Generation Interconnection

Feasibility Study Report

for

Queue Project AE1-230

Shockoe 69 KV

7.2 MW Capacity / 20 MW Energy

APRIL, 2019

Table Of Contents

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 (VEPCO).

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

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

Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC), has proposed a Solar\ Storage generating facility located in Pittsylvania County, Virginia. The installed facilities will have a total capability of 20 MW with 7.2 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 07/31/2020. **This study does not imply a TO commitment to this in-service date.**

Queue Number	**AE1-230**
Project Name	Shockoe 69 KV
Interconnection Customer	
State	Virginia
County	Pittsylvania
Transmission Owner	Dominion
MFO	20
MWE	20
MWC	7.2
Fuel	Storage; Solar
Basecase Study Year	2022

Point of Interconnection

AE1-230 will interconnect with the Dominion transmission system at the Shockoe DP 69 kV substation.

Cost Summary

The AE1-230 project may be responsible for a contribution to the following costs

(Reference System Reinforcements in the Network Impacts section for details):

Description	Total Cost
System Upgrades	$34,805,600

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

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

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.

Transmission Owner Scope of Work

Attachment facilities and local upgrades (if required) along with terms and conditions to interconnect AE1-230 will be specified in a separate two party Interconnection Agreement (IA) between Mecklenburg Electrical Co-

operative and the IC as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT). The single line is shown below in Attachment 1.

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.

Interconnection Customer Requirements

ITO's Facility Connection Requirements as posted on PJM's website
http://www.pjm.com/~/media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx

Revenue Metering and SCADA Requirements

PJM Requirements

The IC 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 Sections 24.1 and 24.2.

Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

Network Impacts

The Queue Project AE1-230 was evaluated as a 20 MW (Capacity 7.2 MW) injection at the Shockoe DP 69 kV substation in the Dominion area. Project AE1-230 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-230 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

Generation Deliverability

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

None

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
886692	242549	05BANSTR	AEP	242632	05EDAN 2	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	101.84	103.02	DC	3.47
886693	242549	05BANSTR	AEP	242632	05EDAN 2	AEP	1	AEP_P4_#10213_05CLOV4 EQ 999_A	breaker	296.0	101.68	102.83	DC	3.4
887057	242802	05SMITHMTN1	AEP	926050	AC1-083 TAP	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	84.36	85.53	DC	3.47
887058	242802	05SMITHMTN1	AEP	926050	AC1-083 TAP	AEP	1	AEP_P4_#10213_05CLOV4 EQ 999_A	breaker	296.0	83.32	84.46	DC	3.4
886806	926050	AC1-083 TAP	AEP	242550	05BEARSK	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	104.7	105.88	DC	3.47
886807	926050	AC1-083 TAP	AEP	242550	05BEARSK	AEP	1	AEP_P4_#10213_05CLOV4 EQ 999_A	breaker	296.0	103.6	104.75	DC	3.4

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
887476	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	Base Case	single	167.0	119.33	120.8	DC	2.46
887478	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	AEP_P1-2_#5471-A	single	240.0	102.76	103.81	DC	2.52
887444	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	Base Case	single	167.0	124.78	126.25	DC	2.46
887447	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	AEP_P1-2_#5471-A	single	245.0	104.33	105.36	DC	2.52
562502	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	Base Case	single	167.0	127.47	128.94	DC	2.46
562505	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	AEP_P1-2_#5471-A	single	245.0	106.21	107.24	DC	2.52
887411	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	Base Case	single	167.0	127.47	128.94	DC	2.46
887414	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	AEP_P1-2_#5471-A	single	245.0	106.21	107.24	DC	2.52

