-MOUNTAIN RUN 115 KV
<b>Interconnection Customer</b>	
<b>State</b>	Virginia
<b>County</b>	Culpeper
<b>Transmission Owner</b>	Dominion
<b>MFO</b>	40
<b>MWE</b>	40
<b>MWC</b>	40
<b>Fuel</b>	Storage
<b>Basecase Study Year</b>	2022

## 2.1 Point of Interconnection

AE2-188 will interconnect with the Dominion transmission system through the AC2-102 115 kV Interconnection Switchyard which will intersect the Mountain Run to Mitchell DP 115 kV line. The AE2-188 project will be sharing Attachment Facilities with the AC2-102 project. This is the primary Point of Interconnection (POI) chosen by the IC with the ITO's transmission system. Attachment 1 shows a one-line diagram of the proposed interconnection.

## 2.2 Cost Summary<sup>1</sup>

The AE2-188 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrade	\$ 0
Non Direct Connection Network Upgrades	\$ TBD in Facilities Study
<b>Total Costs</b>	<b>\$ TBD in Facilities Study</b>

In addition, the AE2-188 project may be responsible for a contribution to the following costs:

Description	Total Cost
System Upgrades	\$ 25,863,000

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

---

<sup>1</sup> Note that the AE2-188 project intends to share Attachment Facilities with the AC2-102 project. Should the AC2-102 project drop from the Interconnection Queue, the AE2-188 project will be responsible to assume the Attachment Facilities, Direct Connection and Non-Direction costs identified in the AC2-102 System Impact Study report for connection to the Dominion system.

### 3 Transmission Owner Scope of Work

Dominion assessed the impact of the proposed Queue Project AE2-188 was evaluated as a 40.0 MW Capacity (40.0 MW Energy) injection at the AC2-102 115 kV interconnection switchyard (AE2-188 sharing Attachment Facilities with AC2-102) in the Dominion Transmission System, for compliance with NERC Reliability Criteria on Dominion Transmission System. The system was assessed using the summer 2022 AE2 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 Category C Contingency Conditions (Bus Fault, Tower Line, N-1-1, and Stuck Breaker scenarios) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For 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 AE2-188 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.

#### 4 Attachment Facilities

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

None

#### 5 Direct Connection Cost Estimate

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.

None

#### 6 Non-Direct Connection Cost Estimate

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

Description	Total Cost
Remote Terminal Work	\$ TBD in Facilities Study phase
<b>Total Non-Direct Connection Facility Costs</b>	<b>\$ TBD in Facilities Study phase</b>

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 System Reinforcements

Upgrade Description	Cost
Rebuild 2.83 miles of 115 kV Line 153 from Paytes Tap to Spotsylvania with 768 ACSS.	\$3,679,000
Rebuild 0.06 miles of 115 kV Line 153 from Unionville DP to Locust Grove DP with 768 ACSS.	\$500,000
Rebuild 7.46 miles of 115 kV Line 198 from Spotsylvania to Todds Tavern DP with 768 ACSS.	\$9,698,000
Rebuild 1.34 miles of 115 kV Line 198 from Ni River DP to Chancellor with 768 ACSS.	\$1,742,000
Rebuild 5.07 miles of 115 kV Line 198 from Todds Tavern DP to Ni River DP with 768 ACSS.	\$6,591,000
Rebuild 2.8 miles of 115 kV Line 153 from AC1-076 Tap to Paytes Tap with 768 ACSS.	\$3,653,000
<b>TOTAL COST</b>	<b>\$25,863,000</b>

## 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 2022 summer peak load flow model and the results were verified by Dominion. Additionally, Dominion performed an analysis of its transmission system. At the Primary POI, the AE2-188 project contributes to overloads on the Dominion transmission system as shown in the “Network Impact – Option 1” section of the report. The estimated cost of system reinforcements necessary to mitigate these overloads is also provided.

### 9.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by Dominion. The connection of AE2-188 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.

