Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-123

AMHERST-RIVERVILLE138 KV

44.2 MW Capacity / 75 MW Energy

October 2021

Table of Contents

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.

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.

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.

The conduct of light load analysis 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 the light load analysis which shall be performed following execution of the System Impact Study agreement.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Amherst County, Virginia. The installed facilities will have a total capability of 75 MW with 44.2 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 01, 2024. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-123
Project Name	AMHERST-RIVERVILLE138 KV
State	Virginia
County	Amherst
Transmission Owner	AEP
MFO	75
MWE	75
MWC	44.2
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

4.1 Primary

AG1-123 will interconnect with the AEP transmission system via a new station cut into the Amherst - Riverville 138 kV section of the Boxwood - Riverville 138 kV circuit.

To accommodate the interconnection on the Amherst - Riverville 138 kV section of the Boxwood - Riverville 138 kV 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, 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.

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.

4.2 Secondary

AG1-123 will interconnect with the AEP transmission system via a direct connection to the Amherst 69 kV substation.

To accommodate the interconnection to the Amherst 69 kV substation, two (2) new 69 kV circuit breaker(s) will be installed (see Attachment 2). 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 AG1-123 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$9,786,000
Allocation towards System Network Upgrade Costs (PJM Identified - Summer Peak)*	$5,165,400
Allocation towards System Network Upgrade Costs (PJM Identified - Light Load)*	$0
Allocation towards System Network Upgrade Costs (TO Identified)*	$0

Description	Total Cost
Total Costs	**$14,951,400**

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 88-129. 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
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
Amherst - Riverville 138 kV section of the Boxwood - Riverville 138 kV T-Line Cut In	$770,000
Review Protection and Control Settings at the Boxwood 138 kV substation	$45,000
Review Protection and Control Settings at the Riverville 138 kV substation	$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 - Load Flow Analysis - Primary POI

The Queue Project AG1-123 was evaluated as a 75.0 MW (Capacity 44.20 MW) injection tapping the Amherst to Riverville 138 kV line in the AEP area. Project AG1-123 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-123 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

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

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
185043606	938820	AE1-108 TAP	138.0	AEP	314746	4BREMO	138.0	DVP	1	DVP_P1-2: LN 566	single	157.0	98.38	101.98	AC	5.76
185118304	938820	AE1-108 TAP	138.0	AEP	314746	4BREMO	138.0	DVP	1	PJM_PLANT BEAR GARDEN	single	157.0	98.66	101.94	AC	5.27

10.2 Multiple Facility Contingency

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

None.

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
181037253	242549	05BANSTR	138.0	AEP	242632	05EDAN 2	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS 8 138 1	single	296.0	102.69	103.69	AC	3.1

10.4 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
167837401	242549	05BANSTR	138.0	AEP	242632	05EDAN 2	138.0	AEP	1	Base Case	operation	296.0	112.25	113.47	AC	4.44
179782608	242549	05BANSTR	138.0	AEP	242632	05EDAN 2	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	296.0	145.99	147.45	AC	5.27
167837637	242550	05BEARSK	138.0	AEP	940080	AE1-250 TAP	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	392.0	101.59	102.69	AC	5.27
168106985	242775	05ROCKCASS	138.0	AEP	242720	05MONETA	138.0	AEP	1	AEP_P1-2_#5366_42-A	operation	409.0	100.19	101.03	AC	4.21
168106877	242802	05SMITHMTN	138.0	AEP	926050	AC1-083 TAP	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	296.0	108.22	109.67	AC	5.27
168106919	243892	05MEADS8	138.0	AEP	242607	05CLOVRD	138.0	AEP	1	AEP_P1-2_#5366_42-A	operation	407.0	109.07	109.91	AC	4.21
169342706	314746	4BREMO	138.0	DVP	314744	3BREMO	115.0	DVP	1	Base Case	operation	186.1	110.75	115.42	AC	8.94
174608644	314746	4BREMO	138.0	DVP	314744	3BREMO	115.0	DVP	1	PJM_PLANT BEAR GARDEN	operation	205.9	113.3	117.52	AC	8.94
167837428	926050	AC1-083 TAP	138.0	AEP	242550	05BEARSK	138.0	AEP	1	Base Case	operation	296.0	104.41	105.63	AC	4.44
169342595	938820	AE1-108 TAP	138.0	AEP	314746	4BREMO	138.0	DVP	1	Base Case	operation	157.0	132.02	137.64	AC	8.94
184042918	938820	AE1-108 TAP	138.0	AEP	314746	4BREMO	138.0	DVP	1	PJM_PLANT BEAR GARDEN	operation	157.0	149.56	155.14	AC	8.94
169577047	940080	AE1-250 TAP	138.0	AEP	242549	05BANSTR	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	392.0	112.26	113.37	AC	5.27
169577049	940080	AE1-250 TAP	138.0	AEP	242549	05BANSTR	138.0	AEP	1	Base Case	operation	335.0	101.53	102.6	AC	4.44

