Generation Interconnection

System Impact Study Report

for

Queue Project AF1-204

EUGENE 345 KV

63.75 MW Capacity / 255 MW Energy

August, 2020

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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 Wind generating facility located in Vermillion County, Indiana. The installed facilities will have a total capability of 255 MW with 63.75 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this project is December 31, 2022. This study does not imply a TO commitment to this in-service date.

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

Queue Number	**AF1-204**
Project Name	EUGENE 345 KV
State	Indiana
County	Vermillion
Transmission Owner	AEP
MFO	255
MWE	255
MWC	63.75
Fuel	Wind
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

AF1-204 will interconnect with the AEP transmission system via a direct connection to the Eugene 345 kV substation.

To accommodate the interconnection to the Eugene 345 kV substation, one (1) new 345 kV circuit breaker will be installed (Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 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 AF1-204 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,082,000
Direct Connection Network Upgrade	$2,390,000
Non Direct Connection Network Upgrades	$45,000
Allocation for New System Upgrades*	$0
Contribution to Previously Identified Upgrades*	$810,720
Total Costs	**$4,327,720**

*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 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.

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.

6 Transmission Owner Scope of Work

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
345 kV Revenue Metering	$431,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$651,000
Total Attachment Facility Costs	$1,082,000

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
One (1) new 345 kV circuit breaker will be installed (Figure 1). Installation of associated protection and control equipment, 345 kV line risers, and SCADA will also be required.	$2,390,000
Total Direct Connection Facility Costs	$2,390,000

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
Review line protection and control settings at the Eugene 345 kV substation	$45,000
Total Non-Direct Connection Facility Costs	$45,000

7 Incremental Capacity Transfer Rights (ICTRs)

None

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

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

Requirement from the PJM Open Access Transmission Tariff:

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

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 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 Analysis

The Queue Project AF1-204 was evaluated as a 255.0 MW (Capacity 63.75 MW) injection at the Eugene 345 kV substation in the AEP area. Project AF1-204 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-204 was studied with a commercial probability of 100.0 %. 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)

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
41616566	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P4_#1760_05JEFRSO 765_A	breaker	2354.0	130.78	131.95	AC	25.76
41616567	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P4_#6189_05HANG R 765_D1	breaker	2354.0	101.19	101.63	AC	26.83
43525200	243209	05ROCKPT	765.0	AEP	243208	05JEFRSO	765.0	AEP	1	AEP_P7-1_#11042	tower	3970.0	113.04	114.26	AC	42.45
43525202	243209	05ROCKPT	765.0	AEP	243208	05JEFRSO	765.0	AEP	1	AEP_P7-1_#11014	tower	3970.0	108.39	109.52	AC	40.96
43524806	247712	05SULLIVAN	345.0	AEP	254529	16PETE	345.0	IPL	1	AEP_P4_#8648_05JEFRSO 765_B	breaker	1409.0	101.21	102.18	DC	16.04

11.4 Steady-State Voltage Requirements

None

11.5 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
41295795	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P1-2_#709	operation	2354.0	99.62	100.05	AC	26.89
43524892	243878	05MEADOW	345.0	AEP	255205	17REYNOLDS	345.0	NIPS	1	AEP_P1-2_#8807-A	operation	2246.0	113.72	116.14	AC	54.64
51923885	243878	05MEADOW	345.0	AEP	255205	17REYNOLDS	345.0	NIPS	2	AEP_P1-2_#8695	operation	2246.0	113.72	116.14	AC	54.64
43525141	247712	05SULLIVAN	345.0	AEP	254529	16PETE	345.0	IPL	1	AEP_P1-2_#363	operation	1409.0	100.28	101.26	DC	16.16

11.6 System Reinforcements

<table>
<tr><th>ID</th><th>Idx</th><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF1-204</th><th>Upgrade Number</th></tr>
<tr><td>43525202,43525200</td><td>2</td><td>05ROCKPT 765.0 kV - 05JEFRSO 765.0 kV Ckt 1</td><td>(N6497.1) Rockport & Jefferson Relay Thermal Limits - An engineering study will need to be conducted to determine if the Relay Thermal limits settings (2996 A/3970 MVA) can be adjusted to mitigate the overload. New relay packages will be required if the settings cannot be adjusted. Estimated Cost for study: $50,000 ($25,000 each). Estimated Cost for new relay packages: $1.2 M ($600,000 each). New SE rating 3975 MVA.

(N6497.2) Replace 6 Rockport 3000A CTs. $4.8 M. New SE rating expected to be 4142 MVA.

This line overload is presently driven in prior queue cycle and N6497.1 and N6497.2 are required for a prior queue cycle.

(N6497.3) Replace 2 Rockport 3000A non-oil Breakers at Rockport. $6 M. New SE rating 4571 MVA.

The cost allocation for N6497.3 is as follows:

<table><tr><th>Queue</th><th>MW contribution</th><th>Percentage of Cost</th><th>$ cost ($6 M)</th></tr><tr><td>AF1-088</td><td>278.0</td><td>0.867</td><td>5.204</td></tr><tr><td>AF1-204</td><td>42.5</td><td>0.133</td><td>0.796</td></tr></table></td><td>$1.2 M +
$4.8 M +
$6 M</td><td>$0 +
$0 +
$796 K</td><td>N6497.1
N6497.2
N6497.3</td></tr>
</table>

<table>
<tr><th>ID</th><th>Idx</th><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF1-204</th><th>Upgrade Number</th></tr>
<tr><td>43524806</td><td>3</td><td>05SULLIVAN 345.0 kV - 16PETE 345.0 kV Ckt 1</td><td>AEP end SE rating is 1409 MVA.
AEP upgrade: A sag study will be required on the ~0.5 miles section of 954 2x Rail Conductor section 2 to mitigate the overload. New Ratings after the sag study S/N: 1410 MVA S/E: 1888 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $25,000 (no remediations required just sag study) and $0.75 million (complete line reconductor/rebuild required).

The cost allocation is as follows:

<table><tr><th>Queue</th><th>MW contribution</th><th>Percentage of Cost</th><th>$ cost ($25 K)</th></tr><tr><td>AF1-088</td><td>255.7</td><td>0.941</td><td>23.528</td></tr><tr><td>AF1-204</td><td>16.0</td><td>0.059</td><td>1.472</td></tr></table>
The MISO/IP&L end SE rating is sufficient. No upgrade required.</td><td>$25 K</td><td>$1.472 K</td><td>N6781</td></tr>
<tr><td>41616567,41616566</td><td>1</td><td>05JEFRSO 345.0 kV - 06CLIFTY 345.0 kV Ckt Z1</td><td>(N4106.1) Replace 4 Clifty switches. $2M. 12-18 months time estimate.

