Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-091

HICKMAN-RIVER BEND 69 KV

32.4 MW Capacity / 50 MW Energy

January 2021

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1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 Preface

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

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

The 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.

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

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Pulaski County, Virginia. The installed facilities will have a total capability of 50 MW with 32.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 30, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-091
Project Name	HICKMAN-RIVER BEND 69 KV
State	Virginia
County	Pulaski
Transmission Owner	AEP
MFO	50
MWE	50
MWC	32.4
Fuel	Solar
Basecase Study Year	2024

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

4 Point of Interconnection

AG1-091 will interconnect with the AEP transmission system tapping the Hickman to Riverbend 69 kV line.

To accommodate the interconnection on the Hickman - Riverbend 69 kV section of the Hickman – N. Claytor 69 kV circuit, a new three (3) circuit breaker 69 kV switching station physically configured and operated as a ring-bus will be constructed (Attachment 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 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.

Installation of the generator lead first span exiting the POI station, including the first structure outside the AEP fence, will also be included in AEP's scope. In the case where the generator lead is a single span, the structure in the customer station will be the customer's responsibility.

5 Cost Summary

The AG1-091 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$7,842,000
Total System Network Upgrade Costs	$8,486,520
Total Costs	$16,328,520

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

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

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

6.1 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
69 kV Revenue Metering	$317,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$320,000
Total Attachment Facility Costs	**$637,000**

6.2 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
A new three (3) circuit breaker 69 kV switching station physically configured and operated as a ring-bus will be constructed. Installation of associated protection and control equipment, 69 kV line risers, and SCADA will also be required.	$6,500,000
Total Direct Connection Facility Costs	**$6,500,000**

6.3 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
Hickman – Riverbend 69 kV T-Line Cut In	$615,000
Review Protection and Control Settings at the Hickman 69 kV substation	$45,000
Review Protection and Control Settings at the Riverbend 69 kV substation	$45,000
Total Non-Direct Connection Facility Costs	**$705,000**

7 Transmission Owner Analysis

No violations were identified in the Sub-Transmission load flow analysis and the short circuit analysis for the Sub-Transmission will be conducted in the System Impact Study phase.

8 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.

9 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner 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.

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.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

10.2 Meteorological Data Reporting Requirements

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

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

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

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

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-091 was evaluated as a 50.0 MW (Capacity 32.4 MW) injection tapping the Hickman to Riverbend 69 kV line in the AEP area. Project AG1-091 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-091 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453293	242839	05VICKER	138.0	AEP	242715	05MERRIM	138.0	AEP	1	AEP_P7-1_#10876	tower	205.0	96.02	100.96	DC	10.12
161452803	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P2-2_#10186_05CLYTR2 138_2	bus	167.0	84.49	114.43	DC	50.0
161453148	958120	AF2-106 TAP	138.0	AEP	242650	05GLENL1	138.0	AEP	1	AEP_P7-1_#10877-A	tower	169.0	98.4	104.37	DC	10.09

11.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453260	242634	05EDGEMO	138.0	AEP	242839	05VICKER	138.0	AEP	1	AEP_P7-1_#10876	tower	205.0	100.8	105.74	DC	10.12
161453203	937350	AD2-179 TAP	138.0	AEP	958110	AF2-105 TAP	138.0	AEP	1	AEP_P7-1_#10877-B	tower	167.0	101.52	111.0	DC	15.83
161453181	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	AEP_P7-1_#10791-A	tower	240.0	109.23	114.86	DC	13.53
161452802	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P2-2_#10190_05CLYTR3 138_3	bus	167.0	109.32	119.91	DC	17.69
161453125	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P7-1_#10877-B	tower	167.0	126.45	135.93	DC	15.83
161453126	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P7-1_#10877-A	tower	167.0	108.09	117.57	DC	15.83
161453147	958120	AF2-106 TAP	138.0	AEP	242650	05GLENL1	138.0	AEP	1	AEP_P7-1_#10877-B	tower	169.0	116.23	122.2	DC	10.09

