Generation Interconnection

System Impact Study Report

for

Queue Project AF2-133

REYNOLDS-OLIVE #2 345 KV

180 MW Capacity / 300 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, Indiana. The installed facilities will have a total capability of 300 MW with 180 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this project is May 31, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-133
Project Name	REYNOLDS-OLIVE #2 345 KV
State	Indiana
County	Pulaski
Transmission Owner	AEP
MFO	300
MWE	300
MWC	180
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

AF2-133 will interconnect with the AEP transmission system via a new switching station cut into the Olive (AEP) – Reynolds (NIPSCO) 345kVcircuit #2

To accommodate the interconnection on the Olive (AEP) – Reynolds (NIPSCO) 345 kV circuit #2, a new three (3) circuit breaker 345 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 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.

AEP will extend one span of 345 kV transmission line for the generation-leads going to the AF2-133 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 345 kV station fence to which the AEP and AF2-133 transmission line conductors will attach.

5 Cost Summary

The AF2-133 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$19,777,000**
Allocation towards System Network Upgrade Costs*	$8,061,200
Total Costs	**$27,838,200****

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

**Additional Physical Interconnection Costs (Non-Direct) to be determined by NIPSCO.

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
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
A new three (3) circuit breaker 345 kV switching station physically configured and operated as a ring-bus will be constructed (see Attachment 1). Installation of associated protection and control equipment, 345 kV line risers, and SCADA will also be required.	$17,440,000
Total Direct Connection Facility Costs	**$17,440,000**

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
Olive (AEP) – Reynolds (NIPSCO) circuit #2 345kV T-Line Cut In	$1,210,000
Review Protection and Control Settings at the Olive (AEP) 345 kV station	$45,000
Review Protection and Control Settings at the Reynolds (NIPSCO) 345 kV station	TBD by NIPSCO**
Total Non-Direct Connection Facility Costs	**$1,255,000**

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 AF2-133 was evaluated as a 300.0 MW (Capacity 180.0 MW) injection into a tap of the Reynolds to Olive 345kV line, ckt. 2 (specifically the AF1-205 Tap to AF1-215 Tap line segment) in the AEP area. Project AF2-133 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-133 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)

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
95284997	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P4_#6189_05HANG R 765_D1	breaker	2354.0	100.51	101.15	AC	39.32
98712585	264612	19MON 12	345.0	ITCT	241901	02LALLENDORF	345.0	ATSI	1	ATSI-P7-1-TE-138-025T-A	tower	1702.0	112.28	112.29	AC	19.35

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
95285411	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P1-2_#709	operation	2354.0	98.87	99.5	AC	39.4

10.6 System Reinforcements

<table>
<tr><th>ID</th><th>Idx</th><th>Facility</th><th>Upgrade Description</th><th>Cost</th><th>Cost Allocated to AF2-133</th><th>Upgrade Number</th></tr>
<tr><td>98712585</td><td>2</td><td>19MON12 345.0 kV - 02LALLENDORF 345.0 kV Ckt 1</td><td>MISO end SE rating is 1975 MVA once MTEP upgrades #13814 and #15878 are completed by January 2022. This rating is sufficient.

ATSI end SE rating is 1824 MVA.

ATSI upgrade:
Reconductor the existing 6.5 miles of Lallendorf-Monroe 345kV line with bundled (2) 795 26/7 ACSS. Replace substation conductor, Line Drop, Wave Traps, Bitronics Meter for the Monroe 345kV exit at Lallendorf substation to increase the Summer Emergency rating to at least 2578 MVA for ATSI. Cost estimate is $26.095 M. PJM Network Upgrade N6292.

The cost allocation is:

<table>
<tr><th>Queue</th><th>MW contribution</th><th>Summer/ Light Load</th><th>Percentage of Cost</th><th>$ cost ($26.095 M)</th></tr>
<tr><td>AF2-096</td><td>23.7</td><td>Summer</td><td>37.74%</td><td>9.8480</td></tr>
<tr><td>AF2-132</td><td>19.7</td><td>Summer</td><td>31.37%</td><td>8.1859</td></tr>
<tr><td>AF2-133</td><td>19.4</td><td>Summer</td><td>30.89%</td><td>8.0612</td></tr>
</table>

Note: the tower contingency should be re-confirmed in the Facilities Study by ATSI and ITC.</td><td>$26.095 M</td><td>$8.0612 M</td><td>MTEP # 13814

MTEP # 15878

N6292</td></tr>
</table>

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-133	Upgrade Number
95284997	1	**05JEFRSO 345.0 kV - 06CLIFTY 345.0 kV Ckt Z1**	(N4106.1) Replace 4 Clifty switches. $2M. 12-18 months. (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. Past/preliminary sag study results (from Z1-070 Facilities Study): 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. 6-12 months. New SE rating on line expected to be 2826 MVA. If rebuild needed (N4106.4), rebuild the 0.75 mile ACSR ~ 2156 ~ 84/19 ~ BLUEBIRD @ 284 F - Conductor section 1. $1.96M. New conductor SE rating to be 3212 MVA SE. New SE rating on line expected to be 2826 MVA. These upgrades are driven by prior queue cycles. The overload on the line seen in prior queue cycles is for a different contingency than the contingency listed in this AF2-205 report.	$2 M $244 K $1.96 M	$0	N4106.1 N4106.3 N4106.4
			Total Cost	**$30,299,000**	**$8,061,200**	