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
887527	242549	05BANSTR	AEP	242632	05EDAN 2	AEP	1	AEP_P1-2_#5419-A	operation	296.0	101.51	102.66	DC	3.39
887472	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	Base Case	operation	167.0	135.39	139.49	DC	6.83
887473	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	DVP_P1-2: LN 1016-B	operation	240.0	134.2	137.76	DC	8.51
562761	242701	05LEESVI	AEP	314667	4ALTVSTA	DVP	1	Base Case	operation	205.0	119.33	120.79	DC	3.01
887558	242701	05LEESVI	AEP	314667	4ALTVSTA	DVP	1	Base Case	operation	205.0	119.33	120.79	DC	3.01
887441	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	Base Case	operation	167.0	140.84	144.94	DC	6.83
887442	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	DVP_P1-2: LN 1016-B	operation	245.0	135.18	138.66	DC	8.51
887965	242802	05SMITHMTN1	AEP	926050	AC1-083 TAP	AEP	1	AEP_P1-2_#5419-A	operation	296.0	83.13	84.28	DC	3.39
887355	243892	05MEADS8	AEP	242607	05CLOVRD	AEP	1	AEP_P1-2_#5366-B	operation	277.0	142.51	143.78	DC	3.53
887511	247499	05SMITHMTN2	AEP	242775	05ROCKCA	AEP	1	AEP_P1-2_#5366-B	operation	277.0	116.05	117.33	DC	3.53
887858	247499	05SMITHMTN2	AEP	242701	05LEESVI	AEP	1	Base Case	operation	205.0	98.78	100.25	DC	3.0
562705	314666	3ALTVSTA	DVP	314667	4ALTVSTA	DVP	2	DVP_P1-3: 4ALTVSTA-TX#3	operation	130.47	131.45	133.12	DC	2.18
562771	314666	3ALTVSTA	DVP	314667	4ALTVSTA	DVP	1	DVP_P1-3: 4ALTVSTA-TX#4	operation	126.52	126.52	128.14	DC	2.05
562499	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	Base Case	operation	167.0	143.54	147.63	DC	6.83
562500	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	DVP_P1-2: LN 1016-B	operation	245.0	137.06	140.54	DC	8.51
887408	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	Base Case	operation	167.0	143.54	147.63	DC	6.83
887409	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	DVP_P1-2: LN 1016-B	operation	245.0	137.06	140.54	DC	8.51
562921	314696	3SEDGE HILL	DVP	314697	6SEDGE HILL	DVP	1	DVP_P1-3: 6SEDGE HILL-TX#2	operation	226.73	108.2	108.78	DC	2.72
562905	314861	3SKIMMER	DVP	242886	05SKIMMR	AEP	1	AEP_SUBT_P1-3_#2109_3SKIMMER 115_2	operation	55.0	109.69	110.85	DC	1.32
887807	314861	3SKIMMER	DVP	242886	05SKIMMR	AEP	1	AEP_SUBT_P1-3_#2109_3SKIMMER 115_2	operation	55.0	109.69	110.85	DC	1.32
887636	926050	AC1-083 TAP	AEP	242550	05BEARSK	AEP	1	AEP_P1-2_#5419-A	operation	296.0	103.4	104.55	DC	3.39

System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
887444,887447	5	05OTTER 138.0 kV - 05JOHNMT 138.0 kV Ckt 1	**AEP** Description : Current AEP End Rating: S/N: 164, S/E: 205 1) Replace Otter Riser, Sub cond 477 ACSR 26/7 STD. $175k 2) Replace JohnMt - Otter Line, ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor Section 1, 7 Miles. $10.5M Time Estimate : 18-24 Months Cost : $10,670,000	$10,670,000
886692,886693	1	05BANSTR 138.0 kV - 05EDAN 2 138.0 kV Ckt 1	**AEP** Description : Current End Ratings: S/N: 293, S/N: 341 1) Banister - East Danville ACSR ~ 1033.5 ~ 45/7 ~ ORTOLAN, Conductor Section 2. 196 feet, A Sag Study will be required on the 196 foot section of line to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $20,000 (no remediations required just sag study, new ratings: S/N: 296, S/E: 398) and $55.6K (complete line reconductor/rebuild required) Time Estimate : 6-12 Months Cost : $55,600	$55,600
887057,887058	2	05SMITHMTN1 138.0 kV - AC1-083 TAP 138.0 kV Ckt 1	**AEP** Description : No Violation. Current AEP End Ratings: S/N: 296, S/E: 296.	$0
887476,887478	4	05JOHNMT 138.0 kV - 05NEWLDN 138.0 kV Ckt 1	**AEP** Description : Current Station Rating: S/N: 167, S/E: 240 1) Replace ACSR ~ 397.5 ~ 30/7 ~ LARK ~ Fe Clamps 9 d, Conductor Section 1, 14.43 miles Time Estimate : 12-18 Months Cost : $21,650,000	$21,650,000
562505,887411,887414,562502	6	4ALTVSTA 138.0 kV - 05OTTER 138.0 kV Ckt 1	**DVP** Description : Replace Terminal Equipment Time Estimate : 20-24 Months Cost : $300,000 **AEP** Description : Current End Ratings: S/N: 164, S/E: 205 1) Replace Otter, Sub cond 477 ACSR 26/7 STD, $175k 2) Replace ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor Section 1, 1 mile, $1.5M Time Estimate : 18-24 Months Cost : $1,680,000	$1,980,000