10.5 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost
167837402,181037253	1	05BANSTR 138.0 kV - 05EDAN 2 138.0 kV Ckt 1	AEP AEPA0010e : A Sag Study will be required for the 10.7 miles of overhead conductor (2 bundle ACSR ~ 556.5 ~ 26/7 ~ DOVE) to mitigate the overload. New Rating after sag study is SN 298MVA, SE: 396MVA. Project Type : FAC Cost : $42,800 Time Estimate : 6-12 Months	$64,200
185043606,185118304,169342597	2	AE1-108 TAP 138.0 kV - 4BREMO 138.0 kV Ckt 1	DVP dom-397 : Reconductor 8.502 miles of 138 kV line 8 from AE1-108 Tap to Bremo with 636 ACSR 150 C Project Type : FAC Cost : $5,101,200 Time Estimate : 30-36 Months	$5,101,200
			TOTAL COST	$5,165,400

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.

10.6 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".

10.6.1 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
181037253	242549	05BANSTR	AEP	242632	05EDAN 2	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	single	296.0	102.69	103.69	AC	3.1

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242889	05REUSENS	0.05	80|50	0.05
246843	05SMG1	3.72	80|50	3.72
246844	05SMG2	10.1	80|50	10.1
246845	05SMG3	6.33	80|50	6.33
246846	05SMG4	9.94	80|50	9.94
246847	05SMG5	3.87	80|50	3.87
247284	05LEESVG	2.02	80|50	2.02
315156	1HALLBR1	1.34	80|50	1.34
316123	AC1-075 C	0.48	80|50	0.48
925661	AC1-042 C	2.72	80|50	2.72
926023	AC1-080 C	0.16	80|50	0.16
926051	AC1-083 C O1	19.1	80|50	19.1
926521	AC1-123 C O1	2.1	80|50	2.1
926645	AC1-145 C	0.53	80|50	0.53
933941	AD1-017 C	3.82	80|50	3.82
935241	AD1-161 C	2.6	80|50	2.6
938451	AE1-064 C	21.46	80|50	21.46
939011	AE1-130 C	17.63	80|50	17.63
939941	AE1-230 C	1.23	80|50	1.23
940081	AE1-250 C	57.52	80|50	57.52
941801	AE2-185 C	6.14	80|50	6.14
941821	AE2-187 C	6.14	80|50	6.14
942671	AE2-283 C	6.75	80|50	6.75
942751	AE2-291 C	6.12	80|50	6.12
942761	AE2-292 C O1	7.62	80|50	7.62
945081	AF1-173	2.38	80|50	2.38
958131	AF2-107 C	1.89	80|50	1.89
961121	AF2-403	1.36	80|50	1.36
962741	AG1-123 C O1	3.1	80|50	3.1
962751	AG1-124 C O1	4.14	80|50	4.14
963601	AG1-209 C	0.48	80|50	0.48
964531	AG1-316 C O1	4.73	80|50	4.73
966251	AG1-494 C	1.37	80|50	1.37
966691	AG1-539 C	3.2	80|50	3.2
966761	AG1-547 C	5.55	80|50	5.55
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.2308	Confirmed LTF	0.2308
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	2.0551	Confirmed LTF	2.0551