(N4106.3) A sag check will be required for the ACSR ~ 2156 ~ 84/19 ~ BLUEBIRD Conductor Section 1 to determine if the line section can be operated above its emergency rating. Preliminary sag study results: Jefferson – Clifty Creek 345 kV line work will include one location of grading to remediate clearance location of concern in span 1 to 2. Cost is $244 K. If a rebuild is needed, rebuild the 0.75 mile ACSR ~ 2156 ~ 84/19 ~ BLUEBIRD @ 284 F - Conductor section 1. $1.96M.
New SE rating on line expected to be 2826 MVA.

This line overload is presently driven in prior queue cycle and N4106.1 and N4106.3 are required for a prior queue cycle.

(N4106.5) Replace Clifty Bus 5"0 AL Tubular Sch 40. $100 K. 12-18 months.
New SE rating expected to be 3113 MVA.

N4106.5 is needed for the AF1 queue cycle; however, AF1-204 doe not meet PJM cost allocation thresholds presently for this upgrade.</td><td>$2 M + $244 K + $100 K</td><td>$0</td><td>N4106.1
N4106.3
N4106.5</td></tr>
<tr><td></td><td></td><td></td><td>Total Cost</td><td>$14.369M</td><td>$810,720</td><td></td></tr>
</table>

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.

11.7 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".

11.7.1 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
4161656 6	24286 5	05JEFRS O	AEP	24800 0	06CLIFT Y	OVE C	Z1	AEP_P4_#1760_05JEFRS O 765_A	breake r	2354. 0	130.78	131.95	AC	25.76

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243442	05RKG1	111.7067	50/50	111.7067
243443	05RKG2	110.0142	50/50	110.0142
247900	05FR-11G E	5.2385	Adder	6.16
247901	05FR-12G E	5.1516	Adder	6.06
247902	05FR-21G E	5.5062	Adder	6.48
247903	05FR-22G E	5.2720	Adder	6.2
247904	05FR-3G E	10.6778	Adder	12.56
247905	05FR-4G E	8.3629	Adder	9.84
247906	05MDL-1G E	9.1479	Adder	10.76
247907	05MDL-2G E	4.5825	Adder	5.39
247912	05MDL-3G E	4.5825	Adder	5.39
247913	05MDL-4G E	4.5825	Adder	5.39
247943	T-127 E	4.5825	Adder	5.39
250163	Y3-099 BAT	0.1383	Merchant Transmission	0.1383
250167	Y3-100 BAT	0.1383	Merchant Transmission	0.1383
251823	Z1-065 BAT	0.3606	Merchant Transmission	0.3606
274882	W4-005 E	19.9683	Adder	23.49
274890	CAYUG;1U E	6.1180	Adder	7.2
274891	CAYUG;2U E	6.1180	Adder	7.2
276153	W2-048 E	4.1294	Adder	4.86
290261	S-027 E	9.6375	Adder	11.34
290265	S-028 E	9.6375	Adder	11.34
293771	O-035 E	2.9337	Adder	3.45
294401	BSHIL;1U E	3.9556	Adder	4.65
294410	BSHIL;2U E	3.9556	Adder	4.65
909052	X2-022 E	12.4213	Adder	14.61
913222	Y1-054 E	-1.0951	Adder	-1.29
916211	Z1-072 E	2.2201	Adder	2.61
917502	Z2-087 E	9.5041	Adder	11.18
924041	AB2-047 C O1	1.7752	Adder	2.09
924042	AB2-047 E O1	11.8801	Adder	13.98
924261	AB2-070 C O1	1.6968	Adder	2.0
924262	AB2-070 E O1	11.3558	Adder	13.36
925581	AC1-033 C	0.6477	Adder	0.76
925582	AC1-033 E	4.3363	Adder	5.1
925771	AC1-053 C	1.7035	Adder	2.0
925772	AC1-053 E	11.4001	Adder	13.41
926841	AC1-171 C O1	0.5460	Adder	0.64
926842	AC1-171 E O1	3.6468	Adder	4.29
927201	AC1-214 C O1	0.9415	Adder	1.11
927202	AC1-214 E O1	2.9931	Adder	3.52
930042	AB1-006 E	9.9670	Adder	11.73

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
930461	AB1-087	128.9475	50/50	128.9475
930471	AB1-088	128.9475	50/50	128.9475
932601	AC2-080 C O1	1.2922	Adder	1.52
932602	AC2-080 E O1	8.6477	Adder	10.17
933441	AC2-157 C	17.8182	50/50	17.8182
933442	AC2-157 E	29.0718	50/50	29.0718
934051	AD1-031 C O1	1.3152	Adder	1.55
934052	AD1-031 E O1	2.1459	Adder	2.52
935001	AD1-133 C O1	8.8771	Adder	10.44
935002	AD1-133 E O1	5.9180	Adder	6.96
935141	AD1-148	3.2375	Adder	3.81
936771	AD2-100 C	9.0135	Adder	10.6
936772	AD2-100 E	6.0090	Adder	7.07
936971	AD2-131 C	0.5937	Adder	0.7
936972	AD2-131 E	2.9831	Adder	3.51
937041	AD2-138 C	1.7494	Adder	2.06
937042	AD2-138 E	8.1905	Adder	9.64
937211	AD2-159 C	2.1579	Adder	2.54
937212	AD2-159 E	10.1028	Adder	11.89
939741	AE1-205 C O1	4.5882	Adder	5.4
939742	AE1-205 E O1	6.3360	Adder	7.45
940581	AE2-045 C O1	5.8645	Adder	6.9
940582	AE2-045 E O1	8.0513	Adder	9.47
941341	AE2-130 C	229.3488	50/50	229.3488
941342	AE2-130 E	152.8992	50/50	152.8992
941571	AE2-154 C	1.8616	Adder	2.19
941572	AE2-154 E	12.4587	Adder	14.66
941731	AE2-173 O1	2.7310	Adder	3.21
942111	AE2-223 C	1.0651	Adder	1.25
942112	AE2-223 E	7.1280	Adder	8.39
942481	AE2-261 C	12.6216	Adder	14.85
942482	AE2-261 E	8.4144	Adder	9.9
942601	AE2-276	11.7225	50/50	11.7225
944201	AF1-088 FTIR	234.4500	50/50	234.4500
944221	AF1-090 C O1	2.6401	Adder	3.11
944222	AF1-090 E O1	12.3607	Adder	14.54
945391	AF1-204 C O1	6.4407	50/50	6.4407
945392	AF1-204 E O1	19.3220	50/50	19.3220
945421	AF1-207 C	1.7996	Adder	2.12
945422	AF1-207 E	7.7277	Adder	9.09
945871	AF1-252 O1	4.6802	Adder	5.51
945881	AF1-253 O1	3.2402	Adder	3.81
946541	AF1-318 C O1	2.6241	Adder	3.09
946542	AF1-318 E O1	12.2868	Adder	14.46
946581	AF1-322 C	4.8116	Adder	5.66
946582	AF1-322 E	6.6447	Adder	7.82
954681	J949 C	11.1384	PJM External (MISO)	11.1384
954761	J468 C	1.8135	PJM External (MISO)	1.8135
954762	J468 E	10.2762	PJM External (MISO)	10.2762
990901	L-005 E	6.0231	Adder	7.09
WEC	WEC	1.6279	Confirmed LTF	1.6279
LGE-0012019	LGE-0012019	3.5431	LTF	3.5431