ID	Index	Facility	Upgrade Description	Cost
886806,886807	3	**AC1-083 TAP 138.0 kV - 05BEARSK 138.0 kV Ckt 1**	**AEP** Description : 1) A Sag Study will be required on the 0.3 mile section of ACSR ~ 1033.5 ~ 45/7 ~ ORTOLAN, conductor section 1 to mitigate the overload . Depending on the sag study results, cost for this upgrade is expected to be between $20,000 (no remediations required just sag study, new ratings : S/N: 296, S/E: 398) and $450,000 (complete line reconductor/rebuild required). Time Estimate: a) Sag Study: 12-18 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. Time Estimate : 12-18 Months Cost : $450,000	$450,000
			TOTAL COST	**$34,805,600**

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.

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
886692	242549	05BANSTR	AEP	242632	05EDAN 2	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	101.84	103.02	DC	3.47

Bus #	Bus	MW Impact
246843	05SMG1	3.33
246844	05SMG2	8.78
246845	05SMG3	5.15
246846	05SMG4	9.08
246847	05SMG5	3.43
247284	05LEESVG	1.91
315156	1HALLBR1	1.46
315165	1HURT 1	6.6
315166	1HURT 2	6.6
919841	AA2-070	1.67
924572	AB2-109 E	0.76
925661	AC1-042 C	2.77
925662	AC1-042 E	4.52
925991	AC1-075 C	2.96
925992	AC1-075 E	1.68
926021	AC1-080 C	0.99
926022	AC1-080 E	0.56
926051	AC1-083 C O1	19.07
926052	AC1-083 E O1	31.12
926521	AC1-123 C O1	12.93
926522	AC1-123 E O1	6.09
926641	AC1-145 C	3.3
926642	AC1-145 E	5.38
932821	AC2-107 C	5.26
932822	AC2-107 E	2.46
933621	AC2-180 C	0.37
933622	AC2-180 E	0.73
933941	AD1-017 C	3.81
933942	AD1-017 E	6.22
934921	AD1-124 C	0.7
934922	AD1-124 E	0.35
935241	AD1-161 C	2.76
935242	AD1-161 E	2.27
938451	AE1-064 C	25.38
938452	AE1-064 E	13.01
939011	AE1-130 C O1	20.81
939012	AE1-130 E O1	10.2
939941	AE1-230 C1	1.25
939942	AE1-230 E1	0.83
939943	AE1-230 E2	1.39
940081	AE1-250 C	57.33

Bus #	Bus	MW Impact
940082	AE1-250 E	38.22
BAYOU	BAYOU	0.61
BIG_CAJUN1	BIG_CAJUN1	0.99
BIG_CAJUN2	BIG_CAJUN2	1.98
BLUEG	BLUEG	0.3
CALDERWOOD	CALDERWOOD	0.39
CANNELTON	CANNELTON	0.05
CARR	CARR	0.03
CATAWBA	CATAWBA	0.59
CHEOAH	CHEOAH	0.38
CHILHOWEE	CHILHOWEE	0.13
CHOCTAW	CHOCTAW	0.68
COFFEEN	COFFEEN	0.09
COTTONWOOD	COTTONWOOD	2.34
DEARBORN	DEARBORN	0.0
DUCKCREEK	DUCKCREEK	0.15
EDWARDS	EDWARDS	0.06
ELMERSMITH	ELMERSMITH	0.09
FARMERCITY	FARMERCITY	0.09
G-007	G-007	0.11
GIBSON	GIBSON	0.02
HAMLET	HAMLET	2.47
NEWTON	NEWTON	0.22
O-066	O-066	0.36
PRAIRIE	PRAIRIE	0.66
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.11
SMITHLAND	SMITHLAND	0.07
TATANKA	TATANKA	0.12
TILTON	TILTON	0.06
TRIMBLE	TRIMBLE	0.03
TVA	TVA	0.95
UNIONPOWER	UNIONPOWER	0.58

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
887057	242802	05SMITHMTN1	AEP	926050	AC1-083 TAP	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	84.36	85.53	DC	3.47