11.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection

Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
168093653	242608	05CLYTR1	138.0	AEP	242791	05SCHRIS	138.0	AEP	1	AEP_P1-2_#8518_92-B	operation	167.0	132.58	140.49	DC	13.21
168093843	242609	05CLYTR2	138.0	AEP	242610	05CLYTR3	138.0	AEP	Z1	AEP_P1-2_#8518_92-B	operation	337.0	100.66	108.55	DC	26.62
168093826	242721	05MORGAN	138.0	AEP	242609	05CLYTR2	138.0	AEP	1	AEP_P1-2_#5381_87-A	operation	167.0	92.24	109.92	DC	29.51
168093745	242791	05SCHRIS	138.0	AEP	243874	05TECHDR	138.0	AEP	1	AEP_P1-2_#311_5	operation	167.0	113.44	119.12	DC	9.49
168093786	243874	05TECHDR	138.0	AEP	242708	05MFUNK	138.0	AEP	1	AEP_P1-2_#311_5	operation	167.0	109.84	115.53	DC	9.49
169559595	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	Base Case	operation	167.0	116.38	121.62	DC	8.74
169559596	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	AEP_P2-1_242609 05CLYTR2 138 242610 05CLYTR3 138 Z1	operation	240.0	107.55	114.72	DC	17.2
169864731	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	Base Case	operation	134.0	95.17	103.53	DC	11.2
169864741	958120	AF2-106 TAP	138.0	AEP	242650	05GLENL1	138.0	AEP	1	AEP_P1-2_#5381_87-A	operation	169.0	96.36	101.91	DC	9.38

11.5 System Reinforcements - Summer Peak Load Flow

ID	Idx	Facility	Upgrade Description	Cost
161453260	4	05EDGEMO 138.0 kV - 05VICKER 138.0 kV Ckt 1	**AEP** **AEPA0022a (103) : A Sag Study will be required for the 4.7 miles of overhead conductor (ACSR ~ 556.5 ~ 26/7 ~ DOVE) to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between $18,800 (no remediation required, just sag study) and $7.05 million (complete line reconductor/rebuild). 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.** **Project Type : FAC** **Cost : $18,800** **Time Estimate : 6 - 12 months Months**	$18,800
161453126,161453125,161452802,161452803	2	AF2-105 TAP 138.0 kV - 05GLENL2 138.0 kV Ckt 1	**AEP** **AEPA0029a (109) : A sag study will be required on the 21.4 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor to determine what mitigation would be required (if any) to operate at the conductor's MOT. New ratings after sag study SN:167MVA, SE: 245MVA. Depending on the sag study results, the cost for this upgrade is expected to be between $85,600 (no remediation required, just sag study) and $25.68 million (complete line reconductor/rebuild). 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** **Project Type : FAC** **Cost : $85,600** **Time Estimate : 6 - 12 months Months** **AEP** **AEPA0029b (110) : Replace 0.13 mi. 300 CU Overhead Cond** **Project Type : FAC** **Cost : $195,000** **Time Estimate : 24 - 36 months Months**	$280,600
161453293	1	05VICKER 138.0 kV - 05MERRIM 138.0 kV Ckt 1	**AEP** **AEPA0024a (105) : A Sag Study will be required for the 2.5 miles of overhead conductor (ACSR ~ 556.5 ~ 26/7 ~ DOVE) to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between $10,000 (no remediation required, just sag study) and $3.75 million (complete line reconductor/rebuild). 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.** **Project Type : FAC** **Cost : $10,000** **Time Estimate : 6 - 12 months Months**	$10,000
161453147,161453148	3	AF2-106 TAP 138.0 kV - 05GLENL1 138.0 kV Ckt 1	**AEP** **AEPA0023a (104) : Rebuild 0.13 miles of 300 CU (First span out of Glen Lyn)** **Project Type : FAC** **Cost : $150,000** **Time Estimate : 18-24 Months**	$150,000