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
CBM-W2	CBM-W2	34.7993	Confirmed LTF	34.7993
NY	NY	0.8726	Confirmed LTF	0.8726
TVA	TVA	1.8438	Confirmed LTF	1.8438
O-066	O-066	9.8179	Confirmed LTF	9.8179
CHEOAH	CHEOAH	0.0941	Confirmed LTF	0.0941
G-007	G-007	1.5194	Confirmed LTF	1.5194
MADISON	MADISON	23.2203	Confirmed LTF	23.2203
MEC	MEC	8.7220	Confirmed LTF	8.7220
CALDERWOOD	CALDERWOOD	0.0865	Confirmed LTF	0.0865
BLUEG	BLUEG	14.8567	Confirmed LTF	14.8567
TRIMBLE	TRIMBLE	5.3135	Confirmed LTF	5.3135
CATAWBA	CATAWBA	0.2583	Confirmed LTF	0.2583
CBM-W1	CBM-W1	45.3613	Confirmed LTF	45.3613

11.7.2 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
43525200	243209	05ROCKPT	AEP	243208	05JEFRSO	AEP	1	AEP_P7-1_#11042	tower	3970.0	113.04	114.26	AC	42.45

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243442	05RKG1	148.1006	50/50	148.1006
243443	05RKG2	145.8567	50/50	145.8567
243859	05FR-11G C	0.6321	50/50	0.6321
243862	05FR-12G C	0.6224	50/50	0.6224
243864	05FR-21G C	0.6643	50/50	0.6643
243866	05FR-22G C	0.6353	50/50	0.6353
243870	05FR-3G C	1.2867	50/50	1.2867
243873	05FR-4G C	0.9965	50/50	0.9965
246909	05MDL-1G C	1.2899	50/50	1.2899
246910	05MDL-2G C	0.6385	50/50	0.6385
246976	05MDL-3G C	0.6514	50/50	0.6514
246979	05MDL-4G C	0.6353	50/50	0.6353
247556	T-127 C	0.6449	50/50	0.6449
247900	05FR-11G E	14.2569	50/50	14.2569
247901	05FR-12G E	14.0202	50/50	14.0202
247902	05FR-21G E	14.9852	50/50	14.9852
247903	05FR-22G E	14.3479	50/50	14.3479
247904	05FR-3G E	29.0600	50/50	29.0600
247905	05FR-4G E	22.7600	50/50	22.7600
247906	05MDL-1G E	29.0766	50/50	29.0766
247907	05MDL-2G E	14.5656	50/50	14.5656
247912	05MDL-3G E	14.5656	50/50	14.5656
247913	05MDL-4G E	14.5656	50/50	14.5656
247943	T-127 E	14.5656	50/50	14.5656
274650	KINCAID ;1U	10.7387	50/50	10.7387
930041	AB1-006 C	0.8384	50/50	0.8384
930042	AB1-006 E	31.6802	50/50	31.6802
930461	AB1-087	182.7980	50/50	182.7980
930471	AB1-088	182.7980	50/50	182.7980
933441	AC2-157 C	25.2594	50/50	25.2594
933442	AC2-157 E	41.2126	50/50	41.2126
936771	AD2-100 C	14.2204	50/50	14.2204
936772	AD2-100 E	9.4802	50/50	9.4802
936971	AD2-131 C	0.9367	50/50	0.9367
936972	AD2-131 E	4.7063	50/50	4.7063
941341	AE2-130 C	304.0704	50/50	304.0704
941342	AE2-130 E	202.7136	50/50	202.7136
941571	AE2-154 C	5.9173	50/50	5.9173
941572	AE2-154 E	39.6002	50/50	39.6002
942481	AE2-261 C	19.7466	50/50	19.7466
942482	AE2-261 E	13.1644	50/50	13.1644
942601	AE2-276	16.6180	50/50	16.6180

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944201	AF1-088 FTIR	332.3600	50/50	332.3600
944221	AF1-090 C O1	4.2596	50/50	4.2596
944222	AF1-090 E O1	19.9424	50/50	19.9424
945391	AF1-204 C O1	10.6131	50/50	10.6131
945392	AF1-204 E O1	31.8393	50/50	31.8393
945871	AF1-252 O1	7.5510	50/50	7.5510
945881	AF1-253 O1	5.2276	50/50	5.2276
946581	AF1-322 C	15.2939	50/50	15.2939
946582	AF1-322 E	21.1201	50/50	21.1201
954681	J949 C	18.7680	PJM External (MISO)	18.7680
954761	J468 C	3.1133	PJM External (MISO)	3.1133
954762	J468 E	17.6422	PJM External (MISO)	17.6422
WEC	WEC	1.3936	Confirmed LTF	1.3936
LGEE	LGEE	0.2613	Confirmed LTF	0.2613
CBM-W2	CBM-W2	61.0565	Confirmed LTF	61.0565
NY	NY	1.0579	Confirmed LTF	1.0579
TVA	TVA	5.2500	Confirmed LTF	5.2500
O-066	O-066	12.4723	Confirmed LTF	12.4723
CBM-S1	CBM-S1	26.7358	Confirmed LTF	26.7358
G-007	G-007	1.9292	Confirmed LTF	1.9292
MADISON	MADISON	16.9284	Confirmed LTF	16.9284
MEC	MEC	10.3142	Confirmed LTF	10.3142
BLUEG	BLUEG	0.3732	Confirmed LTF	0.3732
TRIMBLE	TRIMBLE	0.4825	Confirmed LTF	0.4825
CATAWBA	CATAWBA	0.0497	Confirmed LTF	0.0497
CBM-W1	CBM-W1	41.2204	Confirmed LTF	41.2204

11.7.3 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
4352480 6	24771 2	05SULLIVA N	AEP	25452 9	16PET E	IPL	1	AEP_P4_#8648_05JEFRS O 765_B	breake r	1409. 0	101.21	102.18	DC	16.04