### **11.2 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 AE2-188 was evaluated as a 40.0 MW (Capacity 40.0 MW) injection at the AC2-102 Interconnection Switchyard which intersects the Mountain Run to Mitchell DP 115 kV line in the Dominion area. Project AE2-188 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-188 was studied with a commercial probability of 53%. Potential network impacts were as follows:

# Summer Peak Load Flow

### 13 Generation Deliverability

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

None

### 14 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	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
1946965	313703	3UNIONVILLE	DVP	314764	3LOCST G	DVP	1	DVP_P4-2: 2T70	breaker	235.0	95.4	105.14	DC	22.89
1948221	313703	3UNIONVILLE	DVP	314764	3LOCST G	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	235.0	98.82	108.78	DC	23.41
1948222	313703	3UNIONVILLE	DVP	314764	3LOCST G	DVP	1	DVP_P7-1: LN 70-2153-B-B	tower	235.0	96.31	106.28	DC	23.41
1946997	314764	3LOCST G	DVP	313703	3UNIONVILLE	DVP	1	DVP_P4-2: 573T594	breaker	235.0	98.9	103.31	DC	10.35
1946945	314778	3PAY TAP	DVP	314755	3SPOTSYL	DVP	1	DVP_P4-2: 2T70	breaker	260.0	98.35	107.16	DC	22.89
1948227	314778	3PAY TAP	DVP	314755	3SPOTSYL	DVP	1	DVP_P7-1: LN 70-2153-B-B	tower	260.0	99.53	108.54	DC	23.41

### 15 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	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
1946646	314755	3SPOTSYL	DVP	314779	3TDTAVRN	DVP	1	DVP_P4-2: 573T594	breaker	260.0	146.12	150.11	DC	10.37
1946739	314775	3NI RVER	DVP	314135	3CHANCE	DVP	1	DVP_P4-2: 573T594	breaker	260.0	132.16	136.15	DC	10.37
1948226	314778	3PAY TAP	DVP	314755	3SPOTSYL	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	260.0	101.8	110.8	DC	23.41
1946711	314779	3TDTAVRN	DVP	314775	3NI RVER	DVP	1	DVP_P4-2: 573T594	breaker	260.0	136.62	140.61	DC	10.37
1946893	926000	AC1-076 TAP	DVP	314778	3PAY TAP	DVP	1	DVP_P4-2: 2T70	breaker	260.0	106.69	115.5	DC	22.89

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
1948188	926000	AC1-076 TAP	DVP	314778	3PAY TAP	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	260.0	110.05	119.05	DC	23.41
1948189	926000	AC1-076 TAP	DVP	314778	3PAY TAP	DVP	1	DVP_P7-1: LN 70-2153-B-B	tower	260.0	107.82	116.82	DC	23.41

## 16 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	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
1947797	313703	3UNIONVILLE	DVP	314764	3LOCST G	DVP	1	DVP_P1-2: LN 2-A	operation	191.76	116.49	128.43	DC	22.89
1947888	314764	3LOCST G	DVP	926000	AC1-076 TAP	DVP	1	DVP_P1-2: LN 2-A	operation	212.44	104.35	115.13	DC	22.89
1947500	314768	3MITCHEL	DVP	314815	3OAK GRE	DVP	1	DVP_P1-2: LN 2-A	operation	217.14	140.14	158.61	DC	40.1
1947764	314778	3PAY TAP	DVP	314755	3SPOTSYL	DVP	1	DVP_P1-2: LN 2-A	operation	212.44	120.04	130.82	DC	22.89
1947909	314815	3OAK GRE	DVP	313703	3UNIONVILLE	DVP	1	DVP_P1-2: LN 2-A	operation	224.66	102.64	112.83	DC	22.89
1947980	925670	AC1-043 TAP	DVP	314345	3MT RUN	DVP	1	DVP_P1-2: LN 2-D	operation	331.82	93.33	105.42	DC	40.1
1947675	926000	AC1-076 TAP	DVP	314778	3PAY TAP	DVP	1	DVP_P1-2: LN 2-A	operation	212.44	130.2	140.98	DC	22.89
1947978	926480	AC1-120 TAP	DVP	314768	3MITCHEL	DVP	1	DVP_P1-2: LN 2-A	operation	331.82	93.33	105.42	DC	40.1