ID	Idx	Facility	Upgrade Description	Cost
161453181	6	**AE2-280 TAP 138.0 kV - 05EDGEMO 138.0 kV Ckt 1**	**AEP** **AEPA0025a (106) : Rebuild Edgemont-AE2-280 138 kV (3.5 miles) using 795 ACSR 26/7 DRAKE** **Project Type : FAC** **Cost : $5,250,000** **Time Estimate : 18-24 Months** **AEP** **AEPA0025b (107) : Replace Sub cond 795 AAC 37 Str. At Edgemont** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12-18 months Months**	$5,350,000
161453203	5	**AD2-179 TAP 138.0 kV - AF2-105 TAP 138.0 kV Ckt 1**	**AEP** **AEPA0037a (433) : A sag study will be required on the 1.78 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 $7,120 (no remediation required, just sag study) and $2.67 million (complete line reconductor/rebuild).New rating after sag study: S/N: 167 S/E: 245. 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.** **Project Type : FAC** **Cost : $7,120** **Time Estimate : 6-12 Months** **AEP** **AEPA0037b (434) : Rebuild/reconductor 1.78 mi. 300 CU Overhead Cond** **Project Type : FAC** **Cost : $2,670,000** **Time Estimate : 24 - 36 months Months**	$2,677,120
			TOTAL COST	**$8,486,520**

11.6 Flow Gate Details

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

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453293	242839	05VICKER	AEP	242715	05MERRIM	AEP	1	AEP_P7-1_#10876	tower	205.0	96.02	100.96	DC	10.12

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.3036	50/50	1.3036
242907	05CLAY-2	1.3058	50/50	1.3058
247619	Y1-049	0.0944	50/50	0.0944
934756	AD1-102 C	4.3508	50/50	4.3508
934757	AD1-102 E	29.1185	50/50	29.1185
937341	AD2-178 C O1	10.5070	50/50	10.5070
937342	AD2-178 E O1	7.0046	50/50	7.0046
937351	AD2-179 C O1	11.3208	50/50	11.3208
937352	AD2-179 E O1	7.5472	50/50	7.5472
942641	AE2-280 C O1	22.7081	50/50	22.7081
942642	AE2-280 E O1	15.1387	50/50	15.1387
958111	AF2-105 C	10.7112	50/50	10.7112
958112	AF2-105 E	7.1408	50/50	7.1408
958121	AF2-106 C	17.0874	50/50	17.0874
958122	AF2-106 E	11.3916	50/50	11.3916
962421	AG1-091 C	6.5558	50/50	6.5558
962422	AG1-091 E	3.5612	50/50	3.5612
WEC	WEC	0.0646	Confirmed LTF	0.0646
LGEE	LGEE	0.1451	Confirmed LTF	0.1451
CPLE	CPLE	0.1304	Confirmed LTF	0.1304
CBM-W2	CBM-W2	2.3117	Confirmed LTF	2.3117
NY	NY	0.0547	Confirmed LTF	0.0547
TVA	TVA	0.4256	Confirmed LTF	0.4256
O-066	O-066	0.7874	Confirmed LTF	0.7874
SIGE	SIGE	0.0364	Confirmed LTF	0.0364
CBM-S2	CBM-S2	2.7875	Confirmed LTF	2.7875
CBM-S1	CBM-S1	0.1106	Confirmed LTF	0.1106
G-007	G-007	0.1239	Confirmed LTF	0.1239
MEC	MEC	0.3575	Confirmed LTF	0.3575
LAGN	LAGN	0.4917	Confirmed LTF	0.4917
CBM-W1	CBM-W1	2.6918	Confirmed LTF	2.6918

11.6.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453125	958110	AF2-105 TAP	AEP	242651	05GLENL2	AEP	1	AEP_P7-1_#10877-B	tower	167.0	126.45	135.93	DC	15.83