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243442	05RKG1	59.7541	50/50	59.7541
243443	05RKG2	58.8488	50/50	58.8488
247900	05FR-11G E	3.5667	Adder	4.2
247901	05FR-12G E	3.5075	Adder	4.13
247902	05FR-21G E	3.7489	Adder	4.41
247903	05FR-22G E	3.5895	Adder	4.22
247904	05FR-3G E	7.2700	Adder	8.55
247905	05FR-4G E	5.6939	Adder	6.7
274882	W4-005 E	12.9912	Adder	15.28
276153	W2-048 E	2.6966	Adder	3.17
909052	X2-022 E	8.1114	Adder	9.54
925771	AC1-053 C	1.1077	Adder	1.3
925772	AC1-053 E	7.4127	Adder	8.72
930461	AB1-087	140.6130	50/50	140.6130
930471	AB1-088	140.6130	50/50	140.6130
933441	AC2-157 C	19.4302	50/50	19.4302
933442	AC2-157 E	31.7018	50/50	31.7018
935141	AD1-148	2.1142	Adder	2.49
936771	AD2-100 C	6.1143	Adder	7.19
936772	AD2-100 E	4.0762	Adder	4.8
936971	AD2-131 C	0.4028	Adder	0.47
936972	AD2-131 E	2.0236	Adder	2.38
937211	AD2-159 C	1.4039	Adder	1.65
937212	AD2-159 E	6.5728	Adder	7.73
941341	AE2-130 C	122.6832	50/50	122.6832
941342	AE2-130 E	81.7888	50/50	81.7888
942481	AE2-261 C	8.5013	Adder	10.0
942482	AE2-261 E	5.6675	Adder	6.67
942601	AE2-276	12.7830	50/50	12.7830
944201	AF1-088 FTIR	255.6600	50/50	255.6600
944221	AF1-090 C O1	1.8254	Adder	2.15
944222	AF1-090 E O1	8.5463	Adder	10.05
945391	AF1-204 C O1	3.4095	Adder	4.01
945392	AF1-204 E O1	10.2284	Adder	12.03
945871	AF1-252 O1	3.2360	Adder	3.81
945881	AF1-253 O1	2.2403	Adder	2.64
953401	J811	6.4904	PJM External (MISO)	6.4904
953651	J815	12.8250	PJM External (MISO)	12.8250
953881	J848 C	2.0612	PJM External (MISO)	2.0612
953882	J848 E	11.1513	PJM External (MISO)	11.1513
954411	J912	5.5220	PJM External (MISO)	5.5220
954681	J949 C	11.8167	PJM External (MISO)	11.8167

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
954761	J468 C	1.9386	PJM External (MISO)	1.9386
954762	J468 E	10.9854	PJM External (MISO)	10.9854
955031	J979 C	1.6489	PJM External (MISO)	1.6489
955032	J979 E	8.9211	PJM External (MISO)	8.9211
955131	J991	13.6780	PJM External (MISO)	13.6780
956451	J1139	8.5170	PJM External (MISO)	8.5170
WEC	WEC	0.8946	Confirmed LTF	0.8946
NY	NY	0.4689	Confirmed LTF	0.4689
O-066	O-066	5.5306	Confirmed LTF	5.5306
CHEOAH	CHEOAH	0.4670	Confirmed LTF	0.4670
G-007	G-007	0.8570	Confirmed LTF	0.8570
MADISON	MADISON	12.5617	Confirmed LTF	12.5617
MEC	MEC	4.8433	Confirmed LTF	4.8433
GIBSON	GIBSON	6.4559	Confirmed LTF	6.4559
CALDERWOOD	CALDERWOOD	0.4672	Confirmed LTF	0.4672
BLUEG	BLUEG	9.3293	Confirmed LTF	9.3293
TRIMBLE	TRIMBLE	2.8905	Confirmed LTF	2.8905
CATAWBA	CATAWBA	0.2807	Confirmed LTF	0.2807
CBM-W1	CBM-W1	24.4946	Confirmed LTF	24.4946

11.8 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
AB1-006	Meadow Lake 345kV	In Service
AB1-087	Sullivan 345kV #1	Active
AB1-088	Sullivan 345kV #2	Active
AB2-047	Brokaw-Pontiac Midpoint	Engineering and Procurement
AB2-070	Brokaw-Lanesville	Active
AC1-033	Kewanee	Active
AC1-053	Lanesville-Brokaw	Active
AC1-171	Powerton	Active
AC1-214	Crescent Ridge	Engineering and Procurement
AC2-080	Olive-Reynolds 345kV	Active
AC2-157	Sullivan 345 kV	Active
AD1-031	Kewanee 138 kV	Active
AD1-133	Pontiac MidPoint-Dresden	Active
AD1-148	Brokaw-Lanesville	Active
AD2-100	Kincaid-Pana	Active
AD2-131	Latham Kincaid	Active
AD2-138	Olive-Reynolds 345kV	Active
AD2-159	Chestnut 345kV	Active
AE1-205	McLean 345 kV	Active
AE2-045	Olive-Reynolds 345 kV	Active
AE2-130	Rockport 765 kV	Active
AE2-154	Meadow Lake 345 kV (MLV VIII)	Active
AE2-173	McLean 345 kV	Active
AE2-223	McLean 345 kV	Active
AE2-261	Kincaid-Pana	Active
AE2-276	Sullivan 345kV	Active
AF1-088	Sullivan 345 kV	Active
AF1-090	Kincaid-Pana	Active
AF1-204	Eugene 345 kV	Active
AF1-207	Reynolds–Olive #1 345 kV	Active
AF1-252	Kincaid-Pana	Active
AF1-253	Kincaid-Pana	Active
AF1-318	Crescent Ridge-Corbin	Active
AF1-322	Meadow Lake 345 kV	Active
W2-048	Brokaw-Lanesville	In Service
W4-005	Blue Mound-Latham	Partially in Service - Under Construction
X2-022	Brokaw-Lanesville	In Service
Y1-054	Rochelle 138kV	In Service
Y3-099	Beckjord 2 MW-1	In Service

Queue Number	Project Name	Status
Y3-100	Beckjord 2 MW-2	In Service
Z1-065	Wiley 34.5kV	In Service
Z1-072	Crescent Ridge	In Service
Z2-087	Pontiac MidPoint-Brokaw 345kV	In Service
J1139	MISO	MISO
J468	MISO	MISO
J811	MISO	MISO
J815	MISO	MISO
J848	MISO	MISO
J912	MISO	MISO
J949	MISO	MISO
J979	MISO	MISO
J991	MISO	MISO