## 17 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
1948226,1948227,1946945	3	3PAY TAP 115.0 kV - 3SPOTSYL 115.0 kV Ckt 1	dom-095 (198) : Rebuild 2.83 miles of 115 kV Line 153 from Paytes Tap to Spotsylvania with 768 ACSS. Project Type : FAC Cost : \$3,679,000 Time Estimate : 30-36 Months	\$3,679,000
1946997	2	3LOCST G 115.0 kV - 3UNIONVILLE 115.0 kV Ckt 1	dom-093 (195) : Rebuild 0.06 miles of 115 kV Line 153 from Unionville DP to Locust Grove DP with 768 ACSS. Project Type : FAC Cost : \$500,000 Time Estimate : 30-36 Months	\$500,000
1948221,1948222,1946965	1	3UNIONVILLE 115.0 kV - 3LOCST G 115.0 kV Ckt 1		
1946646	4	3SPOTSYL 115.0 kV - 3TDTAVRN 115.0 kV Ckt 1	dom-018 (77) : Rebuild 7.46 miles of 115 kV Line 198 from Spotsylvania to Todds Tavern DP with 768 ACSS. Project Type : FAC Cost : \$9,698,000 Time Estimate : 30-36 Months	\$9,698,000
1946739	5	3NI RVER 115.0 kV - 3CHANCE 115.0 kV Ckt 1	dom-028 (90) : Rebuild 1.34 miles of 115 kV Line 198 from Ni River DP to Chancellor with 768 ACSS. Project Type : FAC Cost : \$1,742,000 Time Estimate : 30-36 Months	\$1,742,000
1946711	6	3TDTAVRN 115.0 kV - 3NI RVER 115.0 kV Ckt 1	dom-025 (87) : Rebuild 5.07 miles of 115 kV Line 198 from Todds Tavern DP to Ni River DP with 768 ACSS. Project Type : FAC Cost : \$6,591,000 Time Estimate : 30-36 Months	\$6,591,000
1948188,1948189,1946893	7	AC1-076 TAP 115.0 kV - 3PAY TAP 115.0 kV Ckt 1	dom-091 (192) : Rebuild 2.8 miles of 115 kV Line 153 from AC1-076 Tap to Paytes Tap with 768 ACSS. Project Type : FAC Cost : \$3,653,000 Time Estimate : 30-36 Months	\$3,653,000
			<b>TOTAL COST</b>	<b>\$25,863,000</b>

## 18 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. 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.

---

## 18.1 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
1948221	313703	3UNIONVILLE	DVP	314764	3LOCSTG	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	235.0	98.82	108.78	DC	23.41

Bus #	Bus	MW Impact
925671	AC1-043 C	22.19
925672	AC1-043 E	36.2
926481	AC1-120 C O1	23.12
926482	AC1-120 E O1	11.91
926501	AC1-121 C O1	7.94
926502	AC1-121 E O1	3.74
932781	AC2-102 C	17.75
932782	AC2-102 E	28.96
934861	AD1-115 C	11.09
934862	AD1-115 E	18.1
939221	AE1-153 C O1	7.98
939222	AE1-153 E O1	5.32
941831	AE2-188	23.41
CARR	CARR	0.07
CBM-S1	CBM-S1	0.56
CBM-S2	CBM-S2	0.36
CBM-W1	CBM-W1	0.72
CBM-W2	CBM-W2	3.77
CIN	CIN	0.34
CPLE	CPLE	0.15
G-007	G-007	0.24
IPL	IPL	0.21
LGEE	LGEE	0.1
MEC	MEC	0.66
MECS	MECS	0.34
O-066	O-066	1.49
RENSSELAER	RENSSELAER	0.05
WEC	WEC	0.09

## 18.2 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
1946997	314764	3LOCST G	DVP	313703	3UNIONVILLE	DVP	1	DVP_P4-2: 573T594	breaker	235.0	98.9	103.31	DC	10.35

