



**Generation Interconnection
Feasibility Study Report
for
Queue Project AE1-108
BREMO-SCOTTSVILLE 138 KV
108 MW Capacity / 180 MW Energy**

June, 2019

Table Of Contents

Preface	3
General	5
Point of Interconnection	7
Cost Summary	7
Transmission Owner Scope of Work	8
Attachment Facilities	8
Direct Connection Cost Estimate	8
Non-Direct Connection Cost Estimate	8
Schedule	10
Interconnection Customer Requirements	11
Revenue Metering and SCADA Requirements	12
Network Impacts	13
Summer Peak Load Flow	14
Generation Deliverability	15
Multiple Facility Contingency	15
Contribution to Previously Identified	16
Potential Congestion due to Local Energy Deliverability	17
System Reinforcements	19
Flow Gate Details	21
Affected Systems	39
Short Circuit	47
Single-Line Diagram	49
Point of Interconnection	50

Preface

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

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

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

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

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a \$10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model.

The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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

General

The Interconnection Customer has proposed to install PJM Project # AE1-108 a Solar generating facility located in Buckingham County, Virginia (See Figure 2). The installed facilities will have a total capability of 180 MW with 108 MW of this output being recognized by PJM as Capacity. The Point of Interconnection will be to the AEP portion of the Brema (Dominion) – Scottsville (AEP) 138kV tie line (See Figure 1).

The proposed in-service date for this project is August 31, 2021. This study does not imply AEP's commitment to this in-service date.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required for maintaining the reliability of the AEP transmission system.

The Feasibility Study includes Short Circuit and Peak Load steady state power flow analyses. The conduct of power flow studies at other load levels, stability analysis, and coordination with non-PJM Transmission Planners, as required under the PJM planning process, is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of these additional analyses which shall be performed following execution of the System Impact Study agreement.

Queue Number	AE1-108
Project Name	BREMO-SCOTTSVILLE 138 KV
State	Virginia
County	Buckingham
Transmission Owner	AEP
MFO	180
MWE	180
MWC	108
Fuel	Solar
Basecase Study Year	2022

Point of Interconnection

AE1-108 will interconnect with the AEP transmission system via a new station cut into the (Dominion) Bremono – Scottsville (AEP) 138 kV tie line.

To accommodate the interconnection on the (Dominion) Bremono - Scottsville (AEP) 138 kV line, a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Cost Summary

The AE1-108 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$6,000,000
Direct Connection Network Upgrade	\$1,000,000
Non Direct Connection Network Upgrades	\$750,000*
Total Costs	\$7,750,000

*Assumes Dominion work required at Bremono is similar to AEP work required at Scottsville. PJM will need to coordinate with Dominion.

In addition, the AE1-108 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	\$86,225,200

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

Transmission Owner Scope of Work

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.

Description	Total Cost
▪ Construct a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus (See Figure 1). Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required.	\$6,000,000
	\$
	\$
Total Attachment Facility Costs	\$6,000,000

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.

Description	Total Cost
Bremo - Scottsville 138 kV T-Line Cut In	\$1,000,000
	\$
	\$
Total Direct Connection Facility Costs	\$1,000,000

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
138 kV Revenue Metering	\$250,000
Upgrade line protection and controls at the Bremo (Dominion) 138 kV substation	TBD by Dominion
Upgrade line protection and controls at the Scottsville 138 kV substation	\$250,000
Total Non-Direct Connection Facility Costs	\$750,000*

*Assumes Dominion work required at Brema is similar to AEP work required at Scottsville. PJM will need to coordinate with Dominion.

Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after signing Agreement execution.

Interconnection Customer Requirements

It is understood that the Interconnection Customer is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to the Brema - Scottsville 138 kV line are not included in this report; these are assumed to be the Interconnection Customer's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

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.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

Network Impacts

The Queue Project AE1-108 was evaluated as a 180 MW (Capacity 108 MW) injection tapping the (AEP) Scottsville to Bremono Bluff (Dominion) 138 kV line in the AEP area. Project AE1-108 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-108 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)

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
352588	314763	3KIDDSTO	DVP	314774	3SHERWOD	DVP	1	DVP_P1-3: 6BREMO-TX#9	single	169.2	74.25	101.89	DC	46.77
352590	314763	3KIDDSTO	DVP	314774	3SHERWOD	DVP	1	DVP_P1-2: LN 2028	single	169.2	86.24	96.39	DC	17.18
352873	938820	AE1-108 TAP	AEP	242792	05SCOTSV	AEP	1	AEP_P1-2_#7422	single	167.0	85.47	105.06	DC	32.71
644381	938820	AE1-108 TAP	AEP	242792	05SCOTSV	AEP	1	AEP_P1-2_#7422	single	167.0	85.47	105.06	DC	32.71
644064	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	AEP_P1-2_#7422	single	167.0	69.3	87.58	DC	30.54
644065	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	DVP_P1-2: LN 2028	single	167.0	63.16	82.49	DC	32.27

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
642992	242 603	05CLIFFR	AEP	24256 3	05BOXWD	AEP	1	DVP_P2-2: BREMO B4	bus	245.0	12.48	73.51	DC	149.51
643654	242 603	05CLIFFR	AEP	24256 3	05BOXWD	AEP	1	DVP_P4-2: 422	breaker	245.0	12.48	73.51	DC	149.51
642850	242 613	05COLLEEN SS	AEP	93984 0	AE1-220 TAP	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	30.68	131.29	DC	168.01
643386	242 613	05COLLEEN SS	AEP	93984 0	AE1-220 TAP	AEP	1	DVP_P4-2: 422	breaker	167.0	30.68	131.29	DC	168.01
642847	242 792	05SCOTSV	AEP	24261 3	05COLLEEN SS	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	33.02	133.62	DC	168.01
643360	242 792	05SCOTSV	AEP	24261 3	05COLLEEN SS	AEP	1	DVP_P4-2: 422	breaker	167.0	33.02	133.62	DC	168.01
642993	242 862	05AMHERST	AEP	24748 7	05COOLWELLS	AEP	1	AEP_P2-2_#10311_05REUSEN 138_2	bus	50.0	6.91	53.31	DC	23.2
643660	242 862	05AMHERST	AEP	24748 7	05COOLWELLS	AEP	1	AEP_P4_#10314_05REUSEN 138_A	breaker	50.0	6.51	52.91	DC	23.2
643661	242 862	05AMHERST	AEP	24748 7	05COOLWELLS	AEP	1	AEP_P4_#10313_05REUSEN 138_G	breaker	50.0	6.66	51.52	DC	23.2
642928	242 867	05CLIFFORD	AEP	24286 2	05AMHERST	AEP	1	AEP_P2-2_#10311_05REUSEN 138_2	bus	50.0	18.31	64.71	DC	23.2
642929	242 867	05CLIFFORD	AEP	24286 2	05AMHERST	AEP	1	DVP_P2-2: BREMO B4	bus	50.0	14.72	75.69	DC	30.49
643537	242 867	05CLIFFORD	AEP	24286 2	05AMHERST	AEP	1	AEP_P4_#10314_05REUSEN 138_A	breaker	50.0	17.91	64.31	DC	23.2
643538	242 867	05CLIFFORD	AEP	24286 2	05AMHERST	AEP	1	AEP_P4_#10313_05REUSEN 138_G	breaker	50.0	14.71	61.11	DC	23.2
643539	242 867	05CLIFFORD	AEP	24286 2	05AMHERST	AEP	1	DVP_P4-2: 422	breaker	50.0	14.72	75.69	DC	30.49