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.4314	50/50	1.4314
242907	05CLAY-2	1.4374	50/50	1.4374
247619	Y1-049	0.1003	50/50	0.1003
934756	AD1-102 C	4.7249	50/50	4.7249
934757	AD1-102 E	31.6227	50/50	31.6227
937341	AD2-178 C O1	11.1643	50/50	11.1643
937342	AD2-178 E O1	7.4429	50/50	7.4429
937351	AD2-179 C O1	22.4244	50/50	22.4244
937352	AD2-179 E O1	14.9496	50/50	14.9496
942641	AE2-280 C O1	18.3926	50/50	18.3926
942642	AE2-280 E O1	12.2617	50/50	12.2617
958111	AF2-105 C	24.9738	50/50	24.9738
958112	AF2-105 E	16.6492	50/50	16.6492
958121	AF2-106 C	16.1685	50/50	16.1685
958122	AF2-106 E	10.7790	50/50	10.7790
962421	AG1-091 C	10.2582	50/50	10.2582
962422	AG1-091 E	5.5723	50/50	5.5723
CPLE	CPLE	0.2771	Confirmed LTF	0.2771
G-007A	G-007A	0.0192	Confirmed LTF	0.0192
VFT	VFT	0.0516	Confirmed LTF	0.0516
CBM-W2	CBM-W2	0.2688	Confirmed LTF	0.2688
NY	NY	0.0011	Confirmed LTF	0.0011
PRAIRIE	PRAIRIE	0.0026	Confirmed LTF	0.0026
TVA	TVA	0.1064	Confirmed LTF	0.1064
CBM-S2	CBM-S2	3.6018	Confirmed LTF	3.6018
CBM-S1	CBM-S1	0.0201	Confirmed LTF	0.0201
CBM-N	CBM-N	0.0084	Confirmed LTF	0.0084
GIBSON	GIBSON	0.0246	Confirmed LTF	0.0246
BLUEG	BLUEG	0.0972	Confirmed LTF	0.0972
TRIMBLE	TRIMBLE	0.0323	Confirmed LTF	0.0323
LAGN	LAGN	0.1313	Confirmed LTF	0.1313

11.6.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453147	958120	AF2-106 TAP	AEP	242650	05GLENL1	AEP	1	AEP_P7-1_#10877-B	tower	169.0	116.23	122.2	DC	10.09

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.4184	50/50	1.4184
242907	05CLAY-2	1.4107	50/50	1.4107
247619	Y1-049	0.0986	50/50	0.0986
934756	AD1-102 C	4.6449	50/50	4.6449
934757	AD1-102 E	31.0871	50/50	31.0871
937341	AD2-178 C O1	10.9750	50/50	10.9750
937342	AD2-178 E O1	7.3166	50/50	7.3166
937351	AD2-179 C O1	10.4466	50/50	10.4466
937352	AD2-179 E O1	6.9644	50/50	6.9644
942641	AE2-280 C O1	18.0811	50/50	18.0811
942642	AE2-280 E O1	12.0540	50/50	12.0540
958111	AF2-105 C	9.2112	50/50	9.2112
958112	AF2-105 E	6.1408	50/50	6.1408
958121	AF2-106 C	32.8743	50/50	32.8743
958122	AF2-106 E	21.9162	50/50	21.9162
962421	AG1-091 C	6.5383	50/50	6.5383
962422	AG1-091 E	3.5517	50/50	3.5517
CPLE	CPLE	0.2737	Confirmed LTF	0.2737
G-007A	G-007A	0.0192	Confirmed LTF	0.0192
VFT	VFT	0.0516	Confirmed LTF	0.0516
CBM-W2	CBM-W2	0.2688	Confirmed LTF	0.2688
NY	NY	0.0011	Confirmed LTF	0.0011
PRAIRIE	PRAIRIE	0.0026	Confirmed LTF	0.0026
TVA	TVA	0.1050	Confirmed LTF	0.1050
CBM-S2	CBM-S2	3.5600	Confirmed LTF	3.5600
CBM-S1	CBM-S1	0.0198	Confirmed LTF	0.0198
CBM-N	CBM-N	0.0084	Confirmed LTF	0.0084
GIBSON	GIBSON	0.0240	Confirmed LTF	0.0240
BLUEG	BLUEG	0.0955	Confirmed LTF	0.0955
TRIMBLE	TRIMBLE	0.0317	Confirmed LTF	0.0317
LAGN	LAGN	0.1313	Confirmed LTF	0.1313