Bus #	Bus	MW Impact
926001	AC1-076 C	13.41
926002	AC1-076 E	21.8
926731	AC1-158 C	151.64
926732	AC1-158 E	66.54
934541	AD1-078 C	6.25
934542	AD1-078 E	3.67
941381	AE2-134	8.56
941832	AE2-188 BAT	10.35
BLUEG	BLUEG	0.15
CALDERWOOD	CALDERWOOD	0.01
CANNELTON	CANNELTON	0.01
CBM-N	CBM-N	0.02
CBM-S2	CBM-S2	0.05
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
COFFEEN	COFFEEN	0.01
COTTONWOOD	COTTONWOOD	0.03
CPL	CPL	0.04
DUCKCREEK	DUCKCREEK	0.03
EDWARDS	EDWARDS	0.01
ELMERSMITH	ELMERSMITH	0.01
FARMERCITY	FARMERCITY	0.01
G-007A	G-007A	0.1
GIBSON	GIBSON	0.01
NEWTON	NEWTON	0.04
NYISO	NYISO	0.1
PRAIRIE	PRAIRIE	0.06
SANTEETLA	SANTEETLA	0.0
SMITHLAND	SMITHLAND	0.0
TATANKA	TATANKA	0.02
TILTON	TILTON	0.02
TRIMBLE	TRIMBLE	0.02
TVA	TVA	0.03
UNIONPOWER	UNIONPOWER	0.01
VFT	VFT	0.26

### 18.3 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
1948226	314778	3PAY TAP	DVP	314755	3SPOTSYL	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	260.0	101.8	110.8	DC	23.41

Bus #	Bus	MW Impact
925671	AC1-043 C	22.19
925672	AC1-043 E	36.2
926001	AC1-076 C	17.03
926002	AC1-076 E	27.69
926481	AC1-120 C O1	23.12
926482	AC1-120 E O1	11.91
926501	AC1-121 C O1	7.94
926502	AC1-121 E O1	3.74
932781	AC2-102 C	17.75
932782	AC2-102 E	28.96
934541	AD1-078 C	9.86
934542	AD1-078 E	5.79
934861	AD1-115 C	11.09
934862	AD1-115 E	18.1
939221	AE1-153 C O1	7.98
939222	AE1-153 E O1	5.32
941381	AE2-134	10.88
941831	AE2-188	23.41
CARR	CARR	0.07
CBM-S1	CBM-S1	0.56
CBM-S2	CBM-S2	0.36
CBM-W1	CBM-W1	0.72
CBM-W2	CBM-W2	3.77
CIN	CIN	0.34
CPL	CPL	0.15
G-007	G-007	0.24
IPL	IPL	0.21
LGEE	LGEE	0.1
MEC	MEC	0.66
MECS	MECS	0.34
O-066	O-066	1.49
RENSSELAER	RENSSELAER	0.05
WEC	WEC	0.09

## 18.4 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
1946646	314755	3SPOTSYL	DVP	314779	3TDTAVRN	DVP	1	DVP_P4-2: 573T594	breaker	260.0	146.12	150.11	DC	10.37

Bus #	Bus	MW Impact
925671	AC1-043 C	8.71
925672	AC1-043 E	14.22
926001	AC1-076 C	10.39
926002	AC1-076 E	16.9
926481	AC1-120 C O1	10.65
926482	AC1-120 E O1	5.48
926501	AC1-121 C O1	3.66
926502	AC1-121 E O1	1.72
926611	AC1-143 C O1	3.85
926612	AC1-143 E O1	1.76
926731	AC1-158 C	195.86
926732	AC1-158 E	85.96
932781	AC2-102 C	7.87
932782	AC2-102 E	12.83
934541	AD1-078 C	6.35
934542	AD1-078 E	3.73
934861	AD1-115 C	4.36
934862	AD1-115 E	7.11
941381	AE2-134	6.64
941831	AE2-188	10.37
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-S1	CBM-S1	0.06
CBM-W1	CBM-W1	0.16
CBM-W2	CBM-W2	0.47
CIN	CIN	0.07
G-007	G-007	0.04
HAMLET	HAMLET	0.03
IPL	IPL	0.05
LGEE	LGEE	0.02
MEC	MEC	0.12
MECS	MECS	0.1
O-066	O-066	0.28
RENSELAER	RENSELAER	0.01
WEC	WEC	0.02

## 18.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
1946739	314775	3NI RVER	DVP	314135	3CHANCE	DVP	1	DVP_P4-2:573T594	breaker	260.0	132.16	136.15	DC	10.37

