Generation Interconnection

System Impact Study Report

for

Queue Project AF2-105

GLEN LYN #2 - MORGANS CUT 138 KV

60 MW Capacity / 100 MW Energy

February 2021

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact 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 System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. 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 System Impact Study is performed.

The System Impact 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.

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.

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 100 MW with 60 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this project is March 28, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-105
Project Name	MORGANS CUT 138 KV
State	Virginia
County	Pulaski
Transmission Owner	AEP
MFO	100
MWE	100
MWC	60
Fuel	Solar
Basecase Study Year	2023

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

AF2-105 will interconnect with the AEP transmission system via a new station cut into the Glen Lyn #2 - Morgans Cut 138 kV section of the Glen Lyn #2 – Claytor #2 circuit.

To accommodate the interconnection on the Glen Lyn #2 - Morgans Cut 138 kV section of the Glen Lyn #2 – Claytor #2 circuit, a new three (3) circuit breaker 138 kV switching station physically configured and operated as a ring-bus will be constructed (see Attachment 1). Installation of associated protection and control equipment, line risers, SCADA, jumpers, switches, 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.

AEP will extend one span of 138 kV transmission line for the generation-leads going to the AF2-105 site. Unless this span extends directly from within the AEP station at the POI to the IC collector station structure, AEP will build and own the first transmission line structure outside of the proposed 138 kV station fence to which the AEP and AF2-105 transmission line conductors will attach.

5 Cost Summary

The AF2-105 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$9,786,000
Allocation towards System Network Upgrade Costs*	$30,860,000
Total Costs	**$40,646,000**

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

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.

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.

Note 1: 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.

Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

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
138 kV Revenue Metering	$376,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$400,000
Total Attachment Facility Costs	**$776,000**

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 138 kV switching station physically configured and operated as a ring-bus will be constructed. Installation of associated protection and control equipment, 138 kV line risers, and SCADA will also be required.	$8,150,000
Total Direct Connection Facility Costs	$8,150,000

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
Glen Lyn - Morgans Cut 138 kV T-Line Cut In	$770,000
Review Protection and Control Settings at the Glen Lyn #2 138 kV station	$45,000
Review Protection and Control Settings at the Claytor #2 138 kV station	$45,000
Total Non-Direct Connection Facility Costs	**$860,000**

7 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 Agreement execution.

8 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.

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 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)

9.3 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/

10 Summer Peak Analysis

The Queue Project AF2-105 was evaluated as a 100.0 MW (Capacity 60.0 MW) injection into a tap of the Glen Lyn – Morgans Cut 138 kV line (specifically a tap of the Glen Lyn – AD2-179 Tap 138 kV line segment) in the AEP area. Project AF2-105 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-105 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

None

10.2 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
95682640	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	AEP_P4_#10191_05CLYTR3 138_C	breaker	240.0	95.03	107.29	AC	30.1
144715711	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P7-1_#10877-B	tower	146.0	94.26	122.28	AC	41.64

10.3 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
95682669	941430	AE2-140 TAP	138.0	AEP	242620	05DANVL2	138.0	AEP	1	AEP_P4_#10171_05AXTON 138_G	breaker	392.0	111.97	113.12	AC	5.28

10.4 Steady-State Voltage Requirements

To be determined

10.5 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
95682858	242620	05DANVL2	138.0	AEP	242631	05EDAN 1	138.0	AEP	1	AEP_P1-2_#1370	operation	402.0	114.07	115.3	AC	5.78
144714922	937350	AD2-179 TAP	138.0	AEP	242721	05MORGAN	138.0	AEP	1	Base Case	operation	134.0	58.0	106.88	AC	66.58
156845037	937350	AD2-179 TAP	138.0	AEP	242721	05MORGAN	138.0	AEP	1	AEP_P1-2_#5381-AA	operation	146.0	67.09	134.78	AC	100.0
95682852	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	Base Case	operation	167.0	92.25	101.33	AC	15.46
95682853	942640	AE2-280 TAP	138.0	AEP	242634	05EDGEMO	138.0	AEP	1	AEP_P1-2_#10190	operation	240.0	94.54	106.47	AC	29.5
144714924	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	AEP_P1-2_#5381-B	operation	146.0	67.85	135.31	AC	100.0
144714925	958110	AF2-105 TAP	138.0	AEP	242651	05GLENL2	138.0	AEP	1	242721 05MORGAN 138 937350 AD2-179 TAP 138 1	operation	146.0	67.81	135.26	AC	100.0