11.6.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
161453260	242634	05EDGEMO	AEP	242839	05VICKER	AEP	1	AEP_P7-1_#10876	tower	205.0	100.8	105.74	DC	10.12

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.3036	50/50	1.3036
242907	05CLAY-2	1.3058	50/50	1.3058
247619	Y1-049	0.0944	50/50	0.0944
934756	AD1-102 C	4.3508	50/50	4.3508
934757	AD1-102 E	29.1185	50/50	29.1185
937341	AD2-178 C O1	10.5070	50/50	10.5070
937342	AD2-178 E O1	7.0046	50/50	7.0046
937351	AD2-179 C O1	11.3208	50/50	11.3208
937352	AD2-179 E O1	7.5472	50/50	7.5472
942641	AE2-280 C O1	22.7081	50/50	22.7081
942642	AE2-280 E O1	15.1387	50/50	15.1387
958111	AF2-105 C	10.7112	50/50	10.7112
958112	AF2-105 E	7.1408	50/50	7.1408
958121	AF2-106 C	17.0874	50/50	17.0874
958122	AF2-106 E	11.3916	50/50	11.3916
962421	AG1-091 C	6.5558	50/50	6.5558
962422	AG1-091 E	3.5612	50/50	3.5612
WEC	WEC	0.0646	Confirmed LTF	0.0646
LGEE	LGEE	0.1451	Confirmed LTF	0.1451
CPLE	CPLE	0.1304	Confirmed LTF	0.1304
CBM-W2	CBM-W2	2.3117	Confirmed LTF	2.3117
NY	NY	0.0547	Confirmed LTF	0.0547
TVA	TVA	0.4256	Confirmed LTF	0.4256
O-066	O-066	0.7874	Confirmed LTF	0.7874
SIGE	SIGE	0.0364	Confirmed LTF	0.0364
CBM-S2	CBM-S2	2.7875	Confirmed LTF	2.7875
CBM-S1	CBM-S1	0.1106	Confirmed LTF	0.1106
G-007	G-007	0.1239	Confirmed LTF	0.1239
MEC	MEC	0.3575	Confirmed LTF	0.3575
LAGN	LAGN	0.4917	Confirmed LTF	0.4917
CBM-W1	CBM-W1	2.6918	Confirmed LTF	2.6918

11.6.5 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
161453203	937350	AD2-179 TAP	AEP	958110	AF2-105 TAP	AEP	1	AEP_P7-1_#10877-B	tower	167.0	101.52	111.0	DC	15.83

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.4314	50/50	1.4314
242907	05CLAY-2	1.4374	50/50	1.4374
247619	Y1-049	0.1003	50/50	0.1003
934756	AD1-102 C	4.7249	50/50	4.7249
934757	AD1-102 E	31.6227	50/50	31.6227
937341	AD2-178 C O1	11.1643	50/50	11.1643
937342	AD2-178 E O1	7.4429	50/50	7.4429
937351	AD2-179 C O1	22.4244	50/50	22.4244
937352	AD2-179 E O1	14.9496	50/50	14.9496
942641	AE2-280 C O1	18.3926	50/50	18.3926
942642	AE2-280 E O1	12.2617	50/50	12.2617
958121	AF2-106 C	16.1685	50/50	16.1685
958122	AF2-106 E	10.7790	50/50	10.7790
962421	AG1-091 C	10.2582	50/50	10.2582
962422	AG1-091 E	5.5723	50/50	5.5723
CPLE	CPLE	0.2771	Confirmed LTF	0.2771
G-007A	G-007A	0.0192	Confirmed LTF	0.0192
VFT	VFT	0.0516	Confirmed LTF	0.0516
CBM-W2	CBM-W2	0.2688	Confirmed LTF	0.2688
NY	NY	0.0011	Confirmed LTF	0.0011
PRAIRIE	PRAIRIE	0.0026	Confirmed LTF	0.0026
TVA	TVA	0.1064	Confirmed LTF	0.1064
CBM-S2	CBM-S2	3.6018	Confirmed LTF	3.6018
CBM-S1	CBM-S1	0.0201	Confirmed LTF	0.0201
CBM-N	CBM-N	0.0084	Confirmed LTF	0.0084
GIBSON	GIBSON	0.0246	Confirmed LTF	0.0246
BLUEG	BLUEG	0.0972	Confirmed LTF	0.0972
TRIMBLE	TRIMBLE	0.0323	Confirmed LTF	0.0323
LAGN	LAGN	0.1313	Confirmed LTF	0.1313