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
643006	247 487	05COOLWELLS S	AEP	24287 6	05MONROE A	AEP	1	AEP_P2-2_#10311_05REUSEN 138_2	bus	50.0	5.51	51.91	DC	23.2
643670	247 487	05COOLWELLS S	AEP	24287 6	05MONROE A	AEP	1	AEP_P4_#10314_05REUSEN 138_A	breaker	50.0	5.11	51.51	DC	23.2
643671	247 487	05COOLWELLS S	AEP	24287 6	05MONROE A	AEP	1	AEP_P4_#10313_05REUSEN 138_G	breaker	50.0	7.93	51.56	DC	23.2
351419	314 763	3KIDDSTO	DVP	31477 4	3SHERWOD	DVP	1	DVP_P2-2: BREMO B1	bus	208.0	72.98	110.41	DC	77.87
351862	314 763	3KIDDSTO	DVP	31477 4	3SHERWOD	DVP	1	DVP_P4-2: 29822	breaker	208.0	72.98	110.41	DC	77.87
351863	314 763	3KIDDSTO	DVP	31477 4	3SHERWOD	DVP	1	DVP_P4-2: 210622	breaker	208.0	72.98	110.41	DC	77.87
351864	314 763	3KIDDSTO	DVP	31477 4	3SHERWOD	DVP	1	DVP_P4-2: 202722	breaker	208.0	72.78	110.22	DC	77.87
351346	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	44.13	151.92	DC	180.0
351347	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P2-2: BREMO B1	bus	167.0	73.0	134.16	DC	102.13
351636	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P4-2: 422	breaker	167.0	44.13	151.92	DC	180.0
351637	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	AEP_P4_#8476_05CLOVR D 500_A	breaker	167.0	84.95	117.6	DC	54.52
642797	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	44.13	151.92	DC	180.0
642798	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P2-2: BREMO B1	bus	167.0	73.0	134.16	DC	102.13
643202	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	DVP_P4-2: 422	breaker	167.0	44.13	151.92	DC	180.0
643203	938 820	AE1-108 TAP	AEP	24279 2	05SCOTSV	AEP	1	AEP_P4_#8476_05CLOVR D 500_A	breaker	167.0	84.95	117.6	DC	54.52
642756	939 840	AE1-220 TAP	AEP	24260 3	05CLIFFR	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	30.68	131.29	DC	168.01

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
352544	313867	6BREMODIST	DVP	314765	6MTEAGLE	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	117.16	122.91	DC	38.05
352545	313867	6BREMODIST	DVP	314765	6MTEAGLE	DVP	1	DVP_P1-2: LN 2027-A	single	661.76	112.69	118.44	DC	38.05
352501	314747	6BREMO	DVP	313867	6BREMODIST	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	119.49	125.24	DC	38.05
352502	314747	6BREMO	DVP	313867	6BREMODIST	DVP	1	DVP_P1-2: LN 2027-A	single	661.76	115.02	120.77	DC	38.05
352579	314765	6MTEAGLE	DVP	314749	6CHARLVL	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	113.35	119.1	DC	38.05
352580	314765	6MTEAGLE	DVP	314749	6CHARLVL	DVP	1	DVP_P1-2: LN 2027-A	single	661.76	108.9	114.65	DC	38.05

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
644393	242613	05COLLEEN SS	AEP	939840	AE1-220 TAP	AEP	1	DVP_P1-3: 6BREMO-TX#9	operation	167.0	59.48	116.51	DC	95.25
644352	242792	05SCOTSV	AEP	242613	05COLLEEN SS	AEP	1	DVP_P1-3: 6BREMO-TX#9	operation	167.0	61.75	118.79	DC	95.25
352542	313867	6BREMODIST	DVP	314765	6MTEAGLE	DVP	1	DVP_P1-2: LN 2027-B	operation	661.76	130.02	139.62	DC	63.41
352550	313867	6BREMODIST	DVP	314765	6MTEAGLE	DVP	1	Base Case	operation	661.76	89.29	95.97	DC	44.17
353017	313868	6CARTERV	DVP	933500	AC2-165 TAP	DVP	1	DVP_P1-2: LN 2028	operation	800.88	89.84	96.8	DC	55.66
352964	314310	6JUDES F	DVP	314322	6MDLTHAN	DVP	1	DVP_P1-2: LN 2028	operation	800.88	94.34	101.3	DC	55.65
352927	314333	6POWHATN	DVP	314310	6JUDES F	DVP	1	DVP_P1-2: LN 2028	operation	800.88	98.1	105.06	DC	55.65
353030	314686	6CLOVER	DVP	934610	AD1-087 TAP	DVP	1	DVP_P1-2: LN 556	operation	814.98	97.09	97.77	DC	12.18
352779	314744	3BREMO	DVP	314747	6BREMO	DVP	1	DVP_P1-2: LN 91-B	operation	269.78	71.39	116.45	DC	121.55
352996	314744	3BREMO	DVP	938540	AE1-073 TAP	DVP	1	DVP_P1-3: 6BREMO-TX#9	operation	224.66	60.53	95.23	DC	77.95
352499	314747	6BREMO	DVP	313867	6BREMODIST	DVP	1	DVP_P1-2: LN 2027-B	operation	661.76	132.35	141.95	DC	63.41
352507	314747	6BREMO	DVP	313867	6BREMODIST	DVP	1	Base Case	operation	661.76	91.6	98.28	DC	44.17
353006	314747	6BREMO	DVP	313868	6CARTERV	DVP	1	DVP_P1-2: LN 2028	operation	800.88	90.54	97.5	DC	55.66
352587	314763	3KIDDSTO	DVP	314774	3SHERWOD	DVP	1	DVP_P1-3: 6BREMO-TX#9	operation	169.2	86.13	132.2	DC	77.95
352577	314765	6MTEAGLE	DVP	314749	6CHARLVL	DVP	1	DVP_P1-2: LN 2027-B	operation	661.76	126.93	136.53	DC	63.41
352961	314774	3SHERWOD	DVP	314773	3RED HIL	DVP	1	DVP_P1-3: 6BREMO-TX#9	operation	169.2	48.3	94.37	DC	77.95
352936	933500	AC2-165 TAP	DVP	314333	6POWHATN	DVP	1	DVP_P1-2: LN 2028	operation	800.88	97.39	104.35	DC	55.66
352829	938540	AE1-073 TAP	DVP	314763	3KIDDSTO	DVP	1	DVP_P1-3: 6BREMO-TX#9	operation	224.66	79.91	114.61	DC	77.95
352459	938820	AE1-108 TAP	AEP	314746	4BREMO	DVP	1	AEP_P1-2_#5403-A	operation	156.98	12.98	105.54	DC	171.61
352868	938820	AE1-108 TAP	AEP	242792	05SCOTSV	AEP	1	AEP_P1-2_#7422	operation	167.0	84.89	117.54	DC	54.52