10.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-105	Upgrade Number
144715711	5	**AF2-105 TAP 138.0 kV - 05GLENL2 138.0 kV Ckt 1**	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. 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. Replace 0.13 mi. 300 CU Overhead Cond Cost Estimate: $195 K Time Estimate: 24-36 months New expected SE rating to be 245MVA.	$85.6 K $195 K	$85.6 K $195 K	N6996.1 N6996.2
95682669	7	**AE2-140 TAP 138.0 kV - 05DANVL2 138.0 kV Ckt 1**	Replace two sub cond 1590 AAC 61 Str at Danville. Cost Estimate: $100 K Time Estimate: 12-18 months Replace Axton - Danville Line, ACSR ~ 1033.5 ~ 45/7 ~ ORTOLAN Conductor Section 1, 0.06 Miles. Cost Estimate: $90 K Time Estimate: 18-24 months The upgrades above are driven by a prior queue cycle. Replace Axton - Danville Line, ACSR ~ 336.4 ~ 30/7 ~ ORIOLE ~ FE Conductor Section 2, 16.3 Miles. Cost Estimate: $24.45 M Time Estimate: 18-24 months Replace Axton - Danville Line, ACSR/SSAC ~ 795 ~ 26/7 ~ DRAKE/S Conductor Section 3, 0.52 Miles. Cost Estimate: $780 K Time Estimate: 18-24 months New expected SE rating to be 527 MVA. Note: It should be evaluated in the Facilities Study whether it's feasible to add a 138 kV breaker to the Axton ring bus in series with the 'G' circuit breaker to eliminate this stuck breaker contingency. This may be a more cost effective solution depending on the severity of the overload and which upgrades on the line would be required.	$100 K $90 K $24.45 M $780 K	$0 $0 $24.45 M $780 K	N6998.1 N6998.2 N6998.3 N6998.4

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-105	Upgrade Number
95682640,156845451	4	**AE2-280 TAP 138.0 kV - 05EDGEMO 138.0 kV Ckt 1**	Rebuild Edgemont-AE2-280 138 kV (3.5 miles) using 795 ACSR 26/7 DRAKE Cost Estimate: $5.25 M Time Estimate: 18-24 months New expected SE rating to be 255 MVA. Replace Sub cond 795 AAC 37 Str. At Edgemont Cost Estimate: $100 K Time Estimate: 12-18 months New expected SE rating to be 381 MVA.	$5.25 M $100 K	$5.25 M $100 K	N6997.1 N6997.2
			Total Cost	**$31,050,600**	**$30,860,000**	

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

10.7 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".

10.7.1 Index 1

None

10.7.2 Index 2

None

10.7.3 Index 3

None

10.7.4 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
9568264 0	94264 0	AE2-280 TAP	AEP	24263 4	05EDGEM O	AEP	1	AEP_P4_#10191_05CLYTR 3 138_C	breaker	240.0	95.03	107.29	AC	30.1

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242907	05CLAY-2	2.4176	50/50	2.4176
247619	Y1-049	0.1782	50/50	0.1782
934751	AD1-102 C	7.5512	50/50	7.5512
934752	AD1-102 E	50.5380	50/50	50.5380
937341	AD2-178 C O1	18.1786	50/50	18.1786
937342	AD2-178 E O1	12.1190	50/50	12.1190
937351	AD2-179 C O1	19.2552	50/50	19.2552
937352	AD2-179 E O1	12.8368	50/50	12.8368
942641	AE2-280 C O1	35.2312	50/50	35.2312
942642	AE2-280 E O1	23.4875	50/50	23.4875
958111	AF2-105 C	18.0582	50/50	18.0582
958112	AF2-105 E	12.0388	50/50	12.0388
958121	AF2-106 C	5.2288	Adder	6.15
958122	AF2-106 E	3.4859	Adder	4.1
LGEE	LGEE	0.1883	Confirmed LTF	0.1883
CBM-W2	CBM-W2	2.6126	Confirmed LTF	2.6126
NY	NY	0.0680	Confirmed LTF	0.0680
TVA	TVA	0.5082	Confirmed LTF	0.5082
WEC	WEC	0.0907	Confirmed LTF	0.0907
O-066	O-066	1.0282	Confirmed LTF	1.0282
CBM-S2	CBM-S2	0.6531	Confirmed LTF	0.6531
CBM-S1	CBM-S1	3.0416	Confirmed LTF	3.0416
G-007	G-007	0.1602	Confirmed LTF	0.1602
MADISON	MADISON	0.0262	Confirmed LTF	0.0262
MEC	MEC	0.4799	Confirmed LTF	0.4799
CBM-W1	CBM-W1	3.4027	Confirmed LTF	3.4027