11.9 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#709	CONTINGENCY 'AEP_P1-2_#709' OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1 END
AEP_P4_#6189_05HANG R 765_D1	CONTINGENCY 'AEP_P4_#6189_05HANG R 765_D1' OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 / 242921 05CORNU 765 242924 05HANG R 765 1 OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1 OPEN BRANCH FROM BUS 242921 TO BUS 242934 CKT 1 / 242921 05CORNU 765 242934 05CORNU 345 1 REMOVE UNIT 1A FROM BUS 247245 / 247245 05HRKG1A 18.0 REMOVE UNIT 1B FROM BUS 247246 / 247246 05HRKG1B 18.0 REMOVE UNIT 1S FROM BUS 247247 / 247247 05HRKG1S 18.0 REMOVE UNIT 2A FROM BUS 247248 / 247248 05HRKG2A 18.0 REMOVE UNIT 2B FROM BUS 247249 / 247249 05HRKG2B 18.0 REMOVE UNIT 2S FROM BUS 247250 / 247250 05HRKG2S 18.0 END
AEP_P1-2_#8807-A	CONTINGENCY 'AEP_P1-2_#8807-A' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 2 / 243878 05MEADOW 345 255205 17REYNOLDS 345 2 END
AEP_P4_#8648_05JEFRSO 765_B	CONTINGENCY 'AEP_P4_#8648_05JEFRSO 765_B' OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 2 / 243208 05JEFRSO 765 242865 05JEFRSO 345 2 OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865 05JEFRSO 345 248000 06CLIFTY 345 Z1 END
AEP_P1-2_#363	CONTINGENCY 'AEP_P1-2_#363' OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 END
AEP_P1-2_#8695	CONTINGENCY 'AEP_P1-2_#8695' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878 05MEADOW 345 255205 17REYNOLDS 345 1 END

Contingency Name	Contingency Definition
AEP_P7-1_#11014	CONTINGENCY 'AEP_P7-1_#11014' OPEN BRANCH FROM BUS 243217 TO BUS 243221 CKT 1 / 243217 05DEQUIN 345 243221 05EUGENE 345 1 OPEN BRANCH FROM BUS 243217 TO BUS 247712 CKT 1 / 243217 05DEQUIN 345 247712 05SULLIVAN 345 1 END
AEP_P7-1_#11042	CONTINGENCY 'AEP_P7-1_#11042' OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878 05MEADOW 345 255205 17REYNOLDS 345 1 OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 2 / 243878 05MEADOW 345 255205 17REYNOLDS 345 2 END
AEP_P4_#1760_05JEFRSO 765_A	CONTINGENCY 'AEP_P4_#1760_05JEFRSO 765_A' OPEN BRANCH FROM BUS 243207 TO BUS 243208 CKT 1 / 243207 05GRNTWN 765 243208 05JEFRSO 765 1 OPEN BRANCH FROM BUS 242924 TO BUS 243208 CKT 1 / 242924 05HANG R 765 243208 05JEFRSO 765 1 END

12 Light Load Analysis

The Queue Project AF1-204 was evaluated as a 255.0 MW injection at the Eugene 345 kV substation in the AEP area. Project AF1-204 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-204 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

12.1 Generation Deliverability

(Single or N-1 contingencies)

None

12.2 Multiple Facility Contingency

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

None

12.3 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
10216452 6	24321 1	05ALLEN	345. 0	AEP	24293 3	05RPMONE	345. 0	AEP	1	AEP_P1-2_#744 1	single	897.0	152.0	153.4	DC	11.6

12.4 Steady-State Voltage Requirements

None

12.5 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.

None

12.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF1-204	Upgrade Number
102164526	1	**05ALLEN 345.0 kV - 05RPMONE 345.0 kV Ckt 1**	A sag study is required on 12.25 miles of line. Cost of sag study is $49 K. New expected SE rating to be 971 MVA. If the sag study concludes a complete Rebuild/Reconductor is required, the estimated cost is $ 24.5 million. A sag study will be required on ACSR/PE~ 1414 ~ 62/19, 6.07 miles of line. The cost is expected to be 24,280. New Ratings after sag study: S/N: 971 MVA S/E: 1419 MVA. Rebuild/Reconductor, cost: $ 12.14 million. This overload is presently driven by a prior queue cycle and AF1-204 presently has no cost responsibility.	$49 K + $24.280 K	$0	N6740 N6740.1
			Total Cost	**$24,329,000**	**$0**	

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.

12.7 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".

12.7.1 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
102164526	243211	05ALLEN	AEP	242933	05RPMONE	AEP	1	AEP_P1-2_#7441	single	897.0	152.0	153.4	DC	11.6

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243795	05HDWTR1G C	0.6617	80/20	0.6617
243859	05FR-11G C	0.5315	80/20	0.5315
243862	05FR-12G C	0.5234	80/20	0.5234
243864	05FR-21G C	0.5586	80/20	0.5586
243866	05FR-22G C	0.5342	80/20	0.5342
243870	05FR-3G C	1.0820	80/20	1.0820
243873	05FR-4G C	0.8379	80/20	0.8379
246909	05MDL-1G C	1.1299	80/20	1.1299
246910	05MDL-2G C	0.5593	80/20	0.5593
246953	05TIMB G C	1.1144	80/20	1.1144
246976	05MDL-3G C	0.5706	80/20	0.5706
246979	05MDL-4G C	0.5565	80/20	0.5565
246991	05WLD G1 C	0.3442	80/20	0.3442
247255	05WLD G2 C	0.3614	80/20	0.3614
247521	T-131 C	1.2976	80/20	1.2976
247536	05BLUFF P WF	0.6334	80/20	0.6334
247543	V3-007 C	0.6617	80/20	0.6617
247556	T-127 C	0.5650	80/20	0.5650
247901	05FR-12G E	2.0880	80/20	2.0880
247902	05FR-21G E	2.2317	80/20	2.2317
247904	05FR-3G E	4.3279	80/20	4.3279
247905	05FR-4G E	3.3897	80/20	3.3897
247906	05MDL-1G E	4.5112	80/20	4.5112
247907	05MDL-2G E	2.2598	80/20	2.2598
247911	05TIMB G E	4.4872	80/20	4.4872
247912	05MDL-3G E	2.2598	80/20	2.2598
247913	05MDL-4G E	2.2598	80/20	2.2598
247925	T-131 E	5.1902	80/20	5.1902
247929	S-071 E	2.5336	80/20	2.5336
247943	T-127 E	2.2598	80/20	2.2598
247958	05WLD G2 E	4.7233	80/20	4.7233
247963	05HDWTR1G E	4.4282	80/20	4.4282
274847	GR RIDGE ;BU	0.8867	80/20	0.8867
274848	CAMPGROVE;RU	0.8106	80/20	0.8106
274849	CRESCENT ;1U	0.2646	80/20	0.2646
274850	MENDOTA H;RU	0.1479	80/20	0.1479
274851	PROVIDENC;RU	0.4036	80/20	0.4036
274853	TWINGROVE;U1	1.0327	80/20	1.0327
274854	TWINGROVE;U2	1.0327	80/20	1.0327
274855	GSG-6 ;RU	0.6229	80/20	0.6229
274856	ECOGROVE ;U1	0.5602	80/20	0.5602
274857	BIG SKY ;U1	0.6642	80/20	0.6642