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
644376	938820	AE1-108 TAP	AEP	242792	05SCOTSV	AEP	1	AEP_P1-2_#7422	operation	167.0	84.89	117.54	DC	54.52
644058	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	DVP_P1-2: LN 8-B	operation	167.0	10.6	97.85	DC	168.01
644059	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	AEP_P1-2_#10336-B	operation	167.0	10.6	97.85	DC	168.01
644063	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	Base Case	operation	167.0	48.11	78.47	DC	50.71

System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
352501,352502	11	6BREMO 230.0 kV - 6BREMODIST 230.0 kV Ckt 1	<u>DVP</u> Description: Rebuild / Uprate Line 2028 0.13 mi Time Estimate : 13-18 Months Cost : \$300,000	\$300,000
642993,643660,643661	7	05AMHERST 69.0 kV - 05COOLWELLSS 69.0 kV Ckt 1	<u>AEP</u> Description: No Violation. Current AEP End Ratings: S/N: 50 MVA, S/E: 50 MVA.	\$0
643360,642847	6	05SCOTSV 138.0 kV - 05COLLEEN SS 138.0 kV Ckt 1	<u>AEP</u> Description: Current Ratings: S/N: 167, S/E: 167 1) A Sag Study will be required on the 24.9 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor Section 1, to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between \$99,600 (no remediation required just sag study and \$37.35 million (complete line reconductor/rebuild required). New rating after sag study: S/N: 167, S/E: 235. Time Estimate: a) Sag Study: 6-12 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. Cost: \$99,600.	\$99,600
352588,352590,351862,351863,351864,351419	1	3KIDDSTO 115.0 kV - 3SHERWOD 115.0 kV Ckt 1	<u>DVP</u> Description : Wreck and rebuild Va CPCN Required future 230 kV Line includes \$2.8M for rearrangement Time Estimate : 36-40 Months Cost : \$22,000,000	\$22,000,000
352544,352545	10	6BREMODIST 230.0 kV - 6MTEAGLE 230.0 kV Ckt 1	<u>DVP</u> Description : Rebuild / uprate Line2028 15 mi Va CPCN Time Estimate : 36-44 Months Cost : \$37,500,000	\$37,500,000
643202,643203,352873,642797,642798,351346,351347,351636,351637,644381	2	AE1-108 TAP 138.0 kV - 05SCOTSV 138.0 kV Ckt 1	<u>AEP</u> Description: Current End Ratings: S/N: 167, S/E: 167 1) Rebuild/reconductor 6.5 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK, Conductor Section 1. Time Estimate : 24-36 Months Cost : \$9,750,000	\$9,750,000

ID	Index	Facility	Upgrade Description	Cost
642850,643386	5	05COLLEEN SS 138.0 kV - AE1-220 TAP 138.0 kV Ckt 1	<u>AEP</u> Description: Current End Ratings: S/N: 167, S/E: 167 1) A Sag Study will be required on the 1.1 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor, to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between \$20,000 (no remediation required just sag study and \$1.65 million (complete line reconductor/rebuild required). New ratings after sag study: S/N: 167 MVA, S/E: 245 MVA. Time Estimate: a) Sag Study: 6-12 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. Cost : \$20,000	\$20,000
644064,644065,642756	3	AE1-220 TAP 138.0 kV - 05CLIFFR 138.0 kV Ckt 1	<u>AEP</u> Description: Current End Ratings: S/N: 167, S/E: 167 1) A Sag Study will be required on the 2.5 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor, to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between \$20,000 (no remediation required just sag study and \$1.65 million (complete line reconductor/rebuild required). New ratings after sag study: S/N: 167 MVA, S/E: 245 MVA. Time Estimate: a) Sag Study: 6-12 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. Cost : \$20,000	\$20,000
642992,643654	4	05CLIFFR 138.0 kV - 05BOXWD 138.0 kV Ckt 1	<u>AEP</u> Description: Current End Ratings: S/N: 167, S/E: 167 1) A Sag Study will be required on the 8.9 mile of ACSR ~ 397.5 ~ 30/7 ~ LARK Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between \$35,600 (no remediation required just sag study and \$13.35 million (complete line reconductor/rebuild required). New ratings after sag study: S/N: 167, S/E: 245 MVA. Time Estimate: a) Sag Study: 6-12 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. Cost : \$35,600	\$35,600
352579,352580	12	6MTEAGLE 230.0 kV - 6CHARLVL 230.0 kV Ckt 1	<u>DVP</u> Description: Rebuild & uprate Line 2028 6.5 mi Va CPCN Time Estimate : 36-44 Months Cost : \$16,500,000	\$16,500,000
643670,643006,643671	9	05COOLWELLSS 69.0 kV - 05MONROE A 69.0 kV Ckt 1	<u>AEP</u> Description: No Violation. Current AEP End Ratings are: S/N: 50 MVA, S/E: 50 MVA.	\$0
642928,642929,643538,643539,643537	8	05CLIFFORD 69.0 kV - 05AMHERST 69.0 kV Ckt 1	<u>AEP</u> Description: No Violation. Current AEP End Ratings are: S/N: 50 MVA, S/E: 50 MVA.	\$0
			TOTAL COST	\$86,225,200