Bus #	Bus	MW Impact
925671	AC1-043 C	8.71
925672	AC1-043 E	14.22
926001	AC1-076 C	10.39
926002	AC1-076 E	16.9
926481	AC1-120 C O1	10.65
926482	AC1-120 E O1	5.48
926501	AC1-121 C O1	3.66
926502	AC1-121 E O1	1.72
926611	AC1-143 C O1	3.85
926612	AC1-143 E O1	1.76
926731	AC1-158 C	195.86
926732	AC1-158 E	85.96
932781	AC2-102 C	7.87
932782	AC2-102 E	12.83
934541	AD1-078 C	6.35
934542	AD1-078 E	3.73
934861	AD1-115 C	4.36
934862	AD1-115 E	7.11
941381	AE2-134	6.64
941831	AE2-188	10.37
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-S1	CBM-S1	0.06
CBM-W1	CBM-W1	0.16
CBM-W2	CBM-W2	0.47
CIN	CIN	0.07
G-007	G-007	0.04
HAMLET	HAMLET	0.03
IPL	IPL	0.05
LGEE	LGEE	0.02
MEC	MEC	0.12
MECS	MECS	0.1
O-066	O-066	0.28
RENSELAER	RENSELAER	0.01
WEC	WEC	0.02

## 18.6 Index 6

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
1946711	314779	3TDTAVRN	DVP	314775	3NIRVER	DVP	1	DVP_P4-2:573T594	breaker	260.0	136.62	140.61	DC	10.37

Bus #	Bus	MW Impact
925671	AC1-043 C	8.71
925672	AC1-043 E	14.22
926001	AC1-076 C	10.39
926002	AC1-076 E	16.9
926481	AC1-120 C O1	10.65
926482	AC1-120 E O1	5.48
926501	AC1-121 C O1	3.66
926502	AC1-121 E O1	1.72
926611	AC1-143 C O1	3.85
926612	AC1-143 E O1	1.76
926731	AC1-158 C	195.86
926732	AC1-158 E	85.96
932781	AC2-102 C	7.87
932782	AC2-102 E	12.83
934541	AD1-078 C	6.35
934542	AD1-078 E	3.73
934861	AD1-115 C	4.36
934862	AD1-115 E	7.11
941381	AE2-134	6.64
941831	AE2-188	10.37
CARR	CARR	0.01
CATAWBA	CATAWBA	0.01
CBM-S1	CBM-S1	0.06
CBM-W1	CBM-W1	0.16
CBM-W2	CBM-W2	0.47
CIN	CIN	0.07
G-007	G-007	0.04
HAMLET	HAMLET	0.03
IPL	IPL	0.05
LGEE	LGEE	0.02
MEC	MEC	0.12
MECS	MECS	0.1
O-066	O-066	0.28
RENSELAER	RENSELAER	0.01
WEC	WEC	0.02

## 18.7 Index 7

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
1948188	926000	AC1-076 TAP	DVP	314778	3PAY TAP	DVP	1	DVP_P7-1: LN 70-2153-B-A	tower	260.0	110.05	119.05	DC	23.41

Bus #	Bus	MW Impact
925671	AC1-043 C	22.19
925672	AC1-043 E	36.2
926001	AC1-076 C	17.03
926002	AC1-076 E	27.69
926481	AC1-120 C O1	23.12
926482	AC1-120 E O1	11.91
926501	AC1-121 C O1	7.94
926502	AC1-121 E O1	3.74
932781	AC2-102 C	17.75
932782	AC2-102 E	28.96
934861	AD1-115 C	11.09
934862	AD1-115 E	18.1
939221	AE1-153 C O1	7.98
939222	AE1-153 E O1	5.32
941381	AE2-134	10.88
941831	AE2-188	23.41
CARR	CARR	0.07
CBM-S1	CBM-S1	0.56
CBM-S2	CBM-S2	0.36
CBM-W1	CBM-W1	0.72
CBM-W2	CBM-W2	3.77
CIN	CIN	0.34
CPLE	CPLE	0.15
G-007	G-007	0.24
IPL	IPL	0.21
LGEE	LGEE	0.1
MEC	MEC	0.66
MECS	MECS	0.34
O-066	O-066	1.49
RENSSELAER	RENSSELAER	0.05
WEC	WEC	0.09

## Affected Systems

## **19 Affected Systems**

### **19.1 LG&E**

LG&E Impacts to be determined during later study phases (as applicable).