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
274858	BIG SKY ;U2	0.6642	80/20	0.6642
274859	EASYR;U1 E	2.6568	80/20	2.6568
274860	EASYR;U2 E	2.6568	80/20	2.6568
274861	TOP CROP ;1U	0.5944	80/20	0.5944
274862	TOP CROP ;2U	1.1539	80/20	1.1539
274863	CAYUGA RI;1U	0.8462	80/20	0.8462
274864	CAYUGA RI;2U	0.8462	80/20	0.8462
274871	GR RIDGE ;2U	1.1260	80/20	1.1260
274872	LEE DEKAL;1U	1.3755	80/20	1.3755
274877	BISHOP HL;1U	0.5424	80/20	0.5424
274878	BISHOP HL;2U	0.5424	80/20	0.5424
274879	MINONK ;1U	1.1437	80/20	1.1437
274880	GENERATOR;	1.1448	80/20	1.1448
274881	PILOT HIL;1E	4.2124	80/20	4.2124
274882	W4-005 E	7.6661	80/20	7.6661
274887	PILOT HIL;1U	1.0531	80/20	1.0531
274888	KELLYCK ;1U	1.0531	80/20	1.0531
274890	CAYUG;1U E	3.3849	80/20	3.3849
274891	CAYUG;2U E	3.3849	80/20	3.3849
275149	KELLYCK ;1E	4.2124	80/20	4.2124
276156	O-029 C	0.3034	80/20	0.3034
276157	O-029 C	0.3280	80/20	0.3280
276158	O-029 C	0.5986	80/20	0.5986
290021	O50 E	4.5748	80/20	4.5748
290051	GSG-6; E	2.4917	80/20	2.4917
290108	LEEDK;1U E	5.7314	80/20	5.7314
290261	S-027 E	4.1309	80/20	4.1309
290265	S-028 E	4.1309	80/20	4.1309
293061	N-015 E	3.5466	80/20	3.5466
293513	O-009 C1	0.5603	80/20	0.5603
293514	O-009 C2	0.2843	80/20	0.2843
293515	O-009 C3	0.3143	80/20	0.3143
293516	O-009 E1	2.2425	80/20	2.2425
293517	O-009 E2	1.1390	80/20	1.1390
293518	O-009 E3	1.2543	80/20	1.2543
293644	O22 E1	2.3777	80/20	2.3777
293645	O22 E2	4.6155	80/20	4.6155
293715	O-029 E	2.3974	80/20	2.3974
293716	O-029 E	1.3145	80/20	1.3145
293717	O-029 E	1.2082	80/20	1.2082
293771	O-035 E	1.6146	80/20	1.6146
294392	P-010 E	4.5042	80/20	4.5042
294401	BSHIL;1U E	2.1697	80/20	2.1697
294410	BSHIL;2U E	2.1697	80/20	2.1697
294763	P-046 E	2.2409	80/20	2.2409
917501	Z2-087 C	0.7128	80/20	0.7128
917502	Z2-087 E	4.7700	80/20	4.7700
918051	AA1-018 C OP	0.5671	80/20	0.5671
923881	AB2-028 C	1.3189	80/20	1.3189
923882	AB2-028 E	8.8267	80/20	8.8267
924041	AB2-047 C O1	1.7776	80/20	1.7776
924042	AB2-047 E O1	11.8964	80/20	11.8964

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
924261	AB2-070 C O1	1.3040	80/20	1.3040
924262	AB2-070 E O1	8.7264	80/20	8.7264
925301	AB2-191	0.2389	80/20	0.2389
925581	AC1-033 C	0.7089	80/20	0.7089
925582	AC1-033 E	4.7456	80/20	4.7456
925771	AC1-053 C	1.2998	80/20	1.2998
925772	AC1-053 E	8.6986	80/20	8.6986
926821	AC1-168 C O1	0.5655	80/20	0.5655
926822	AC1-168 E O1	3.7949	80/20	3.7949
926841	AC1-171 C O1	0.5472	80/20	0.5472
926842	AC1-171 E O1	3.6552	80/20	3.6552
926861	AC1-173 C	0.4365	80/20	0.4365
926862	AC1-173 E	2.9101	80/20	2.9101
926901	**AC1-176 C (Withdrawn : 07/09/2020)**	**0.5633**	**80/20**	**0.5633**
926902	**AC1-176 E (Withdrawn : 07/09/2020)**	**3.7871**	**80/20**	**3.7871**
927201	AC1-214 C O1	1.0339	80/20	1.0339
927202	AC1-214 E O1	3.2867	80/20	3.2867
930041	AB1-006 C	0.7344	80/20	0.7344
930042	AB1-006 E	4.9151	80/20	4.9151
932601	AC2-080 C O1	1.5255	80/20	1.5255
932602	AC2-080 E O1	10.2089	80/20	10.2089
933281	AC2-140 C	3.1415	80/20	3.1415
933282	AC2-140 E	0.1653	80/20	0.1653
933591	AC2-176 C O1	0.2529	80/20	0.2529
933592	AC2-176 E O1	3.2458	80/20	3.2458
933601	AC2-177 C O1	1.3202	80/20	1.3202
933602	AC2-177 E O1	8.8350	80/20	8.8350
934431	AD1-067 C	0.0624	80/20	0.0624
934432	AD1-067 E	0.2625	80/20	0.2625
934721	AD1-100 C	8.9064	80/20	8.9064
934722	AD1-100 E	41.5632	80/20	41.5632
935141	AD1-148	2.4324	80/20	2.4324
936291	AD2-038 C O1	1.1084	80/20	1.1084
936292	AD2-038 E O1	7.4176	80/20	7.4176
936371	AD2-047 C O1	2.0411	80/20	2.0411
936372	AD2-047 E O1	9.9653	80/20	9.9653
936722	AD2-091 BAT	6.7775	80/20	6.7775
936752	AD2-096 BAT	3.0915	80/20	3.0915
936971	AD2-131 C	0.4852	80/20	0.4852
936972	AD2-131 E	2.4378	80/20	2.4378
937001	AD2-134 C	1.2996	80/20	1.2996
937002	AD2-134 E	5.3687	80/20	5.3687
937041	AD2-138 C	2.0653	80/20	2.0653
937042	AD2-138 E	9.6691	80/20	9.6691
937211	AD2-159 C	1.6529	80/20	1.6529
937212	AD2-159 E	7.7386	80/20	7.7386
938851	AE1-113 C	3.7652	80/20	3.7652
938852	AE1-113 E	13.3492	80/20	13.3492
938861	AE1-114 C O1	1.8877	80/20	1.8877
938862	AE1-114 E O1	6.4403	80/20	6.4403
939321	AE1-163 C O1	2.7852	80/20	2.7852