Flow Gate Details

The following appendices contain additional information about each flow gate presented in the body of the report. For each appendix, a description of the flow gate 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 flow gate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gauge 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
351864	314763	3KIDDSTO	DVP	314774	3SHERWOD	DVP	1	DVP_P4-2: 202722	breaker	208.0	72.78	110.22	DC	77.87

Bus #	Bus	MW Impact
315170	1BREMO 3	37.26
315171	1BREMO 4	81.88
938071	AE1-009 C O1	6.88
938072	AE1-009 E O1	3.62
938541	AE1-073 C	28.02
938542	AE1-073 E	15.76
938821	AE1-108 C O1	46.72
938822	AE1-108 E O1	31.15
939841	AE1-220 C O1	14.59
939842	AE1-220 E O1	7.29
CARR	CARR	0.05
CBM-S1	CBM-S1	1.08
CBM-S2	CBM-S2	0.59
CBM-W1	CBM-W1	1.47
CBM-W2	CBM-W2	7.33
CIN	CIN	0.68
CPLE	CPLE	0.21
G-007	G-007	0.17
IPL	IPL	0.44
LGEE	LGEE	0.2
MEC	MEC	1.32
MECS	MECS	0.73
O-066	O-066	0.57
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.18

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
643202	938820	AE1-108 TAP	AEP	242792	05SCOTSV	AEP	1	DVP_P4-2: 422	breaker	167.0	44.13	151.92	DC	180.0

Bus #	Bus	MW Impact
315170	1BREMO 3	71.0
938071	AE1-009 C O1	13.1
938072	AE1-009 E O1	6.9
938821	AE1-108 C O1	108.0
938822	AE1-108 E O1	72.0

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
642756	939840	AE1-220 TAP	AEP	242603	05CLIFFR	AEP	1	DVP_P2-2: BREMO B4	bus	167.0	30.68	131.29	DC	168.01

Bus #	Bus	MW Impact
315170	1BREMO 3	66.27
938071	AE1-009 C O1	12.23
938072	AE1-009 E O1	6.44
938821	AE1-108 C O1	100.81
938822	AE1-108 E O1	67.2
939841	AE1-220 C O1	65.88
939842	AE1-220 E O1	32.89
CBM-S2	CBM-S2	0.0
CPL	CPL	0.0

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
643654	242603	05CLIFFR	AEP	242563	05BOXWD	AEP	1	DVP_P4-2: 422	breaker	245.0	12.48	73.51	DC	149.51

Bus #	Bus	MW Impact
315170	1BREMO 3	58.97
938071	AE1-009 C O1	10.88
938072	AE1-009 E O1	5.73
938821	AE1-108 C O1	89.71
938822	AE1-108 E O1	59.8
939841	AE1-220 C O1	55.83
939842	AE1-220 E O1	27.87
BLUEG	BLUEG	0.03
CANNELTON	CANNELTON	0.0
CBM-S2	CBM-S2	0.02
COFFEEN	COFFEEN	0.0
CPL	CPL	0.01
DEARBORN	DEARBORN	0.0
DUCKCREEK	DUCKCREEK	0.0
EDWARDS	EDWARDS	0.0
ELMERSMITH	ELMERSMITH	0.0
FARMERCITY	FARMERCITY	0.0
GIBSON	GIBSON	0.0
NEWTON	NEWTON	0.01
PRAIRIE	PRAIRIE	0.01
SMITHLAND	SMITHLAND	0.0
TATANKA	TATANKA	0.0
TILTON	TILTON	0.0
TRIMBLE	TRIMBLE	0.0
TVA	TVA	0.0

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
643386	242613	05COLLEEN SS	AEP	939840	AE1-220 TAP	AEP	1	DVP_P4-2: 422	breaker	167.0	30.68	131.29	DC	168.01

Bus #	Bus	MW Impact
315170	1BREMO 3	66.27
938071	AE1-009 C O1	12.23
938072	AE1-009 E O1	6.44
938821	AE1-108 C O1	100.81
938822	AE1-108 E O1	67.2
CBM-S2	CBM-S2	0.0
CPL	CPL	0.0

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
643360	242792	05SCOTSV	AEP	242613	05COLLEEN SS	AEP	1	DVP_P4-2: 422	breaker	167.0	33.02	133.62	DC	168.01

Bus #	Bus	MW Impact
315170	1BREMO 3	66.27
938071	AE1-009 C O1	12.23
938072	AE1-009 E O1	6.44
938821	AE1-108 C O1	100.81
938822	AE1-108 E O1	67.2
CBM-S2	CBM-S2	0.0
CPL	CPL	0.0

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
642993	242862	05AMHERST	AEP	247487	05COOLWELLSS	AEP	1	AEP_P2-2_#10311_05REUSEN138_2	bus	50.0	6.91	53.31	DC	23.2

Bus #	Bus	MW Impact
315170	1BREMO 3	4.64
315171	1BREMO 4	10.2
938071	AE1-009 C O1	0.86
938072	AE1-009 E O1	0.45
938541	AE1-073 C	2.76
938542	AE1-073 E	1.55
938821	AE1-108 C O1	13.92
938822	AE1-108 E O1	9.28
939841	AE1-220 C O1	18.13
939842	AE1-220 E O1	9.05
BAYOU	BAYOU	0.23
BIG_CAJUN1	BIG_CAJUN1	0.36
BIG_CAJUN2	BIG_CAJUN2	0.72
BLUEG	BLUEG	1.11
CALDERWOOD	CALDERWOOD	0.13
CANNELTON	CANNELTON	0.07
CATAWBA	CATAWBA	0.07
CBM-N	CBM-N	0.05
CHEOAH	CHEOAH	0.12
CHILHOWEE	CHILHOWEE	0.04
CHOCTAW	CHOCTAW	0.24
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.92
DEARBORN	DEARBORN	0.14
DUCKCREEK	DUCKCREEK	0.24
EDWARDS	EDWARDS	0.11
ELMERSMITH	ELMERSMITH	0.12
FARMERCITY	FARMERCITY	0.07
G-007A	G-007A	0.23
GIBSON	GIBSON	0.04
HAMLET	HAMLET	0.14
NEWTON	NEWTON	0.3
NYISO	NYISO	0.23
O-066A	O-066A	0.11
PRAIRIE	PRAIRIE	0.56
SANTEETLA	SANTEETLA	0.03
SMITHLAND	SMITHLAND	0.05
TATANKA	TATANKA	0.13
TILTON	TILTON	0.13
TRIMBLE	TRIMBLE	0.12