### **19.2 MISO**

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

### **19.3 TVA**

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

### **19.4 Duke Energy Progress**

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

### **19.5 NYISO**

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

## 20 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 2-D	CONTINGENCY 'DVP_P1-2: LN 2-D' OPEN BRANCH FROM BUS 926480 TO BUS 314768 CKT 1 /* AC1-120 TAP 115.00 - 3MITCHEL 115.00 OPEN BRANCH FROM BUS 314768 TO BUS 314815 CKT 1 /* 3MITCHEL 115.00 - 3OAK GRE 115.00 OPEN BUS 314768 /* ISLAND: 3MITCHEL 115.00 END
DVP_P4-2: 573T594	CONTINGENCY 'DVP_P4-2: 573T594' /* SPOTSYLVANIA 500 KV OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00 OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END
DVP_P1-2: LN 2-A	CONTINGENCY 'DVP_P1-2: LN 2-A' OPEN BRANCH FROM BUS 314345 TO BUS 925670 CKT 1 /* 3MT RUN 115.00 - AC1-043 TAP 115.00 END
DVP_P7-1: LN 70-2153-B-A	CONTINGENCY 'DVP_P7-1: LN 70-2153-B-A' OPEN BRANCH FROM BUS 926610 TO BUS 314743 CKT 1 /* AC1-143 TAP 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314743 CKT 1 /* 3MT RUN 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314753 CKT 1 /* 3MT RUN 115.00 - 3CULPEPR 115.00 OPEN BRANCH FROM BUS 314753 TO BUS 314873 CKT 1 /* 3CULPEPR 115.00 - 3CULPE_1 115.00 OPEN BUS 314743 /* ISLAND: 3BRANDY 115.00 OPEN BUS 314753 /* ISLAND: 3CULPEPR 115.00 OPEN BUS 314873 /* ISLAND: 3CULPE_1 115.00 OPEN BRANCH FROM BUS 314080 TO BUS 939220 CKT 1 /* 6REMNGTN 230.00 - AE1-153 TAP 230.00 END
DVP_P4-2: 2T70	CONTINGENCY 'DVP_P4-2: 2T70' /* MOUNTAIN RUN 115 KV OPEN BRANCH FROM BUS 314345 TO BUS 925670 CKT 1 /* MT. RUN 115.00 - AC1-043 TAP 115.00 /* CONTINGENCY LINE ADDED FOR AE1 BUILD OPEN BRANCH FROM BUS 926610 TO BUS 314743 CKT 1 /* AC1-143 TAP 115.00 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314743 CKT 1 /* 3MT RUN 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314753 CKT 1 /* 3MT RUN 115.00 - 3CULPEPR 115.00 OPEN BRANCH FROM BUS 314753 TO BUS 314873 CKT 1 /* 3CULPEPR 115.00 - 3CULPE_1 115.00 OPEN BUS 314743 /* ISLAND: 3BRANDY 115.00 OPEN BUS 314753 /* ISLAND: 3CULPEPR 115.00 OPEN BUS 314873 /* ISLAND: 3CULPE_1 115.00 END

Contingency Name	Contingency Definition
<b>DVP_P7-1: LN 70-2153-B-B</b>	CONTINGENCY 'DVP_P7-1: LN 70-2153-B-B' OPEN BRANCH FROM BUS 926610 TO BUS 314743 CKT 1 /* AC1-143 TAP 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314743 CKT 1 /* 3MT RUN 115.00 - 3BRANDY 115.00 OPEN BRANCH FROM BUS 314345 TO BUS 314753 CKT 1 /* 3MT RUN 115.00 - 3CULPEPR 115.00 OPEN BRANCH FROM BUS 314753 TO BUS 314873 CKT 1 /* 3CULPEPR 115.00 - 3CULPE_1 115.00 OPEN BUS 314743 /* ISLAND: 3BRANDY 115.00 OPEN BUS 314753 /* ISLAND: 3CULPEPR 115.00 OPEN BUS 314873 /* ISLAND: 3CULPE_1 115.00 OPEN BRANCH FROM BUS 939220 TO BUS 314758 CKT 1 /* AE1-153 TAP 230.00 - 6GORDNVL 230.00 END

# Short Circuit

## 21 Short Circuit

The following Breakers are overduty:

None

## 22 Attachment 1: One Line Diagram