10.7.5 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
144715711	958110	AF2-105 TAP	AEP	242651	05GLENL2	AEP	1	AEP_P7-1_#10877-B	tower	146.0	94.26	122.28	AC	41.64

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242906	05CLAY-1	1.5263	50/50	1.5263
242907	05CLAY-2	1.5327	50/50	1.5327
247619	Y1-049	0.1095	50/50	0.1095
934751	AD1-102 C	4.7303	50/50	4.7303
934752	AD1-102 E	31.6587	50/50	31.6587
937341	AD2-178 C O1	11.1730	50/50	11.1730
937342	AD2-178 E O1	7.4486	50/50	7.4486
937351	AD2-179 C O1	22.4364	50/50	22.4364
937352	AD2-179 E O1	14.9576	50/50	14.9576
942641	AE2-280 C O1	18.4139	50/50	18.4139
942642	AE2-280 E O1	12.2759	50/50	12.2759
958111	AF2-105 C	24.9840	50/50	24.9840
958112	AF2-105 E	16.6560	50/50	16.6560
958121	AF2-106 C	16.1829	50/50	16.1829
958122	AF2-106 E	10.7886	50/50	10.7886
NEWTON	NEWTON	0.0430	Confirmed LTF	0.0430
CPLE	CPLE	0.2970	Confirmed LTF	0.2970
BLUEG	BLUEG	0.1163	Confirmed LTF	0.1163
G-007A	G-007A	0.0312	Confirmed LTF	0.0312
VFT	VFT	0.0839	Confirmed LTF	0.0839
CBM-W2	CBM-W2	0.1802	Confirmed LTF	0.1802
PRAIRIE	PRAIRIE	0.0310	Confirmed LTF	0.0310
TVA	TVA	0.1036	Confirmed LTF	0.1036
COFFEEN	COFFEEN	0.0074	Confirmed LTF	0.0074
EDWARDS	EDWARDS	0.0178	Confirmed LTF	0.0178
CBM-S2	CBM-S2	2.1617	Confirmed LTF	2.1617
CBM-S1	CBM-S1	0.4090	Confirmed LTF	0.4090
TILTON	TILTON	0.0372	Confirmed LTF	0.0372
MADISON	MADISON	0.1351	Confirmed LTF	0.1351
GIBSON	GIBSON	0.0300	Confirmed LTF	0.0300
FARMERCITY	FARMERCITY	0.0008	Confirmed LTF	0.0008
TRIMBLE	TRIMBLE	0.0384	Confirmed LTF	0.0384

10.7.6 Index 6

None

10.7.7 Index 7

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95682669	941430	AE2-140 TAP	AEP	242620	05DANVL2	AEP	1	AEP_P4_#10171_05AXTON 138_G	breaker	392.0	111.97	113.12	AC	5.28

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244012	05PINNACLE	-1.4030	Adder	-1.65
247723	05PHILPOTT	0.6300	50/50	0.6300
926461	**AC1-117 C (Suspended)**	**3.6964**	**50/50**	**3.6964**
926462	**AC1-117 E (Suspended)**	**6.0310**	**50/50**	**6.0310**
934751	AD1-102 C	1.0343	Adder	1.22
934752	AD1-102 E	6.9222	Adder	8.14
937351	AD2-179 C O1	2.7795	Adder	3.27
937352	AD2-179 E O1	1.8530	Adder	2.18
938741	AE1-100 C O1	22.6654	50/50	22.6654
938742	AE1-100 E O1	13.0367	50/50	13.0367
938931	AE1-121 O1	261.2740	50/50	261.2740
939441	AE1-176	0.1225	Adder	0.14
940083	AE1-250 BAT	11.4465	Merchant Transmission	11.4465
940601	AE2-047 C O1	4.0840	50/50	4.0840
940602	AE2-047 E O1	2.2185	50/50	2.2185
941431	AE2-140 C O1	69.9152	50/50	69.9152
941432	AE2-140 E O1	46.6102	50/50	46.6102
941671	AE2-166 C	26.2640	50/50	26.2640
941672	AE2-166 E	17.5093	50/50	17.5093
942641	AE2-280 C O1	3.6617	Adder	4.31
942642	AE2-280 E O1	2.4411	Adder	2.87
958111	AF2-105 C	2.6913	Adder	3.17
958112	AF2-105 E	1.7942	Adder	2.11
958121	AF2-106 C	4.1914	Adder	4.93
958122	AF2-106 E	2.7943	Adder	3.29
LGEE	LGEE	0.1928	Confirmed LTF	0.1928
NY	NY	0.0354	Confirmed LTF	0.0354
WEC	WEC	0.0882	Confirmed LTF	0.0882
O-066	O-066	0.7997	Confirmed LTF	0.7997
CHEOAH	CHEOAH	0.2367	Confirmed LTF	0.2367
G-007	G-007	0.1269	Confirmed LTF	0.1269
MEC	MEC	0.2606	Confirmed LTF	0.2606
CALDERWOOD	CALDERWOOD	0.2142	Confirmed LTF	0.2142
CATAWBA	CATAWBA	0.5768	Confirmed LTF	0.5768
CBM-W1	CBM-W1	3.4528	Confirmed LTF	3.4528