Bus #	Bus	MW Impact
246843	05SMG1	3.33
246844	05SMG2	8.78
246845	05SMG3	5.15
246846	05SMG4	9.08
246847	05SMG5	3.43
247284	05LEESVG	1.91
315156	1HALLBR1	1.46
315165	1HURT 1	6.6
315166	1HURT 2	6.6
919841	AA2-070	1.67
924572	AB2-109 E	0.76
925661	AC1-042 C	2.77
925662	AC1-042 E	4.52
925991	AC1-075 C	2.96
925992	AC1-075 E	1.68
926021	AC1-080 C	0.99
926022	AC1-080 E	0.56
926521	AC1-123 C O1	12.93
926522	AC1-123 E O1	6.09
926641	AC1-145 C	3.3
926642	AC1-145 E	5.38
932821	AC2-107 C	5.26
932822	AC2-107 E	2.46
933621	AC2-180 C	0.37
933622	AC2-180 E	0.73
934921	AD1-124 C	0.7
934922	AD1-124 E	0.35
935241	AD1-161 C	2.76
935242	AD1-161 E	2.27
938451	AE1-064 C	25.38
938452	AE1-064 E	13.01
939011	AE1-130 C O1	20.81
939012	AE1-130 E O1	10.2
939841	AE1-220 C O1	4.05
939842	AE1-220 E O1	2.02
939941	AE1-230 C1	1.25
939942	AE1-230 E1	0.83
939943	AE1-230 E2	1.39
940083	AE1-250 EBAT	54.44
BAYOU	BAYOU	0.61

Bus #	Bus	MW Impact
BIG_CAJUN1	BIG_CAJUN1	0.99
BIG_CAJUN2	BIG_CAJUN2	1.98
BLUEG	BLUEG	0.3
CALDERWOOD	CALDERWOOD	0.39
CANNELTON	CANNELTON	0.05
CARR	CARR	0.03
CATAWBA	CATAWBA	0.59
CHEOAH	CHEOAH	0.38
CHILHOWEE	CHILHOWEE	0.13
CHOCTAW	CHOCTAW	0.68
COFFEEN	COFFEEN	0.09
COTTONWOOD	COTTONWOOD	2.34
DEARBORN	DEARBORN	0.0
DUCKCREEK	DUCKCREEK	0.15
EDWARDS	EDWARDS	0.06
ELMERSMITH	ELMERSMITH	0.09
FARMERCITY	FARMERCITY	0.09
G-007	G-007	0.11
GIBSON	GIBSON	0.02
HAMLET	HAMLET	2.47
NEWTON	NEWTON	0.22
O-066	O-066	0.36
PRAIRIE	PRAIRIE	0.66
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.11
SMITHLAND	SMITHLAND	0.07
TATANKA	TATANKA	0.12
TILTON	TILTON	0.06
TRIMBLE	TRIMBLE	0.03
TVA	TVA	0.95
UNIONPOWER	UNIONPOWER	0.58

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
886806	926050	AC1-083 TAP	AEP	242550	05BEARSK	AEP	1	AEP_P4_#10210_05CLOVRD 138_A2	breaker	296.0	104.7	105.88	DC	3.47

Bus #	Bus	MW Impact
246843	05SMG1	3.33
246844	05SMG2	8.78
246845	05SMG3	5.15
246846	05SMG4	9.08
246847	05SMG5	3.43
247284	05LEESVG	1.91
315156	1HALLBR1	1.46
315165	1HURT 1	6.6
315166	1HURT 2	6.6
919841	AA2-070	1.67
924572	AB2-109 E	0.76
925661	AC1-042 C	2.77
925662	AC1-042 E	4.52
925991	AC1-075 C	2.96
925992	AC1-075 E	1.68
926021	AC1-080 C	0.99
926022	AC1-080 E	0.56
926051	AC1-083 C O1	19.07
926052	AC1-083 E O1	31.12
926521	AC1-123 C O1	12.93
926522	AC1-123 E O1	6.09
926641	AC1-145 C	3.3
926642	AC1-145 E	5.38
932821	AC2-107 C	5.26
932822	AC2-107 E	2.46
933621	AC2-180 C	0.37
933622	AC2-180 E	0.73
933941	AD1-017 C	3.81
933942	AD1-017 E	6.22
934921	AD1-124 C	0.7
934922	AD1-124 E	0.35
935241	AD1-161 C	2.76
935242	AD1-161 E	2.27
938451	AE1-064 C	25.38
938452	AE1-064 E	13.01
939011	AE1-130 C O1	20.81
939012	AE1-130 E O1	10.2
939841	AE1-220 C O1	4.05
939842	AE1-220 E O1	2.02
939941	AE1-230 C1	1.25