11.6.6 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
161453181	942640	AE2-280 TAP	AEP	242634	05EDGEMO	AEP	1	AEP_P7-1_#10791-A	tower	240.0	109.23	114.86	DC	13.53

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.5994	50/50	1.5994
242907	05CLAY-2	1.6053	50/50	1.6053
247619	Y1-049	0.1140	50/50	0.1140
934756	AD1-102 C	5.3134	50/50	5.3134
934757	AD1-102 E	35.5614	50/50	35.5614
937341	AD2-178 C O1	12.6878	50/50	12.6878
937342	AD2-178 E O1	8.4586	50/50	8.4586
937351	AD2-179 C O1	16.2366	50/50	16.2366
937352	AD2-179 E O1	10.8244	50/50	10.8244
942641	AE2-280 C O1	28.4484	50/50	28.4484
942642	AE2-280 E O1	18.9656	50/50	18.9656
958111	AF2-105 C	16.2366	50/50	16.2366
958112	AF2-105 E	10.8244	50/50	10.8244
958121	AF2-106 C	24.2658	50/50	24.2658
958122	AF2-106 E	16.1772	50/50	16.1772
962421	AG1-091 C	8.7678	50/50	8.7678
962422	AG1-091 E	4.7627	50/50	4.7627
WEC	WEC	0.0302	Confirmed LTF	0.0302
LGEE	LGEE	0.0660	Confirmed LTF	0.0660
CPLE	CPLE	0.2382	Confirmed LTF	0.2382
CBM-W2	CBM-W2	1.5142	Confirmed LTF	1.5142
NY	NY	0.0332	Confirmed LTF	0.0332
TVA	TVA	0.3122	Confirmed LTF	0.3122
O-066	O-066	0.4375	Confirmed LTF	0.4375
SIGE	SIGE	0.0187	Confirmed LTF	0.0187
CBM-S2	CBM-S2	3.7480	Confirmed LTF	3.7480
CBM-S1	CBM-S1	0.0768	Confirmed LTF	0.0768
G-007	G-007	0.0683	Confirmed LTF	0.0683
MEC	MEC	0.1939	Confirmed LTF	0.1939
LAGN	LAGN	0.3658	Confirmed LTF	0.3658
CBM-W1	CBM-W1	1.2197	Confirmed LTF	1.2197

11.7 Queue Dependencies

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

Queue Number	Project Name	Status
AD1-102	Wurno-Claytor Lake 138 KV	Active
AD2-178	Wurno 138kV	Active
AD2-179	Morgans Cut-Glen Lyn 138kV	Active
AE2-280	Claytor Lake-Edgemont 138 kV	Active
AF2-105	Morgans Cut 138 kV	Active
AF2-106	Hazel Hollow 138 kV	Active
AG1-091	Hickman-River Bend 69 kV	Active
Y1-049	Wurno 34.5kV	In Service