Bus #	Bus	MW Impact
TVA	TVA	0.4
UNIONPOWER	UNIONPOWER	0.17
VFT	VFT	0.62

Index 8

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
643539	242867	05CLIFFORD	AEP	242862	05AMHERST	AEP	1	DVP_P4-2: 422	breaker	50.0	14.72	75.69	DC	30.49

Bus #	Bus	MW Impact
315170	1BREMO 3	12.03
938071	AE1-009 C O1	2.22
938072	AE1-009 E O1	1.17
938821	AE1-108 C O1	18.29
938822	AE1-108 E O1	12.2
939841	AE1-220 C O1	10.87
939842	AE1-220 E O1	5.43
CALDERWOOD	CALDERWOOD	0.0
CATAWBA	CATAWBA	0.0
CBM-S1	CBM-S1	0.0
CBM-W1	CBM-W1	0.02
CBM-W2	CBM-W2	0.05
CHEOAH	CHEOAH	0.0
CHILHOWEE	CHILHOWEE	0.0
CIN	CIN	0.01
HAMLET	HAMLET	0.02
IPL	IPL	0.01
LGEE	LGEE	0.0
MEC	MEC	0.01
MECS	MECS	0.01
SANTEETLA	SANTEETLA	0.0
UNIONPOWER	UNIONPOWER	0.0
WEC	WEC	0.0

Index 9

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC DC	MW IMPACT
643671	247487	05COOLWELLS S	AEP	242876	05MONROE A	AEP	1	AEP_P4_#10313_05REUSE N 138_G	breaker	50.0	7.93	51.56	DC	23.2

Bus #	Bus	MW Impact
315170	1BREMO 3	4.64
315171	1BREMO 4	10.2
938071	AE1-009 C O1	0.86
938072	AE1-009 E O1	0.45
938541	AE1-073 C	2.76
938542	AE1-073 E	1.55
938821	AE1-108 C O1	13.92
938822	AE1-108 E O1	9.28
939841	AE1-220 C O1	18.13
939842	AE1-220 E O1	9.05
BAYOU	BAYOU	0.23
BIG_CAJUN1	BIG_CAJUN1	0.36
BIG_CAJUN2	BIG_CAJUN2	0.72
BLUEG	BLUEG	1.11
CALDERWOOD	CALDERWOOD	0.13
CANNELTON	CANNELTON	0.07
CATAWBA	CATAWBA	0.07
CBM-N	CBM-N	0.05
CHEOAH	CHEOAH	0.12
CHILHOWEE	CHILHOWEE	0.04
CHOCTAW	CHOCTAW	0.24
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.92
DEARBORN	DEARBORN	0.14
DUCKCREEK	DUCKCREEK	0.24
EDWARDS	EDWARDS	0.11
ELMERSMITH	ELMERSMITH	0.12
FARMERCITY	FARMERCITY	0.07
G-007A	G-007A	0.23
GIBSON	GIBSON	0.04
HAMLET	HAMLET	0.14
NEWTON	NEWTON	0.3
NYISO	NYISO	0.23
O-066A	O-066A	0.11
PRAIRIE	PRAIRIE	0.56
SANTEETLA	SANTEETLA	0.03
SMITHLAND	SMITHLAND	0.05
TATANKA	TATANKA	0.13
TILTON	TILTON	0.13
TRIMBLE	TRIMBLE	0.12
TVA	TVA	0.4

Bus #	Bus	MW Impact
UNIONPOWER	UNIONPOWER	0.17
VFT	VFT	0.62

Index 10

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
352544	313867	6BREMODIST	DVP	314765	6MTEAGLE	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	117.16	122.91	DC	38.05

Bus #	Bus	MW Impact
314429	3JTRSVLE	0.54
315150	1BUGGS 1	7.33
315151	1BUGGS 2	7.33
315153	1CLOVER1	6.64
315154	1CLOVER2	6.55
315159	1KERR 2	0.77
315164	1KERR 7	0.76
315170	1BREMO 3	30.26
315171	1BREMO 4	66.48
315191	1BEARGRDN G1	13.63
315192	1BEARGRDN G2	13.63
315193	1BEARGRDN S1	28.05
920291	AA2-127	2.83
924021	AB2-043 C O1	0.39
924031	AB2-045 C	0.97
924161	AB2-060 C O1	1.15
924301	AB2-077 C O1	0.24
924311	AB2-078 C O1	0.24
924321	AB2-079 C O1	0.24
925611	AC1-036 C	0.17
925831	AC1-062	0.07
926271	AC1-105 C O1	3.21
926761	AC1-162 C	48.05
932511	AC2-071 C	0.95
933501	AC2-165 C	32.69
934621	AD1-088 C	14.59
935221	AD1-157 C	0.37
935231	AD1-160 C	1.78
936261	AD2-033 C	14.42
936361	AD2-046 C O1	5.5
936481	AD2-063 C O1	14.24
936651	AD2-082 C	2.73
938071	AE1-009 C O1	5.58
938371	AE1-056 C	10.47
938541	AE1-073 C	17.49
938821	AE1-108 C O1	38.05
939181	AE1-148 C O1	5.53
939201	AE1-150 C O1	19.26
939371	AE1-168 C	20.88
939841	AE1-220 C O1	12.08

Bus #	Bus	MW Impact
AA2-074	AA2-074	1.48
CARR	CARR	0.28
CBM-S1	CBM-S1	2.84
CBM-S2	CBM-S2	4.09
CBM-W1	CBM-W1	1.71
CBM-W2	CBM-W2	17.5
CIN	CIN	0.86
CPLE	CPLE	2.17
IPL	IPL	0.52
LGEE	LGEE	0.25
MEC	MEC	2.25
MECS	MECS	0.26
RENSSELAER	RENSSELAER	0.22
WEC	WEC	0.22

Index 11

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
352501	314747	6BREMO	DVP	313867	6BREMODIST	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	119.49	125.24	DC	38.05