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.1949	Confirmed LTF	0.1949
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.3627	Confirmed LTF	0.3627
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.5712	Confirmed LTF	0.5712
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.3802	Confirmed LTF	0.3802
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	1.2354	Confirmed LTF	1.2354
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.0812	Confirmed LTF	0.0812
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	1.1965	Confirmed LTF	1.1965
LTFEXP_NY	LTFEXP_NY->LTFIMP_NY	0.0548	Confirmed LTF	0.0548
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	0.7796	Confirmed LTF	0.7796
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.0586	Confirmed LTF	0.0586
242889	05REUSENS	0.05	80|50	0.05
246843	05SMG1	3.72	80|50	3.72
246844	05SMG2	10.1	80|50	10.1
246845	05SMG3	6.33	80|50	6.33
246846	05SMG4	9.94	80|50	9.94
246847	05SMG5	3.87	80|50	3.87
247284	05LEESVG	2.02	80|50	2.02
315156	1HALLBR1	1.34	80|50	1.34
316123	AC1-075 C	0.48	80|50	0.48
925661	AC1-042 C	2.72	80|50	2.72
926023	AC1-080 C	0.16	80|50	0.16
926051	AC1-083 C O1	19.1	80|50	19.1
926521	AC1-123 C O1	2.1	80|50	2.1
926645	AC1-145 C	0.53	80|50	0.53
933941	AD1-017 C	3.82	80|50	3.82
935241	AD1-161 C	2.6	80|50	2.6
938451	AE1-064 C	21.46	80|50	21.46
939011	AE1-130 C	17.63	80|50	17.63
939941	AE1-230 C	1.23	80|50	1.23
940081	AE1-250 C	57.52	80|50	57.52
941801	AE2-185 C	6.14	80|50	6.14
941821	AE2-187 C	6.14	80|50	6.14
942671	AE2-283 C	6.75	80|50	6.75
942751	AE2-291 C	6.12	80|50	6.12
942761	AE2-292 C O1	7.62	80|50	7.62
945081	AF1-173	2.38	80|50	2.38
958131	AF2-107 C	1.89	80|50	1.89
961121	AF2-403	1.36	80|50	1.36
962741	AG1-123 C O1	3.1	80|50	3.1
962751	AG1-124 C O1	4.14	80|50	4.14
963601	AG1-209 C	0.48	80|50	0.48
964531	AG1-316 C O1	4.73	80|50	4.73
966251	AG1-494 C	1.37	80|50	1.37
966691	AG1-539 C	3.2	80|50	3.2

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
966761	AG1-547 C	5.55	80|50	5.55
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.2308	Confirmed LTF	0.2308
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	2.0551	Confirmed LTF	2.0551
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.1949	Confirmed LTF	0.1949
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.3627	Confirmed LTF	0.3627
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.5712	Confirmed LTF	0.5712
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.3802	Confirmed LTF	0.3802
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	1.2354	Confirmed LTF	1.2354
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.0812	Confirmed LTF	0.0812
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	1.1965	Confirmed LTF	1.1965
LTFEXP_NY	LTFEXP_NY->LTFIMP_NY	0.0548	Confirmed LTF	0.0548
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	0.7796	Confirmed LTF	0.7796
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.0586	Confirmed LTF	0.0586

10.6.2 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
185118304	938820	AE1-108 TAP	AEP	314746	4BREMO	DVP	1	PJM_PLANT BEAR GARDEN	single	157.0	98.66	101.94	AC	5.27