10.8 Queue Dependencies

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

Queue Number	Project Name	Status
AC1-117	Stockton 34.5kV	Suspended
AD1-102	Wurno-Claytor Lake 138 KV	Active
AD2-178	Wurno 138kV	Active
AD2-179	Morgans Cut-Glen Lyn 138kV	Active
AE1-100	Axton 138 kV	Active
AE1-121	Axton 138 kV	Active
AE1-176	Roanoke-Vinton 12 kV (Niagara Hydro)	In Service
AE1-250	Smith Mountain-E. Danville 138 kV	Active
AE2-047	Ridgeway-Solite 69 kV	Active
AE2-140	Axton-Danville 138 kV	Active
AE2-166	Stockton 138 kV	Active
AE2-280	Claytor Lake-Edgemont 138 kV	Active
AF2-105	Morgans Cut 138 kV	Active
AF2-106	Hazel Hollow 138 kV	Active
Y1-049	Wurno 34.5kV	In Service

10.9 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#311	CONTINGENCY 'AEP_P1-2_#311' OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1 OPEN BRANCH FROM BUS 242684 TO BUS 242685 CKT ZB / 242684 05J.FERR 138 242685 05J.FERX 138 ZB END
AEP_P4_#10171_05AXTON 138_G	CONTINGENCY 'AEP_P4_#10171_05AXTON 138_G' OPEN BRANCH FROM BUS 242509 TO BUS 242514 CKT 1 / 242509 05AXTON 765 242514 05J.FERR 765 1 OPEN BRANCH FROM BUS 242509 TO BUS 242545 CKT 1 / 242509 05AXTON 765 242545 05AXTONX 138 1 OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT SR / 242544 05AXTON 138 242545 05AXTONX 138 SR OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT ZB / 242544 05AXTON 138 242545 05AXTONX 138 ZB OPEN BRANCH FROM BUS 242544 TO BUS 943810 CKT 2 / 242544 05AXTON 138 943810 AF1-049 TAP 138 2 END
242721 05MORGAN 138 937350 AD2-179 TAP 138 1	CONTINGENCY '242721 05MORGAN 138 937350 AD2-179 TAP 138 1' OPEN BRANCH FROM BUS 242721 TO BUS 937350 CKT 1 END
AEP_P1-2_#10190	CONTINGENCY 'AEP_P1-2_#10190' OPEN BRANCH FROM BUS 243969 TO BUS 242640 CKT 1 / 243969 05FLOYD EQ 999 242640 05FLOYD 138 1 OPEN BRANCH FROM BUS 243969 TO BUS 243967 CKT 1 / 243969 05FLOYD EQ 999 243967 05FLOYD 69.0 1 OPEN BRANCH FROM BUS 243969 TO BUS 243966 CKT 1 / 243969 05FLOYD EQ 999 243966 05FLOYD 34.5 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 247723 TO BUS 242750 CKT 1 / 247723 05PHILPOTT 138 242750 05PHILPOTT Z 138 1 OPEN BRANCH FROM BUS 242750 TO BUS 242844 CKT 1 / 242750 05PHILPOTT Z 138 242844 05W.BASS 138 1 END