Bus #	Bus	MW Impact
314429	3JTRSVLE	0.54
315150	1BUGGS 1	7.33
315151	1BUGGS 2	7.33
315153	1CLOVER1	6.64
315154	1CLOVER2	6.55
315159	1KERR 2	0.77
315164	1KERR 7	0.76
315170	1BREMO 3	30.26
315171	1BREMO 4	66.48
315191	1BEARGRDN G1	13.63
315192	1BEARGRDN G2	13.63
315193	1BEARGRDN S1	28.05
920291	AA2-127	2.83
924021	AB2-043 C O1	0.39
924031	AB2-045 C	0.97
924161	AB2-060 C O1	1.15
924301	AB2-077 C O1	0.24
924311	AB2-078 C O1	0.24
924321	AB2-079 C O1	0.24
925611	AC1-036 C	0.17
925831	AC1-062	0.07
926271	AC1-105 C O1	3.21
926761	AC1-162 C	48.05
932511	AC2-071 C	0.95
933501	AC2-165 C	32.69
934621	AD1-088 C	14.59
935221	AD1-157 C	0.37
935231	AD1-160 C	1.78
936261	AD2-033 C	14.42
936361	AD2-046 C O1	5.5
936481	AD2-063 C O1	14.24
936651	AD2-082 C	2.73
938071	AE1-009 C O1	5.58
938371	AE1-056 C	10.47
938541	AE1-073 C	17.49
938821	AE1-108 C O1	38.05
939181	AE1-148 C O1	5.53
939201	AE1-150 C O1	19.26
939371	AE1-168 C	20.88
939841	AE1-220 C O1	12.08

Bus #	Bus	MW Impact
AA2-074	AA2-074	1.48
CARR	CARR	0.28
CBM-S1	CBM-S1	2.84
CBM-S2	CBM-S2	4.09
CBM-W1	CBM-W1	1.71
CBM-W2	CBM-W2	17.5
CIN	CIN	0.86
CPLE	CPLE	2.17
IPL	IPL	0.52
LGEE	LGEE	0.25
MEC	MEC	2.25
MECS	MECS	0.26
RENSSELAER	RENSSELAER	0.22
WEC	WEC	0.22

Index 12

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
352579	314765	6MTEAGLE	DVP	314749	6CHARLVL	DVP	1	DVP_P1-2: LN 2027-B	single	661.76	113.35	119.1	DC	38.05

Bus #	Bus	MW Impact
314429	3JTRSVLE	0.54
315150	1BUGGS 1	7.33
315151	1BUGGS 2	7.33
315153	1CLOVER1	6.64
315154	1CLOVER2	6.55
315159	1KERR 2	0.77
315164	1KERR 7	0.76
315170	1BREMO 3	30.25
315171	1BREMO 4	66.47
315191	1BEARGRDN G1	13.63
315192	1BEARGRDN G2	13.63
315193	1BEARGRDN S1	28.05
920291	AA2-127	2.83
924021	AB2-043 C O1	0.39
924031	AB2-045 C	0.97
924161	AB2-060 C O1	1.15
924301	AB2-077 C O1	0.24
924311	AB2-078 C O1	0.24
924321	AB2-079 C O1	0.24
925611	AC1-036 C	0.17
925831	AC1-062	0.07
926451	AC1-116 C	0.56
926761	AC1-162 C	48.05
932511	AC2-071 C	0.95
933501	AC2-165 C	32.69
934621	AD1-088 C	14.59
935221	AD1-157 C	0.37
935231	AD1-160 C	1.78
936261	AD2-033 C	14.42
936361	AD2-046 C O1	5.5
936481	AD2-063 C O1	14.24
936651	AD2-082 C	2.73
938071	AE1-009 C O1	5.58
938371	AE1-056 C	10.47
938541	AE1-073 C	17.49
938821	AE1-108 C O1	38.05
939181	AE1-148 C O1	5.53
939201	AE1-150 C O1	19.26
939371	AE1-168 C	20.88
939841	AE1-220 C O1	12.08

Bus #	Bus	MW Impact
AA2-074	AA2-074	1.47
CARR	CARR	0.28
CBM-S1	CBM-S1	2.83
CBM-S2	CBM-S2	4.08
CBM-W1	CBM-W1	1.7
CBM-W2	CBM-W2	17.43
CIN	CIN	0.85
CPLE	CPLE	2.17
IPL	IPL	0.52
LGEE	LGEE	0.25
MEC	MEC	2.24
MECS	MECS	0.24
RENSSELAER	RENSSELAER	0.23
WEC	WEC	0.22

Affected Systems

LG&E

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

MISO

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

TVA

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

Duke Energy Progress

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

NYISO

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

Contingency Name	Contingency Definition
Base Case	
AEP_P1-2_#10336-B	CONTINGENCY 'AEP_P1-2_#10336-B' OPEN BRANCH FROM BUS 938820 TO BUS 314746 CKT 1 / 938820 AE1-108 TAP 138 314746 4BREMO 138 1 END
DVP_P1-2: LN 2027-A	CONTINGENCY 'DVP_P1-2: LN 2027-A' OPEN BRANCH FROM BUS 313868 TO BUS 933500 CKT 1 /* 6CARTERV 230.00 - AC2-165 TAP 230.00 OPEN BRANCH FROM BUS 313868 TO BUS 314747 CKT 1 /* 6CARTERV 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314310 TO BUS 314333 CKT 1 /* 6JUDES F 230.00 - 6POWHATN 230.00 OPEN BUS 313868 /* ISLAND: 6CARTERV 230.00 END
DVP_P1-2: LN 91-B	CONTINGENCY 'DVP_P1-2: LN 91-B' OPEN BRANCH FROM BUS 938540 TO BUS 314763 CKT 1 /* AE1-073 TAP 115.00 - 3KIDDSTO 115.00 OPEN BRANCH FROM BUS 314763 TO BUS 314774 CKT 1 /* 3KIDDSTO 115.00 - 3SHERWOD 115.00 OPEN BUS 314763 /* ISLAND: 3KIDDSTO 115.00 END
DVP_P4-2: 210622	CONTINGENCY 'DVP_P4-2: 210622' /* BREMO 230 KV OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 1 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315191 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G118.000 OPEN BUS 315191 /* ISLAND: 1BEARGRDN G118.000 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 2 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315192 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G218.000 OPEN BRANCH FROM BUS 314326 TO BUS 315193 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN S122.000 OPEN BUS 315192 /* ISLAND: 1BEARGRDN G218.000 OPEN BUS 315193 /* ISLAND: 1BEARGRDN S122.000 OPEN BRANCH FROM BUS 314677 TO BUS 314747 CKT 1 /* 6BUCKING 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313868 TO BUS 314747 CKT 1 /* 6CARTERV 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BUS 314747 /* 6BREMO 230.00 KV OPEN BUS 314326 /* ISLAND: 6BEARGRDN 230.00 END