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
242889	05REUSENS	0.05	80|50	0.05
935241	AD1-161 C	1.94	80|50	1.94
938821	AE1-108 C O1	61.69	80|50	61.69
946591	AF1-323 C	20.17	80|50	20.17
958131	AF2-107 C	8.94	80|50	8.94
960111	AF2-302 C	7.33	80|50	7.33
961801	AG1-022 C	7.33	80|50	7.33
962741	AG1-123 C O1	5.27	80|50	5.27
962751	AG1-124 C O1	6.53	80|50	6.53
964531	AG1-316 C O1	3.53	80|50	3.53
965581	AG1-426	11.69	80|50	11.69
966251	AG1-494 C	3.18	80|50	3.18
LTFEXP_AA2-074	LTFEXP_AA2-074->LTFIMP_AA2-074	0.0504	Confirmed LTF	0.0504
LTFEXP_CBM-S1	LTFEXP_CBM-S1->LTFIMP_CBM-S1	0.2101	LTF/CBM	0.2101
LTFEXP_CBM-S2	LTFEXP_CBM-S2->LTFIMP_CBM-S2	3.4433	LTF/CBM	3.4433
LTFEXP_CBM-W1	LTFEXP_CBM-W1->LTFIMP_CBM-W1	6.881	LTF/CBM	6.881
LTFEXP_CBM-W2	LTFEXP_CBM-W2->LTFIMP_CBM-W2	4.7451	LTF/CBM	4.7451
LTFEXP_CPLE	LTFEXP_CPLE->LTFIMP_CPLE	0.0722	Confirmed LTF	0.0722
LTFEXP_LAGN	LTFEXP_LAGN->LTFIMP_LAGN	0.9211	Confirmed LTF	0.9211
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0201	Confirmed LTF	0.0201
LTFEXP_LGEE	LTFEXP_LGEE->LTFIMP_LGEE	0.3491	Confirmed LTF	0.3491
LTFEXP_MEC	LTFEXP_MEC->LTFIMP_MEC	0.826	Confirmed LTF	0.826
LTFEXP_NY	LTFEXP_NY->LTFIMP_NY	0.1194	Confirmed LTF	0.1194
LTFEXP_SIGE	LTFEXP_SIGE->LTFIMP_SIGE	0.0571	Confirmed LTF	0.0571
LTFEXP_TVA	LTFEXP_TVA->LTFIMP_TVA	0.7731	Confirmed LTF	0.7731
LTFEXP_WEC	LTFEXP_WEC->LTFIMP_WEC	0.1611	Confirmed LTF	0.1611
242889	05REUSENS	0.05	80|50	0.05
935241	AD1-161 C	1.94	80|50	1.94
938821	AE1-108 C O1	61.69	80|50	61.69
946591	AF1-323 C	20.17	80|50	20.17

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
958131	AF2-107 C	8.94	80|50	8.94
960111	AF2-302 C	7.33	80|50	7.33
961801	AG1-022 C	7.33	80|50	7.33
962741	AG1-123 C O1	5.27	80|50	5.27
962751	AG1-124 C O1	6.53	80|50	6.53
964531	AG1-316 C O1	3.53	80|50	3.53
965581	AG1-426	11.69	80|50	11.69
966251	AG1-494 C	3.18	80|50	3.18
LTFEXP_AA2-074	LTFEXP_AA2-074->LTFIMP_AA2-074	0.0504	Confirmed LTF	0.0504
LTFEXP_CBM-S1	LTFEXP_CBM-S1->LTFIMP_CBM-S1	0.2101	LTF/CBM	0.2101
LTFEXP_CBM-S2	LTFEXP_CBM-S2->LTFIMP_CBM-S2	3.4433	LTF/CBM	3.4433
LTFEXP_CBM-W1	LTFEXP_CBM-W1->LTFIMP_CBM-W1	6.881	LTF/CBM	6.881
LTFEXP_CBM-W2	LTFEXP_CBM-W2->LTFIMP_CBM-W2	4.7451	LTF/CBM	4.7451
LTFEXP_CPLE	LTFEXP_CPLE->LTFIMP_CPLE	0.0722	Confirmed LTF	0.0722
LTFEXP_LAGN	LTFEXP_LAGN->LTFIMP_LAGN	0.9211	Confirmed LTF	0.9211
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0201	Confirmed LTF	0.0201
LTFEXP_LGEE	LTFEXP_LGEE->LTFIMP_LGEE	0.3491	Confirmed LTF	0.3491
LTFEXP_MEC	LTFEXP_MEC->LTFIMP_MEC	0.826	Confirmed LTF	0.826
LTFEXP_NY	LTFEXP_NY->LTFIMP_NY	0.1194	Confirmed LTF	0.1194
LTFEXP_SIGE	LTFEXP_SIGE->LTFIMP_SIGE	0.0571	Confirmed LTF	0.0571
LTFEXP_TVA	LTFEXP_TVA->LTFIMP_TVA	0.7731	Confirmed LTF	0.7731
LTFEXP_WEC	LTFEXP_WEC->LTFIMP_WEC	0.1611	Confirmed LTF	0.1611