Bus #	Bus	MW Impact
939942	AE1-230 E1	0.83
939943	AE1-230 E2	1.39
940083	AE1-250 EBAT	54.44
BAYOU	BAYOU	0.61
BIG_CAJUN1	BIG_CAJUN1	0.99
BIG_CAJUN2	BIG_CAJUN2	1.98
BLUEG	BLUEG	0.3
CALDERWOOD	CALDERWOOD	0.39
CANNELTON	CANNELTON	0.05
CARR	CARR	0.03
CATAWBA	CATAWBA	0.59
CHEOAH	CHEOAH	0.38
CHILHOWEE	CHILHOWEE	0.13
CHOCTAW	CHOCTAW	0.68
COFFEEN	COFFEEN	0.09
COTTONWOOD	COTTONWOOD	2.34
DEARBORN	DEARBORN	0.0
DUCKCREEK	DUCKCREEK	0.15
EDWARDS	EDWARDS	0.06
ELMERSMITH	ELMERSMITH	0.09
FARMERCITY	FARMERCITY	0.09
G-007	G-007	0.11
GIBSON	GIBSON	0.02
HAMLET	HAMLET	2.47
NEWTON	NEWTON	0.22
O-066	O-066	0.36
PRAIRIE	PRAIRIE	0.66
RENSSELAER	RENSSELAER	0.02
SANTEETLA	SANTEETLA	0.11
SMITHLAND	SMITHLAND	0.07
TATANKA	TATANKA	0.12
TILTON	TILTON	0.06
TRIMBLE	TRIMBLE	0.03
TVA	TVA	0.95
UNIONPOWER	UNIONPOWER	0.58

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
887476	242687	05JOHNMT	AEP	242734	05NEWLDN	AEP	1	Base Case	single	167.0	119.33	120.8	DC	2.46

Bus #	Bus	MW Impact
246843	05SMG1	1.0
246844	05SMG2	2.63
246845	05SMG3	1.54
246846	05SMG4	2.72
246847	05SMG5	1.03
247284	05LEESVG	1.65
315156	1HALLBR1	2.83
315165	1HURT 1	12.78
315166	1HURT 2	12.78
315266	1PLYWOOD A	0.39
919841	AA2-070	0.5
925661	AC1-042 C	5.45
925991	AC1-075 C	6.8
926021	AC1-080 C	2.27
926051	AC1-083 C O1	2.77
926271	AC1-105 C O1	1.87
926641	AC1-145 C	6.49
927261	AC1-222 C	1.98
932821	AC2-107 C	12.09
933941	AD1-017 C	0.55
934311	AD1-055 C	1.38
936331	AD2-043 C	2.7
938451	AE1-064 C	6.11
939941	AE1-230 C1	2.46
940081	AE1-250 C	5.02
BAYOU	BAYOU	0.0
BLUEG	BLUEG	1.33
CANNELTON	CANNELTON	0.07
CARR	CARR	0.02
CBM-S2	CBM-S2	1.18
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.05
CPLE	CPLE	0.79
DEARBORN	DEARBORN	0.22
DUCKCREEK	DUCKCREEK	0.25
EDWARDS	EDWARDS	0.12
ELMERSMITH	ELMERSMITH	0.11
FARMERCITY	FARMERCITY	0.06
GIBSON	GIBSON	0.05
NEWTON	NEWTON	0.29
PRAIRIE	PRAIRIE	0.42

Bus #	Bus	MW Impact
RENSSELAER	RENSSELAER	0.01
SMITHLAND	SMITHLAND	0.03
TATANKA	TATANKA	0.12
TILTON	TILTON	0.15
TRIMBLE	TRIMBLE	0.15
TVA	TVA	0.05

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
887444	242741	05OTTER	AEP	242687	05JOHNMT	AEP	1	Base Case	single	167.0	124.78	126.25	DC	2.46