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P2-1_242609 05CLYTR2 138 242610 05CLYTR3 138 Z1	CONTINGENCY 'AEP_P2-1_242609 05CLYTR2 138 242610 05CLYTR3 138 Z1' OPEN BRANCH FROM BUS 242609 TO BUS 242610 CKT Z1 END
AEP_P1-2_#311_5	CONTINGENCY 'AEP_P1-2_#311_5' OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1 END
AEP_P7-1_#10876	CONTINGENCY 'AEP_P7-1_#10876' OPEN BRANCH FROM BUS 242608 TO BUS 242791 CKT 1 / 242608 05CLYTR1 138 242791 05SCHRIS 138 1 OPEN BRANCH FROM BUS 242634 TO BUS 242636 CKT 1 / 242634 05EDGEMO 138 242636 05FALLBR 138 1 OPEN BRANCH FROM BUS 242708 TO BUS 243874 CKT 1 / 242708 05M FUNK 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 243874 CKT 1 / 242791 05SCHRIS 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 244118 CKT 1 / 242791 05SCHRIS 138 244118 05SCHRISTB 69.0 1 OPEN BRANCH FROM BUS 244107 TO BUS 244118 CKT 1 / 244107 05CAMBRIA 69.0 244118 05SCHRISTB 69.0 1 END
AEP_P7-1_#10791-A	CONTINGENCY 'AEP_P7-1_#10791-A' OPEN BRANCH FROM BUS 242650 TO BUS 958120 CKT 1 / 242650 05GLENL1 138 958120 AF2-106 TAP 138 1 OPEN BRANCH FROM BUS 242651 TO BUS 958110 CKT 1 / 242651 05GLENL2 138 958110 AF2-105 TAP 138 1 END
AEP_P1-2_#8518_92-B	CONTINGENCY 'AEP_P1-2_#8518_92-B' OPEN BRANCH FROM BUS 942640 TO BUS 242634 CKT 1 / 942640 AE2-280 TAP 138 242634 05EDGEMO 138 1 END
Base Case	

Contingency Name	Contingency Definition
AEP_P7-1_#10877-B	CONTINGENCY 'AEP_P7-1_#10877-B' OPEN BRANCH FROM BUS 242608 TO BUS 242791 CKT 1 / 242608 05CLYTR1 138 242791 05SCHRIS 138 1 OPEN BRANCH FROM BUS 942640 TO BUS 242634 CKT 1 / 942640 AE2-280 TAP 138 242634 05EDGEMO 138 1 OPEN BRANCH FROM BUS 242708 TO BUS 243874 CKT 1 / 242708 05M FUNK 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 243874 CKT 1 / 242791 05SCHRIS 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 244118 CKT 1 / 242791 05SCHRIS 138 244118 05SCHRISTB 69.0 1 OPEN BRANCH FROM BUS 244107 TO BUS 244118 CKT 1 / 244107 05CAMBRIA 69.0 244118 05SCHRISTB 69.0 1 END
AEP_P7-1_#10877-A	CONTINGENCY 'AEP_P7-1_#10877-A' OPEN BRANCH FROM BUS 242608 TO BUS 242791 CKT 1 / 242608 05CLYTR1 138 242791 05SCHRIS 138 1 OPEN BRANCH FROM BUS 242609 TO BUS 942640 CKT 1 / 242609 05CLYTR2 138 942640 AE2-280 TAP 138 1 OPEN BRANCH FROM BUS 242708 TO BUS 243874 CKT 1 / 242708 05M FUNK 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 243874 CKT 1 / 242791 05SCHRIS 138 243874 05TECHDR 138 1 OPEN BRANCH FROM BUS 242791 TO BUS 244118 CKT 1 / 242791 05SCHRIS 138 244118 05SCHRISTB 69.0 1 OPEN BRANCH FROM BUS 244107 TO BUS 244118 CKT 1 / 244107 05CAMBRIA 69.0 244118 05SCHRISTB 69.0 1 END
AEP_P1-2_#5381_87-A	CONTINGENCY 'AEP_P1-2_#5381_87-A' OPEN BRANCH FROM BUS 242651 TO BUS 958110 CKT 1 / 242651 05GLENL2 138 958110 AF2-105 TAP 138 1 END