10.7 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
AA2-074	CPLE-PJM	Confirmed
AC1-042	Altavista-Mt. Airy 69kV	Engineering and Procurement
AC1-056	PJM-AMIL	Confirmed
AC1-075	Perth-Hickory Grove 115kV	Partially in Service - Under Construction
AC1-080	Perth-Hickory Grove 115kV	Under Construction
AC1-083	Smith Mountain-Bearskin 138kV	Under Construction
AC1-123	Smith Mountain-Candler's Mountain 138kV	In Service
AC1-131	PJM-CPLE	Confirmed
AC1-145	Gretna DP 69 kV	Under Construction
AD1-017	Smith Mountain-Bearskin 138 kV	Under Construction
AD1-161	Stonewall-Long Mountain 69 kV	Active
AE1-064	Rockcastle 138 kV	Active
AE1-108	Bremo-Scottsville 138 kV	Active
AE1-130	Meads Store 138 kV	Active
AE1-230	Shockoe 69 kV	Active
AE1-250	Smith Mountain-E. Danville 138 kV	Active
AE2-092	Kidds Store-Sherwood 115 kV	Active
AE2-185	Gladys DP-Stonemill Switching Station 69 kV	Active
AE2-187	Shockoe DP-Chatham 69 kV	Active
AE2-283	Gladys-Stone Mill 69 kV	Active
AE2-291	Grit DP-Perth 115 kV	Active
AE2-292	Grit DP-Perth 115 kV	Active
AF1-173	Gretna DP-Shockoe DP 69 kV	Active
AF1-293	Kidds Store-Fort Union 115 kV	Active
AF1-323	Scottsville-Colleen 138 kV	Active
AF2-107	Clifford 138 kV	Active
AF2-302	Scottsville-Colleen 138 kV	Active
AF2-397	Fork Union-Mt. Eagle 230 kV	Active
AF2-403	Shockoe DP-Chatham 69 kV	Active
AG1-022	Scottsville-Colleen 138 kV	Active
AG1-123	Amherst-Riverville138 kV	Active
AG1-124	Gladstone 138 kV	Active
AG1-209	Gretna 12.5 kV	Active
AG1-284	Fork Union 115 kV	Active
AG1-316	Sherwill 69 kV	Active
AG1-426	Bremo-Scottsville 138 kV	Active
AG1-494	Boxwood-Riverville 138 kV	Active
AG1-539	Grit DP-Perth 115 kV	Active
AG1-547	Mount Airy-Chatham 69 kV	Active

10.8 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P1-2: LN 566	CONTINGENCY 'DVP_P1-2: LN 566' OPEN BRANCH FROM BUS 242519 TO BUS 314912 CKT 1 /* 05CLOVRD 500.00 - 8LEXNGTN 500.00 END
AEP_P2-1_242549 05BANSTR 138 940080 AE1-250 TAP 138 1-A	CONTINGENCY 'AEP_P2-1_242549 05BANSTR 138 940080 AE1-250 TAP 138 1-A' OPEN BRANCH FROM BUS 242549 TO BUS 940080 CKT 1 END
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
AEP_P1-2_#5366_42-A	CONTINGENCY 'AEP_P1-2_#5366_42-A' OPEN BRANCH FROM BUS 242549 TO BUS 940080 CKT 1 / 242549 05BANSTR 138 940080 AE1-250 TAP 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 242632 CKT 1 / 242549 05BANSTR 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 314668 CKT Z1 / 242549 05BANSTR 138 314668 4BANISTR 138 Z1 END
AEP_P4_#10164_05EDAN 2 138_M	CONTINGENCY 'AEP_P4_#10164_05EDAN 2 138_M' OPEN BRANCH FROM BUS 242531 TO BUS 304094 CKT 1 / 242531 05EDANV2 230 304094 6YANCY TAP 230 1 OPEN BRANCH FROM BUS 242531 TO BUS 242632 CKT 4 / 242531 05EDANV2 230 242632 05EDAN 2 138 4 OPEN BRANCH FROM BUS 242549 TO BUS 940080 CKT 1 / 242549 05BANSTR 138 940080 AE1-250 TAP 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 242632 CKT 1 / 242549 05BANSTR 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242549 TO BUS 314668 CKT Z1 / 242549 05BANSTR 138 314668 4BANISTR 138 Z1 / OPEN BRANCH FROM BUS 242550 TO BUS 242802 CKT 1 / 242550 05BEARSK 138 242802 05SMITHMTN 138 1 / OPEN BRANCH FROM BUS 242550 TO BUS 314671 CKT Z1 / 242550 05BEARSK 138 314671 4BEARSKN 138 Z1 OPEN BRANCH FROM BUS 242629 TO BUS 242632 CKT 1 / 242629 05E.MONU 138 242632 05EDAN 2 138 1 OPEN BRANCH FROM BUS 242631 TO BUS 242632 CKT Z1 / 242631 05EDAN 1 138 242632 05EDAN 2 138 Z1 END