Bus #	Bus	MW Impact
246843	05SMG1	1.0
246844	05SMG2	2.63
246845	05SMG3	1.54
246846	05SMG4	2.72
246847	05SMG5	1.03
247284	05LEESVG	1.65
315156	1HALLBR1	2.83
315165	1HURT 1	12.78
315166	1HURT 2	12.78
315266	1PLYWOOD A	0.39
919841	AA2-070	0.5
925661	AC1-042 C	5.45
925991	AC1-075 C	6.8
926021	AC1-080 C	2.27
926051	AC1-083 C O1	2.77
926271	AC1-105 C O1	1.87
926641	AC1-145 C	6.49
927261	AC1-222 C	1.98
932821	AC2-107 C	12.09
933941	AD1-017 C	0.55
934311	AD1-055 C	1.38
936331	AD2-043 C	2.7
938451	AE1-064 C	6.11
939941	AE1-230 C1	2.46
940081	AE1-250 C	5.02
BAYOU	BAYOU	0.0
BLUEG	BLUEG	1.33
CANNELTON	CANNELTON	0.07
CARR	CARR	0.02
CBM-S2	CBM-S2	1.18
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.05
CPLE	CPLE	0.79
DEARBORN	DEARBORN	0.22
DUCKCREEK	DUCKCREEK	0.25
EDWARDS	EDWARDS	0.12
ELMERSMITH	ELMERSMITH	0.11
FARMERCITY	FARMERCITY	0.06
GIBSON	GIBSON	0.05
NEWTON	NEWTON	0.29
PRAIRIE	PRAIRIE	0.42

Bus #	Bus	MW Impact
RENSSELAER	RENSSELAER	0.01
SMITHLAND	SMITHLAND	0.03
TATANKA	TATANKA	0.12
TILTON	TILTON	0.15
TRIMBLE	TRIMBLE	0.15
TVA	TVA	0.05

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
887411	314667	4ALTVSTA	DVP	242741	05OTTER	AEP	1	Base Case	single	167.0	127.47	128.94	DC	2.46

Bus #	Bus	MW Impact
246843	05SMG1	1.0
246844	05SMG2	2.63
246845	05SMG3	1.54
246846	05SMG4	2.72
246847	05SMG5	1.03
247284	05LEESVG	1.65
315156	1HALLBR1	2.83
315165	1HURT 1	12.78
315166	1HURT 2	12.78
315266	1PLYWOOD A	0.39
919841	AA2-070	0.5
925661	AC1-042 C	5.45
925991	AC1-075 C	6.8
926021	AC1-080 C	2.27
926051	AC1-083 C O1	2.77
926271	AC1-105 C O1	1.87
926641	AC1-145 C	6.49
927261	AC1-222 C	1.98
932821	AC2-107 C	12.09
933941	AD1-017 C	0.55
934311	AD1-055 C	1.38
936331	AD2-043 C	2.7
938451	AE1-064 C	6.11
939941	AE1-230 C1	2.46
940081	AE1-250 C	5.02
BAYOU	BAYOU	0.0
BLUEG	BLUEG	1.33
CANNELTON	CANNELTON	0.07
CARR	CARR	0.02
CBM-S2	CBM-S2	1.18
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.05
CPLE	CPLE	0.79
DEARBORN	DEARBORN	0.22
DUCKCREEK	DUCKCREEK	0.25
EDWARDS	EDWARDS	0.12
ELMERSMITH	ELMERSMITH	0.11
FARMERCITY	FARMERCITY	0.06
GIBSON	GIBSON	0.05
NEWTON	NEWTON	0.29
PRAIRIE	PRAIRIE	0.42

Bus #	Bus	MW Impact
RENSSELAER	RENSSELAER	0.01
SMITHLAND	SMITHLAND	0.03
TATANKA	TATANKA	0.12
TILTON	TILTON	0.15
TRIMBLE	TRIMBLE	0.15
TVA	TVA	0.05