Contingency Name	Contingency Definition
AEP_P2-2_#10190_05CLYTR3 138_3	CONTINGENCY 'AEP_P2-2_#10190_05CLYTR3 138_3' OPEN BRANCH FROM BUS 242640 TO BUS 243969 CKT 1 / 242640 05FLOYD 138 243969 05FLOYD EQ 999 1 OPEN BRANCH FROM BUS 243967 TO BUS 243969 CKT 1 / 243967 05FLOYD 69.0 243969 05FLOYD EQ 999 1 OPEN BRANCH FROM BUS 243966 TO BUS 243969 CKT 1 / 243966 05FLOYD 34.5 243969 05FLOYD EQ 999 1 OPEN BRANCH FROM BUS 242535 TO BUS 242610 CKT 1 / 242535 05ALUMRG 138 242610 05CLYTR3 138 1 OPEN BRANCH FROM BUS 242535 TO BUS 242640 CKT 1 / 242535 05ALUMRG 138 242640 05FLOYD 138 1 OPEN BRANCH FROM BUS 242608 TO BUS 242610 CKT Z1 / 242608 05CLYTR1 138 242610 05CLYTR3 138 Z1 OPEN BRANCH FROM BUS 242609 TO BUS 242610 CKT Z1 / 242609 05CLYTR2 138 242610 05CLYTR3 138 Z1 OPEN BRANCH FROM BUS 242640 TO BUS 242750 CKT 1 / 242640 05FLOYD 138 242750 05PHILPOTT Z 138 1 OPEN BRANCH FROM BUS 242750 TO BUS 247723 CKT 1 / 242750 05PHILPOTT Z 138 247723 05PHILPOTT 138 1 OPEN BRANCH FROM BUS 242750 TO BUS 242844 CKT 1 / 242750 05PHILPOTT Z 138 242844 05W.BASS 138 1 END
AEP_P2-2_#10186_05CLYTR2 138_2	CONTINGENCY 'AEP_P2-2_#10186_05CLYTR2 138_2' OPEN BRANCH FROM BUS 244132 TO BUS 247868 CKT 3 / 244132 05N.CLAYTREQ 999 247868 05N.CLAYTOR 138 3 OPEN BRANCH FROM BUS 244131 TO BUS 244132 CKT 1 / 244131 05N.CLAYTOR 69.0 244132 05N.CLAYTREQ 999 1 OPEN BRANCH FROM BUS 244132 TO BUS 244138 CKT 3 / 244132 05N.CLAYTREQ 999 244138 05N.CLAYTO 34.5 3 OPEN BRANCH FROM BUS 242609 TO BUS 247870 CKT 2 / 242609 05CLYTR2 138 247870 05CLAYTR HY2 138 2 OPEN BRANCH FROM BUS 247868 TO BUS 247870 CKT 1 / 247868 05N.CLAYTOR 138 247870 05CLAYTR HY2 138 1 OPEN BRANCH FROM BUS 242609 TO BUS 242610 CKT Z1 / 242609 05CLYTR2 138 242610 05CLYTR3 138 Z1 OPEN BRANCH FROM BUS 242609 TO BUS 942640 CKT 1 / 242609 05CLYTR2 138 942640 AE2-280 TAP 138 1 OPEN BRANCH FROM BUS 242609 TO BUS 242721 CKT 1 / 242609 05CLYTR2 138 242721 05MORGAN 138 1 OPEN BRANCH FROM BUS 242609 TO BUS 934750 CKT 1 / 242609 05CLYTR2 138 934750 AD1-102 TAP 138 1 OPEN BRANCH FROM BUS 242907 TO BUS 247870 CKT 1 / 242907 05CLAY-2 11.0 247870 05CLAYTR HY2 138 1 REMOVE SWSHUNT FROM BUS 242609 / 242609 05CLYTR2 138 OPEN BRANCH FROM BUS 244131 TO BUS 244133 CKT 1 / 244131 05N.CLAYTOR 69.0 244133 05INGLES 69.0 1 REMOVE UNIT 3 FROM BUS 242907 / 242907 05CLAY-2 11.0 3 REMOVE UNIT 4 FROM BUS 242907 / 242907 05CLAY-2 11.0 4 END

12 Short Circuit Analysis

The following Breakers are overdutied

None

13 Affected Systems

13.1 TVA

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

13.2 Duke Energy Progress

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

13.3 MISO

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

13.4 LG&E

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