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
939322	AE1-163 E O1	17.1088	80/20	17.1088
939401	AE1-172 C O1	2.5611	80/20	2.5611
939402	AE1-172 E O1	12.0167	80/20	12.0167
939631	AE1-193 C	4.0357	80/20	4.0357
939632	AE1-193 E	27.0083	80/20	27.0083
939641	AE1-194 C	4.0357	80/20	4.0357
939642	AE1-194 E	27.0083	80/20	27.0083
939651	AE1-195 C	4.0357	80/20	4.0357
939652	AE1-195 E	27.0083	80/20	27.0083
939681	AE1-198 C	0.0001	80/20	0.0001
939682	AE1-198 E	6.9073	80/20	6.9073
939781	AE1-209 C O1	0.7508	80/20	0.7508
939782	AE1-209 E O1	5.0244	80/20	5.0244
939791	AE1-210 C O1	0.7508	80/20	0.7508
939792	AE1-210 E O1	5.0244	80/20	5.0244
940101	AE1-252 C O1	0.0001	80/20	0.0001
940102	AE1-252 E O1	10.7190	80/20	10.7190
940752	AE2-062 E	0.0743	80/20	0.0743
941561	AE2-153 C O1	2.1092	80/20	2.1092
941562	AE2-153 E O1	9.8748	80/20	9.8748
941571	AE2-154 C	1.8317	80/20	1.8317
941572	AE2-154 E	12.2583	80/20	12.2583
941691	AE2-169	2.6291	80/20	2.6291
941711	AE2-171	1.9833	80/20	1.9833
941721	AE2-172	2.9032	80/20	2.9032
941731	AE2-173 O1	3.4185	80/20	3.4185
942042	AE2-216 BAT	7.4553	80/20	7.4553
942111	AE2-223 C	1.0666	80/20	1.0666
942112	AE2-223 E	7.1378	80/20	7.1378
942421	AE2-255 C O1	1.4262	80/20	1.4262
942422	AE2-255 E O1	4.2786	80/20	4.2786
942651	AE2-281 C O1	0.3979	80/20	0.3979
942652	AE2-281 E O1	2.4441	80/20	2.4441
943021	AE2-325 C	2.6503	80/20	2.6503
943022	AE2-325 E	1.7627	80/20	1.7627
943381	AF1-009 C	0.3541	80/20	0.3541
943382	AF1-009 E	1.4164	80/20	1.4164
943401	AF1-011 C	0.7635	80/20	0.7635
943402	AF1-011 E	1.2816	80/20	1.2816
943781	AF1-046 C	3.4671	80/20	3.4671
943782	AF1-046 E	2.3114	80/20	2.3114
943791	AF1-047 C	1.2392	80/20	1.2392
943792	AF1-047 E	0.8262	80/20	0.8262
943801	AF1-048 C	2.2375	80/20	2.2375
943802	AF1-048 E	1.4917	80/20	1.4917
943921	AF1-060	0.7224	80/20	0.7224
944121	AF1-080	1.3540	80/20	1.3540
944221	AF1-090 C O1	1.6029	80/20	1.6029
944222	AF1-090 E O1	7.5043	80/20	7.5043
944232	AF1-091 E O1	16.9319	80/20	16.9319
944241	AF1-092 C O1	0.0001	80/20	0.0001
944242	AF1-092 E O1	12.5936	80/20	12.5936

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944532	AF1-118 E O1	35.7980	80/20	35.7980
944542	AF1-119 E O1	17.6880	80/20	17.6880
944831	AF1-148 C O1	0.0001	80/20	0.0001
944832	AF1-148 E O1	15.9016	80/20	15.9016
944931	AF1-158 C O1	0.0001	80/20	0.0001
944932	AF1-158 E O1	12.5145	80/20	12.5145
944961	AF1-161 C	2.1135	80/20	2.1135
944962	AF1-161 E	2.1135	80/20	2.1135
945111	AF1-176 C O1	4.3602	80/20	4.3602
945112	AF1-176 E O1	6.5407	80/20	6.5407
945351	AF1-200 FTIR	121.4325	80/20	121.4325
945371	AF1-202 C O1	2.3251	80/20	2.3251
945372	AF1-202 E O1	11.3517	80/20	11.3517
945391	AF1-204 C O1	2.8994	80/20	2.8994
945392	AF1-204 E O1	8.6981	80/20	8.6981
945421	AF1-207 C	1.9519	80/20	1.9519
945422	AF1-207 E	8.3816	80/20	8.3816
945623	AF1-227 BAT	8.5370	80/20	8.5370
945871	AF1-252 O1	3.5518	80/20	3.5518
945881	AF1-253 O1	2.4589	80/20	2.4589
946161	AF1-281 C	0.2063	80/20	0.2063
946162	AF1-281 E	1.1693	80/20	1.1693
946203	AF1-285 BAT	2.4868	80/20	2.4868
946321	AF1-296 C O1	1.9731	80/20	1.9731
946322	AF1-296 E O1	9.2376	80/20	9.2376
946501	AF1-314 C	2.0853	80/20	2.0853
946502	AF1-314 E	9.7630	80/20	9.7630
946531	AF1-317 C O1	1.3794	80/20	1.3794
946532	AF1-317 E O1	2.0691	80/20	2.0691
946541	AF1-318 C O1	2.8950	80/20	2.8950
946542	AF1-318 E O1	13.5554	80/20	13.5554
990901	L-005 E	3.2425	80/20	3.2425