Contingency Name	Contingency Definition
DVP_P1-2: LN 2193	CONTINGENCY 'DVP_P1-2: LN 2193' OPEN BRANCH FROM BUS 313707 TO BUS 313867 CKT 1 /* 6FORK UNION 230.00 - 6BREMODIST 230.00 OPEN BRANCH FROM BUS 313867 TO BUS 314747 CKT 1 /* 6BREMODIST 230.00 - 6BREMO 230.00 OPEN BUS 313867 /* ISLAND: 6BREMODIST 230.00 END
AEP_P2-1_242720 05MONETA 138 242775 05ROCKCAS SS 138 1	CONTINGENCY 'AEP_P2-1_242720 05MONETA 138 242775 05ROCKCAS SS 138 1' OPEN BRANCH FROM BUS 242720 TO BUS 242775 CKT 1 END
PJM_PLANT BEAR GARDEN	CONTINGENCY 'PJM_PLANT BEAR GARDEN' REMOVE MACHINE G1 FROM BUS 315191 REMOVE MACHINE G2 FROM BUS 315192 REMOVE MACHINE S1 FROM BUS 315193 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
DVP_P4-2: 56602	CONTINGENCY 'DVP_P4-2: 56602' /* LEXINGTON 500 KV OPEN BRANCH FROM BUS 242519 TO BUS 314912 CKT 1 /* 05CLOVRD 500.00 - 8LEXNGTN 500.00 OPEN BRANCH FROM BUS 314856 TO BUS 314912 CKT 1 /* 6LEXNGT2 230.00 - 8LEXNGTN 500.00 END
AEP_P4_#15269_05RIVERV 138_CB5	CONTINGENCY 'AEP_P4_#15269_05RIVERV 138_CB5' OPEN BRANCH FROM BUS 242688 TO BUS 242772 CKT 1 / 242688 05JOSHUA 138 242772 05RIVERV 138 1 REMOVE LOAD C3 FROM BUS 242772 / 242772 05RIVERV 138 C3 END
Base Case	
DVP_P4-2: 547T566	CONTINGENCY 'DVP_P4-2: 547T566' /* LEXINGTON 500 KV OPEN BRANCH FROM BUS 314901 TO BUS 314912 CKT 1 /* 8BATH CO 500.00 - 8LEXNGTN 500.00 OPEN BRANCH FROM BUS 242519 TO BUS 314912 CKT 1 /* 05CLOVRD 500.00 - 8LEXNGTN 500.00 END

Contingency Name	Contingency Definition
AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	CONTINGENCY 'AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1' OPEN BRANCH FROM BUS 242607 TO BUS 243892 CKT 1 END

11 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AG1-123 was evaluated as a 75.0 MW injection tapping the Amherst to Riverville 138 kV line in the AEP area. Project AG1-123 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-123 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

(Single or N-1 contingencies)

None

11.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies)

None

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
181037253	242549	05BANSTR	138.0	AEP	242632	05EDAN2	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	single	296.0	102.69	103.75	AC	3.3
	242607	05CLOVRD	138.0	AEP	243892	05MEADS8	138.0	AEP	1	AEP_P4_#10164_05EDAN 2 138_M	breaker	407.0	109.08	109.99	AC	4.5

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

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
167837401	242549	05BANSTR	138.0	AEP	242632	05EDAN 2	138.0	AEP	1	Base Case	operation	296.0	112.25	113.53	AC	4.68
179782608	242549	05BANSTR	138.0	AEP	242632	05EDAN 2	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	296.0	145.99	147.54	AC	5.58
	242549	05BANSTR	138.0	AEP	940080	AE1-250 TAP	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	392.0	112.26	113.43	AC	5.58
	242550	05BEARSK	138.0	AEP	926050	AC1-083 TAP	138.0	AEP	1	Base Case	operation	392.0	104.41	105.69	AC	4.68
168106985	242775	05ROCKCASS	138.0	AEP	242720	05MONETA	138.0	AEP	1	AEP_P1-2_#5366_42-A	operation	409.0	100.19	101.1	AC	4.55
168106877	242802	05SMITHMTN	138.0	AEP	926050	AC1-083 TAP	138.0	AEP	1	AEP_P2-1_242607 05CLOVRD 138 243892 05MEADS8 138 1	operation	296.0	108.22	109.76	AC	5.58

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).