Contingency Name	Contingency Definition
AEP_P4_#10314_05REUSEN 138_A	CONTINGENCY 'AEP_P4_#10314_05REUSEN 138_A' OPEN BRANCH FROM BUS 242563 TO BUS 242765 CKT 1 / 242563 05BOXWD 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242589 TO BUS 242681 CKT 1 / 242589 05CENTCR 138 242681 05IVY HL 138 1 OPEN BRANCH FROM BUS 242589 TO BUS 243883 CKT 1 / 242589 05CENTCR 138 243883 05LAKEFR 138 1 OPEN BRANCH FROM BUS 242607 TO BUS 243883 CKT 1 / 242607 05CLOVRD 138 243883 05LAKEFR 138 1 OPEN BRANCH FROM BUS 243857 TO BUS 242681 CKT 1 / 243857 05COFFEE 138 242681 05IVY HL 138 1 OPEN BRANCH FROM BUS 243857 TO BUS 242765 CKT 1 / 243857 05COFFEE 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242657 TO BUS 242765 CKT 1 / 242657 05GRAVES 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242765 TO BUS 242890 CKT 1 / 242765 05REUSEN 138 242890 05REUSENS2 34.5 1 END
DVP_P2-2: BREMO B4	CONTINGENCY 'DVP_P2-2: BREMO B4' /* BREMO 115 KV OPEN BRANCH FROM BUS 313874 TO BUS 313875 CKT 1 /* 3JAMES RI TP115.00 - 3TRICESLK 115.00 OPEN BRANCH FROM BUS 313874 TO BUS 314744 CKT 1 /* 3JAMES RI TP115.00 - 3BREMO 115.00 OPEN BRANCH FROM BUS 313874 TO BUS 314762 CKT 1 /* 3JAMES RI TP115.00 - 3JAMES R 115.00 OPEN BUS 313874 /* ISLAND: 3JAMES RI TP115.00 OPEN BUS 313875 /* ISLAND: 3TRICESLK 115.00 OPEN BUS 314762 /* ISLAND: 3JAMES R 115.00 OPEN BRANCH FROM BUS 314744 TO BUS 938540 CKT 1 /* 3BREMO 115.00 - AE1-073 TAP 115.00 /* CONTINGENCY LINE ADDED FOR AE1 BUILD OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 315171 CKT 1 /* 3BREMO 115.00 - 1BREMO 4 18.000 OPEN BUS 315171 /* ISLAND: 1BREMO 4 18.000 END
DVP_P1-2: LN 2027-B	CONTINGENCY 'DVP_P1-2: LN 2027-B' OPEN BRANCH FROM BUS 933500 TO BUS 314333 CKT 1 /* AC2-165 TAP 230.00 - 6POWHATN 230.00 OPEN BRANCH FROM BUS 314310 TO BUS 314322 CKT 1 /* 6JUDES F 230.00 - 6MDLTHAN 230.00 OPEN BRANCH FROM BUS 314310 TO BUS 314333 CKT 1 /* 6JUDES F 230.00 - 6POWHATN 230.00 OPEN BUS 314310 /* ISLAND: 6JUDES F 230.00 OPEN BUS 314333 /* ISLAND: 6POWHATN 230.00 END
DVP_P1-2: LN 556	CONTINGENCY 'DVP_P1-2: LN 556' OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 1 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 2 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314686 TO BUS 314906 CKT 3 /* 6CLOVER 230.00 - 8CLOVER 500.00 OPEN BRANCH FROM BUS 314906 TO BUS 314936 CKT 1 /* 8CLOVER 500.00 - 8RAWLINGS 500.00 OPEN BUS 314906 /* ISLAND: 8CLOVER 500.00 OPEN BUS 314915 /* ISLAND: 8CLOVER_STC 500.00 END

Contingency Name	Contingency Definition
AEP_P1-2_#5403-A	CONTINGENCY 'AEP_P1-2_#5403-A' OPEN BRANCH FROM BUS 242603 TO BUS 939840 CKT 1 / 242603 05CLIFFR 138 939840 AE1-220 TAP 138 1 OPEN BRANCH FROM BUS 242603 TO BUS 242888 CKT 1 / 242603 05CLIFFR 138 242888 05CLIFFORD 46.0 1 END
AEP_P4_#8476_05CLOVRD 500_A	CONTINGENCY 'AEP_P4_#8476_05CLOVRD 500_A' OPEN BRANCH FROM BUS 242519 TO BUS 314912 CKT 1 / 242519 05CLOVRD 500 314912 8LEXNGTN 500 1 OPEN BRANCH FROM BUS 242519 TO BUS 242524 CKT 15 / 242519 05CLOVRD 500 242524 05CLOVRD 345 15 END
DVP_P2-2: BREMO B1	CONTINGENCY 'DVP_P2-2: BREMO B1' /* BREMO 230 KV OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 1 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315191 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G118.000 OPEN BUS 315191 /* ISLAND: 1BEARGRDN G118.000 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 2 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315192 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G218.000 OPEN BRANCH FROM BUS 314326 TO BUS 315193 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN S122.000 OPEN BUS 315192 /* ISLAND: 1BEARGRDN G218.000 OPEN BUS 315193 /* ISLAND: 1BEARGRDN S122.000 OPEN BRANCH FROM BUS 314677 TO BUS 314747 CKT 1 /* 6BUCKING 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313868 TO BUS 314747 CKT 1 /* 6CARTERV 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BUS 314747 /* 6BREMO 230.00 KV OPEN BUS 314326 /* ISLAND: 6BEARGRDN 230.00 END
DVP_P1-3: 6BREMO-TX#9	CONTINGENCY 'DVP_P1-3: 6BREMO-TX#9' OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 END
AEP_P1-2_#7422	CONTINGENCY 'AEP_P1-2_#7422' OPEN BRANCH FROM BUS 242519 TO BUS 314912 CKT 1 / 242519 05CLOVRD 500 314912 8LEXNGTN 500 1 END