12.8 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
AA1-018	Powerton-Goodings Grove	In Service
AB1-006	Meadow Lake 345kV	In Service
AB2-028	Fall Creek-Desoto 345kV	Active
AB2-047	Brokaw-Pontiac Midpoint	Engineering and Procurement
AB2-070	Brokaw-Lanesville	Active
AB2-191	Mendota Hills	In Service
AC1-033	Kewanee	Active
AC1-053	Lanesville-Brokaw	Active
AC1-168	Kewanee-Streator	Active
AC1-171	Powerton	Active
AC1-173	Logtown 138kV	In Service
AC1-176	Timber Switch 138kV	Withdrawn
AC1-214	Crescent Ridge	Engineering and Procurement
AC2-080	Olive-Reynolds 345kV	Active
AC2-140	DC Cook Unit 2	Engineering and Procurement
AC2-176	Jay 138 kV	Under Construction
AC2-177	Desoto-Tanners Creek 345kV	Active
AD1-067	Mendota Hills	Active
AD1-100	Loretto-Wilton & Braidwood-Davis Creek	Active
AD1-148	Brokaw-Lanesville	Active
AD2-038	Powerton	Active
AD2-047	Davis Creek 138 kV	Active
AD2-091	Hardin Tap 345kV	Active
AD2-096	Marysville 345kV	Active
AD2-131	Latham Kincaid	Active
AD2-134	Shady Oaks	Active
AD2-138	Olive-Reynolds 345kV	Active
AD2-159	Chestnut 345kV	Active
AE1-113	Mole Creek 345 kV	Active
AE1-114	Maryland-Lancaster 138 kV	Active
AE1-163	Powerton-Nevada 345 kV	Active
AE1-172	Loretto-Wilton Center	Active
AE1-193	Crete 345 kV	Active
AE1-194	Crete 345 kV	Active
AE1-195	Crete 345 kV	Active
AE1-198	Crete 345 kV	Active
AE1-209	Desoto 345 kV	Active
AE1-210	Desoto 345 kV	Active
AE1-252	Loretto-Wilton Center	Active

Queue Number	Project Name	Status
AE2-062	Normantown	Active
AE2-153	Braidwood-Davis Creek	Active
AE2-154	Meadow Lake 345 kV (MLV VIII)	Active
AE2-169	Delaware-Van Buren 138 kV	Active
AE2-171	Makahoy 138 kV	Active
AE2-172	Mississinewa-Gaston 138 kV	Active
AE2-173	McLean 345 kV	Active
AE2-216	Hardin Switch 345 kV	Active
AE2-223	McLean 345 kV	Active
AE2-255	Molecreek 345 kV	Active
AE2-281	Powerton-Nevada 345 kV	Active
AE2-325	Valley 138 kV	Active
AF1-009	Dixon-McGirr	Active
AF1-011	Schauff Road	Active
AF1-046	Twin Branch-Guardian 138 kV	Active
AF1-047	Mark Center 69 kV	Active
AF1-048	Belvidere-Marengo	Active
AF1-060	Lena 138 kV	Active
AF1-080	Deer Creek-Fisher Body-Mullin 138 kV	Active
AF1-090	Kincaid-Pana	Active
AF1-091	Butler-S Hicksville 138 kV	Active
AF1-092	Huntington Jct. 138 kV	Active
AF1-118	Sorenson-Desoto 345 kV	Active
AF1-119	Keystone-Desoto 345 kV	Active
AF1-148	Sorenson-Desoto 345 kV	Active
AF1-158	Edison-Gravel Pit 138 kV	Active
AF1-161	Valley 138 kV	Active
AF1-176	Corey 138 kV	Active
AF1-200	Plano 345 kV	Active
AF1-202	Keystone-Desoto 345 kV	Active
AF1-204	Eugene 345 kV	Active
AF1-207	Reynolds–Olive #1 345 kV	Active
AF1-227	Marysville-East Lima 345 kV	Active
AF1-252	Kincaid-Pana	Active
AF1-253	Kincaid-Pana	Active
AF1-281	Nelson-Lee County	Active
AF1-285	Gunn Road 345 kV	Active
AF1-296	Garden Plain 138 kV	Active
AF1-314	Lena 138 kV	Active
AF1-317	Electric Jct-Nelson	Active
AF1-318	Crescent Ridge-Corbin	Active
V3-007	Desoto-Tanners Creek #1 345kV	Under Construction
W4-005	Blue Mound-Latham	Partially in Service - Under Construction
Z2-087	Pontiac MidPoint-Brokaw 345kV	In Service

12.9 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#7441	CONTINGENCY 'AEP_P1-2_#7441' OPEN BRANCH FROM BUS 242928 TO BUS 246999 CKT 1 / 242928 05MARYSV 765 246999 05SORENS 765 1 END

13 Short Circuit Analysis

The following Breakers are overdutied

Bus Name	Breaker	Voltage	Interrupting Capability	Duty Percentage Pre Queue	Duty Percentage Post Queue

13.1 System Reinforcements - Short Circuit

14 Stability and Reactive Power

To be determined in the Facilities Study Phase.

15 Affected Systems

15.1 TVA

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

15.2 Duke Energy Progress

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

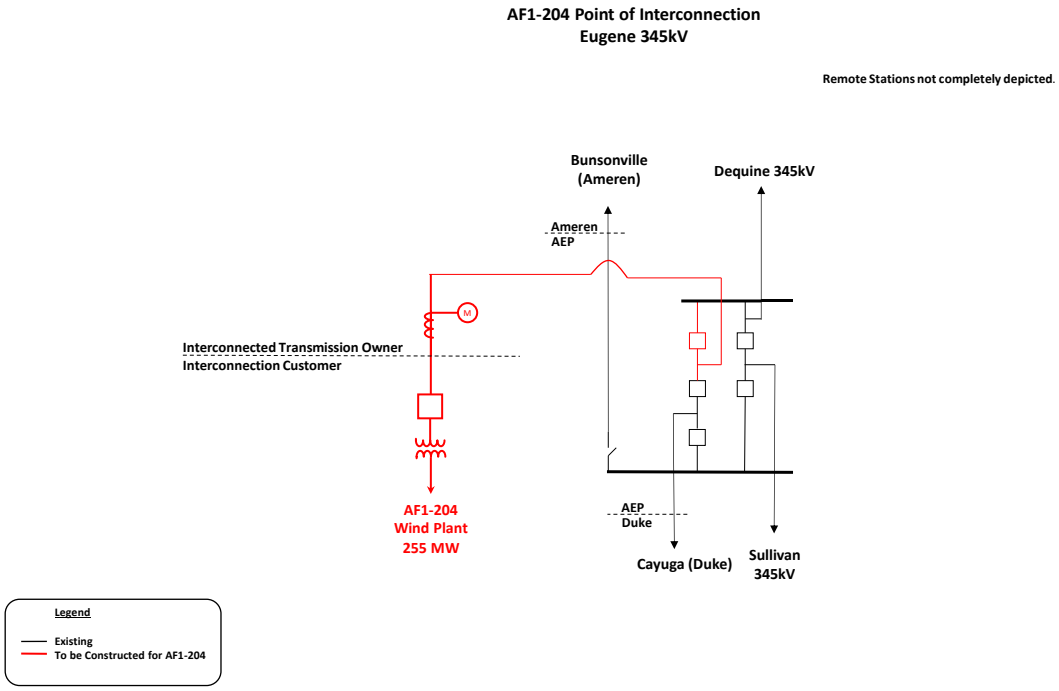
15.3 MISO

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

15.4 LG&E

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

16 Attachment 1: One-Line Diagram



17 Attachment 2: Site Location