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Contingency Definition
AEP_P1-2_#5471-A	CONTINGENCY 'AEP_P1-2_#5471-A' OPEN BRANCH FROM BUS 242575 TO BUS 242737 CKT 1 / 242575 05CAMDLM 138 242737 05OPOSSUMCK 138 1 OPEN BRANCH FROM BUS 242575 TO BUS 242781 CKT 1 / 242575 05CAMDLM 138 242781 05RUSTBR 138 1 OPEN BRANCH FROM BUS 242575 TO BUS 926520 CKT 1 / 242575 05CAMDLM 138 926520 AC1-123 TAP 138 1 END
AEP_SUBT_P1-3_#2109_3SKIMMER 115_2	CONTINGENCY 'AEP_SUBT_P1-3_#2109_3SKIMMER 115_2' OPEN BRANCH FROM BUS 314861 TO BUS 242886 CKT 2 / 314861 3SKIMMER 115 242886 05SKIMMR 69.0 2 END
AEP_P1-2_#5419-A	CONTINGENCY 'AEP_P1-2_#5419-A' OPEN BRANCH FROM BUS 242607 TO BUS 243892 CKT 1 / 242607 05CLOVRD 138 243892 05MEADS8 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 939010 CKT 1 / 243892 05MEADS8 138 939010 AE1-130 TAP 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 243893 CKT Z1 / 243892 05MEADS8 138 243893 05MEADS 8 24.9 Z1 END
AEP_P4_#10213_05CLOV4 EQ 999_A	CONTINGENCY 'AEP_P4_#10213_05CLOV4 EQ 999_A' OPEN BRANCH FROM BUS 242560 TO BUS 242607 CKT 1 / 242560 05BONSCK 138 242607 05CLOVRD 138 1 OPEN BRANCH FROM BUS 242560 TO BUS 242840 CKT 1 / 242560 05BONSCK 138 242840 05VINTON 138 1 OPEN BRANCH FROM BUS 242607 TO BUS 243892 CKT 1 / 242607 05CLOVRD 138 243892 05MEADS8 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 939010 CKT 1 / 243892 05MEADS8 138 939010 AE1-130 TAP 138 1 OPEN BRANCH FROM BUS 242773 TO BUS 242840 CKT 1 / 242773 05ROANO1 138 242840 05VINTON 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 243893 CKT Z1 / 243892 05MEADS8 138 243893 05MEADS 8 24.9 Z1 END
AEP_P1-2_#5366-B	CONTINGENCY 'AEP_P1-2_#5366-B' OPEN BRANCH FROM BUS 242549 TO BUS 940080 CKT 1 / 242549 05BANSTR 138 940080 AE1-250 TAP 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 242632 CKT 1 / 242549 05BANSTR 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 314668 CKT Z1 / 242549 05BANSTR 138 314668 4BANISTR 138 Z1 END
DVP_P1-3: 6SEDGE HILL-TX#2	CONTINGENCY 'DVP_P1-3: 6SEDGE HILL-TX#2' OPEN BRANCH FROM BUS 314696 TO BUS 314697 CKT 2 /* 3SEDGE HILL 115.00 - 6SEDGE HILL 230.00 END

Contingency Name	Contingency Definition
Base Case	
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
AEP_P4_#10210_05CLOVRD 138_A2	CONTINGENCY 'AEP_P4_#10210_05CLOVRD 138_A2' OPEN BRANCH FROM BUS 244044 TO BUS 242607 CKT 1 / 244044 05CLOV4 EQ 999 242607 05CLOVRD 138 1 OPEN BRANCH FROM BUS 244044 TO BUS 244041 CKT 1 / 244044 05CLOV4 EQ 999 244041 05CLOV 4 69.0 1 OPEN BRANCH FROM BUS 244044 TO BUS 244043 CKT 1 / 244044 05CLOV4 EQ 999 244043 05CLOV4 34.5 1 OPEN BRANCH FROM BUS 242607 TO BUS 243883 CKT 1 / 242607 05CLOVRD 138 243883 05LAKEFR 138 1 OPEN BRANCH FROM BUS 242607 TO BUS 243892 CKT 1 / 242607 05CLOVRD 138 243892 05MEADS8 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 939010 CKT 1 / 243892 05MEADS8 138 939010 AE1-130 TAP 138 1 OPEN BRANCH FROM BUS 243892 TO BUS 243893 CKT Z1 / 243892 05MEADS8 138 243893 05MEADS 8 24.9 Z1 END
DVP_P1-3: 4ALTVSTA-TX#3	CONTINGENCY 'DVP_P1-3: 4ALTVSTA-TX#3' OPEN BRANCH FROM BUS 314666 TO BUS 314667 CKT 1 /* 3ALTVSTA 115.00 - 4ALTVSTA 138.00 END
DVP_P1-2: LN 1016-B	CONTINGENCY 'DVP_P1-2: LN 1016-B' OPEN BRANCH FROM BUS 927260 TO BUS 314696 CKT 1 /* AC1-222 TAP 115.00 - 3SEDGE HILL 115.00 END

Short Circuit

Short Circuit

The following Breakers are overduty:

None

Attachment 1

Single Line Diagram