Contingency Name	Contingency Definition
AEP_P1-2_#1370	CONTINGENCY 'AEP_P1-2_#1370' OPEN BRANCH FROM BUS 242509 TO BUS 242514 CKT 1 / 242509 05AXTON 765 242514 05J.FERR 765 1 OPEN BRANCH FROM BUS 242509 TO BUS 242545 CKT 1 / 242509 05AXTON 765 242545 05AXTONX 138 1 OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT SR / 242544 05AXTON 138 242545 05AXTONX 138 SR OPEN BRANCH FROM BUS 242544 TO BUS 242545 CKT ZB / 242544 05AXTON 138 242545 05AXTONX 138 ZB END
AEP_P4_#10191_05CLYTR3 138_C	CONTINGENCY 'AEP_P4_#10191_05CLYTR3 138_C' OPEN BRANCH FROM BUS 243969 TO BUS 242640 CKT 1 / 243969 05FLOYD EQ 999 242640 05FLOYD 138 1 OPEN BRANCH FROM BUS 243969 TO BUS 243967 CKT 1 / 243969 05FLOYD EQ 999 243967 05FLOYD 69.0 1 OPEN BRANCH FROM BUS 243969 TO BUS 243966 CKT 1 / 243969 05FLOYD EQ 999 243966 05FLOYD 34.5 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 247869 TO BUS 242608 CKT 1 / 247869 05CLAYTR HY1 138 242608 05CLYTR1 138 1 OPEN BRANCH FROM BUS 242608 TO BUS 242610 CKT Z1 / 242608 05CLYTR1 138 242610 05CLYTR3 138 Z1 OPEN BRANCH FROM BUS 242608 TO BUS 242666 CKT 1 / 242608 05CLYTR1 138 242666 05HAZELH 138 1 OPEN BRANCH FROM BUS 242608 TO BUS 242791 CKT 1 / 242608 05CLYTR1 138 242791 05SCHRIS 138 1 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 247723 TO BUS 242750 CKT 1 / 247723 05PHILPOTT 138 242750 05PHILPOTT Z 138 1 OPEN BRANCH FROM BUS 242750 TO BUS 242844 CKT 1 / 242750 05PHILPOTT Z 138 242844 05W.BASS 138 1 OPEN BRANCH FROM BUS 247869 TO BUS 242906 CKT 1 / 247869 05CLAYTR HY1 138 242906 05CLAY-1 11.0 1 REMOVE UNIT 1 FROM BUS 242906 / 242906 05CLAY-1 11.0 REMOVE UNIT 2 FROM BUS 242906 / 242906 05CLAY-1 11.0 END

Contingency Name	Contingency Definition
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_P1-2_#10186-C	CONTINGENCY 'AEP_P1-2_#10186-C' OPEN BRANCH FROM BUS 942640 TO BUS 242634 CKT 1 / 242609 AE2-280 TAP 138 242634 05EDGEMO 138 1 END
AEP_P7-1_#10791-AA	CONTINGENCY 'AEP_P7-1_#10791-AA' OPEN BRANCH FROM BUS 242650 TO BUS 958120 CKT 1 / 242650 05GLENL1 138 958120 AF2-106 138 1 OPEN BRANCH FROM BUS 242651 TO BUS 958110 CKT 1 / 242651 05GLENL2 138 958110 AF2-105 TAP 138 1 END
AEP_P1-2_#5381-AA	CONTINGENCY 'AEP_P1-2_#5381-AA' OPEN BRANCH FROM BUS 242651 TO BUS 958110 CKT 1 / 242651 05GLENL2 138 958110 AF2-105 TAP 138 1 END
Base Case	
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

Contingency Name	Contingency Definition
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-B	CONTINGENCY 'AEP_P1-2_#5381-B' OPEN BRANCH FROM BUS 244137 TO BUS 242721 CKT 1 / 244137 05MORGANEQ 999 242721 05MORGAN 138 1 OPEN BRANCH FROM BUS 244137 TO BUS 244136 CKT 1 / 244137 05MORGANEQ 999 244136 05MORGAN C 69.0 1 OPEN BRANCH FROM BUS 244137 TO BUS 244135 CKT 1 / 244137 05MORGANEQ 999 244135 05MORGAN C 34.5 1 OPEN BRANCH FROM BUS 242609 TO BUS 242721 CKT 1 / 242609 05CLYTR2 138 242721 05MORGAN 138 1 OPEN BRANCH FROM BUS 937350 TO BUS 242721 CKT 1 / 937350 AD2-179 TAP 138 242721 05MORGAN 138 1 END

11 Light Load Analysis

Not Applicable.

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

13 Stability and Reactive Power

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the Facilities Study Phase.

14 Affected Systems

14.1 TVA

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

14.2 Duke Energy Progress

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

14.3 MISO

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

14.4 LG&E

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

15 Attachment 1: One Line Diagram and Project Site Location