Contingency Name	Contingency Definition
DVP_P4-2: 422	CONTINGENCY 'DVP_P4-2: 422' /* BREMO 115 KV OPEN BRANCH FROM BUS 313874 TO BUS 313875 CKT 1 /* 3JAMES RI TP115.00 - 3TRICESLK 115.00 OPEN BRANCH FROM BUS 313874 TO BUS 314744 CKT 1 /* 3JAMES RI TP115.00 - 3BREMO 115.00 OPEN BRANCH FROM BUS 313874 TO BUS 314762 CKT 1 /* 3JAMES RI TP115.00 - 3JAMES R 115.00 OPEN BUS 313874 /* ISLAND: 3JAMES RI TP115.00 OPEN BUS 313875 /* ISLAND: 3TRICESLK 115.00 OPEN BUS 314762 /* ISLAND: 3JAMES R 115.00 OPEN BRANCH FROM BUS 314744 TO BUS 938540 CKT 1 /* 3BREMO 115.00 - AE1-073 TAP 115.00 /* CONTINGENCY LINE ADDED FOR AE1 BUILD OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 315171 CKT 1 /* 3BREMO 115.00 - 1BREMO 4 18.000 OPEN BUS 315171 /* ISLAND: 1BREMO 4 18.000 END
DVP_P4-2: 202722	CONTINGENCY 'DVP_P4-2: 202722' /* BREMO 230 KV OPEN BRANCH FROM BUS 313868 TO BUS 933500 CKT 1 /* 6CARTERV 230.00 - AC2-165 TAP 230.00 /* CONTINGENCY LINE ADDED FOR AE1 BUILD OPEN BRANCH FROM BUS 313868 TO BUS 314747 CKT 1 /* 6CARTERV 230.00 - 6BREMO 230.00 OPEN BUS 313868 /* ISLAND: 6CARTERV 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 1 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315191 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G118.000 OPEN BUS 315191 /* ISLAND: 1BEARGRDN G118.000 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 2 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315192 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G218.000 OPEN BRANCH FROM BUS 314326 TO BUS 315193 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN S122.000 OPEN BUS 315192 /* ISLAND: 1BEARGRDN G218.000 OPEN BUS 315193 /* ISLAND: 1BEARGRDN S122.000 OPEN BRANCH FROM BUS 314677 TO BUS 314747 CKT 1 /* 6BUCKING 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BUS 314747 /* 6BREMO 230.00 KV OPEN BUS 314326 /* ISLAND: 6BEARGRDN 230.00 END

Contingency Name	Contingency Definition
DVP_P4-2: 29822	CONTINGENCY 'DVP_P4-2: 29822' /* BREMO 230 KV OPEN BRANCH FROM BUS 314677 TO BUS 314692 CKT 1 /* 6BUCKING 230.00 - 6FARMVIL 230.00 OPEN BRANCH FROM BUS 314677 TO BUS 314747 CKT 1 /* 6BUCKING 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314691 TO BUS 314692 CKT 2 /* 3FARMVIL 115.00 - 6FARMVIL 230.00 OPEN BUS 314677 /* ISLAND: 6BUCKING 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 1 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315191 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G118.000 OPEN BUS 315191 /* ISLAND: 1BEARGRDN G118.000 OPEN BRANCH FROM BUS 314326 TO BUS 314747 CKT 2 /* 6BEARGRDN 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314326 TO BUS 315192 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN G218.000 OPEN BRANCH FROM BUS 314326 TO BUS 315193 CKT 1 /* 6BEARGRDN 230.00 - 1BEARGRDN S122.000 OPEN BUS 315192 /* ISLAND: 1BEARGRDN G218.000 OPEN BUS 315193 /* ISLAND: 1BEARGRDN S122.000 OPEN BRANCH FROM BUS 313868 TO BUS 314747 CKT 1 /* 6CARTERV 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314744 TO BUS 314747 CKT 1 /* 3BREMO 115.00 - 6BREMO 230.00 OPEN BUS 314747 /* 6BREMO 230.00 KV OPEN BUS 314326 /* ISLAND: 6BEARGRDN 230.00 END
DVP_P1-2: LN 2028	CONTINGENCY 'DVP_P1-2: LN 2028' OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314765 CKT 1 /* 6BREMODIST 230.00 - 6MTEAGLE 230.00 OPEN BRANCH FROM BUS 314749 TO BUS 314765 CKT 1 /* 6CHARLVL 230.00 - 6MTEAGLE 230.00 OPEN BUS 313867 /* ISLAND: 6BREMODIST 230.00 OPEN BUS 314765 /* ISLAND: 6MTEAGLE 230.00 END
DVP_P1-2: LN 8-B	CONTINGENCY 'DVP_P1-2: LN 8-B' OPEN BRANCH FROM BUS 938820 TO BUS 314746 CKT 1 /* AE1-108 TAP 138.00 - 4BREMO 138.00 OPEN BRANCH FROM BUS 314744 TO BUS 314746 CKT 1 /* 3BREMO 115.00 - 4BREMO 138.00 OPEN BUS 314746 /* ISLAND: 4BREMO 138.00 END
AEP_P2-2_#10311_05REUSEN 138_2	CONTINGENCY 'AEP_P2-2_#10311_05REUSEN 138_2' OPEN BRANCH FROM BUS 242563 TO BUS 242765 CKT 1 / 242563 05BOXWD 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 243857 TO BUS 242765 CKT 1 / 243857 05COFFEE 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242657 TO BUS 242765 CKT 1 / 242657 05GRAVES 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242765 TO BUS 242890 CKT 1 / 242765 05REUSEN 138 242890 05REUSENS2 34.5 1 END

Contingency Name	Contingency Definition
AEP_P4_#10313_05REUSEN 138_G	CONTINGENCY 'AEP_P4_#10313_05REUSEN 138_G' OPEN BRANCH FROM BUS 242563 TO BUS 242765 CKT 1 / 242563 05BOXWD 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242568 TO BUS 247887 CKT 1 / 242568 05BROOKV 138 247887 05MCCONVILLE 138 1 OPEN BRANCH FROM BUS 242568 TO BUS 242785 CKT 1 / 242568 05BROOKV 138 242785 05S.LYNC 138 1 OPEN BRANCH FROM BUS 243857 TO BUS 242765 CKT 1 / 243857 05COFFEE 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242657 TO BUS 247887 CKT 1 / 242657 05GRAVES 138 247887 05MCCONVILLE 138 1 OPEN BRANCH FROM BUS 242657 TO BUS 242765 CKT 1 / 242657 05GRAVES 138 242765 05REUSEN 138 1 OPEN BRANCH FROM BUS 242765 TO BUS 242890 CKT 1 / 242765 05REUSEN 138 242890 05REUSENS2 34.5 1 END

Short Circuit

Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue

None