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

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
95284997	242865	05JEFRSO	AEP	248000	06CLIFTY	OVEC	Z1	AEP_P4_#6189_05HANG R 765_D1	breaker	2354.0	100.51	101.15	AC	39.32

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243441	05CKG2	21.1833	50/50	21.1833
243442	05RKG1	70.1345	50/50	70.1345
243443	05RKG2	69.0719	50/50	69.0719
243859	05FR-11G C	0.4456	50/50	0.4456
243862	05FR-12G C	0.4388	50/50	0.4388
243864	05FR-21G C	0.4684	50/50	0.4684
243866	05FR-22G C	0.4479	50/50	0.4479
243870	05FR-3G C	0.9072	50/50	0.9072
243873	05FR-4G C	0.7025	50/50	0.7025
244130	05ST.JOE CTR	12.2353	50/50	12.2353
246909	05MDL-1G C	0.9332	50/50	0.9332
246910	05MDL-2G C	0.4619	50/50	0.4619
246976	05MDL-3G C	0.4712	50/50	0.4712
246979	05MDL-4G C	0.4596	50/50	0.4596
247556	T-127 C	0.4666	50/50	0.4666
247900	05FR-11G E	10.5940	50/50	10.5940
247901	05FR-12G E	10.4181	50/50	10.4181
247902	05FR-21G E	11.1352	50/50	11.1352
247903	05FR-22G E	10.6616	50/50	10.6616
247904	05FR-3G E	21.5939	50/50	21.5939
247905	05FR-4G E	16.9125	50/50	16.9125
247906	05MDL-1G E	22.1712	50/50	22.1712
247907	05MDL-2G E	11.1064	50/50	11.1064
247912	05MDL-3G E	11.1064	50/50	11.1064
247913	05MDL-4G E	11.1064	50/50	11.1064
247943	T-127 E	11.1064	50/50	11.1064
250163	Y3-099 BAT	0.2450	50/50	0.2450
250167	Y3-100 BAT	0.2450	50/50	0.2450
251823	Z1-065 BAT	0.6500	50/50	0.6500
274775	LINCOLN ;6U	1.3503	50/50	1.3503
274776	LINCOLN ;7U	1.3503	50/50	1.3503
274777	LINCOLN ;8U	1.3503	50/50	1.3503
913222	Y1-054 E	-1.9596	Adder	-2.31
922912	AB1-080	0.7251	50/50	0.7251
930041	AB1-006 C	0.6066	50/50	0.6066
930042	AB1-006 E	24.1564	50/50	24.1564
930461	AB1-087	94.3305	50/50	94.3305
930471	AB1-088	94.3305	50/50	94.3305
932601	AC2-080 C O1	3.5017	50/50	3.5017
932602	AC2-080 E O1	23.4343	50/50	23.4343
933281	AC2-140 C	4.1728	50/50	4.1728
933282	AC2-140 E	0.2196	50/50	0.2196

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
933441	AC2-157 C	13.0348	50/50	13.0348
933442	AC2-157 E	21.2672	50/50	21.2672
937041	AD2-138 C	4.7407	50/50	4.7407
937042	AD2-138 E	22.1953	50/50	22.1953
939641	AE1-194 C	2.8023	Adder	3.3
939642	AE1-194 E	18.7537	Adder	22.06
939651	AE1-195 C	5.7477	Adder	6.76
939652	AE1-195 E	38.4651	Adder	45.25
939681	AE1-198 C	17.0661	Adder	20.08
939682	AE1-198 E	14.5018	Adder	17.06
940581	AE2-045 C O1	11.3508	50/50	11.3508
940582	AE2-045 E O1	15.5852	50/50	15.5852
941341	AE2-130 C	151.7712	50/50	151.7712
941342	AE2-130 E	101.1808	50/50	101.1808
941571	AE2-154 C	4.5120	50/50	4.5120
941572	AE2-154 E	30.1955	50/50	30.1955
942601	AE2-276	8.5755	50/50	8.5755
944201	AF1-088 FTIR	171.5100	50/50	171.5100
945391	AF1-204 C O1	6.7651	50/50	6.7651
945392	AF1-204 E O1	20.2954	50/50	20.2954
945421	AF1-207 C	4.7658	50/50	4.7658
945422	AF1-207 E	20.4648	50/50	20.4648
945501	AF1-215 C O1	22.4298	50/50	22.4298
945502	AF1-215 E O1	14.9532	50/50	14.9532
946581	AF1-322 C	11.6617	50/50	11.6617
946582	AF1-322 E	16.1043	50/50	16.1043
957141	AF2-008 FTIR	85.7550	50/50	85.7550
957142	AF2-008 NFTI	85.7550	50/50	85.7550
957393	AF2-033 BAT	2.1964	50/50	2.1964
957841	AF2-078 C O1	16.8204	50/50	16.8204
957842	AF2-078 E O1	11.2136	50/50	11.2136
958381	AF2-132 C O1	23.1984	50/50	23.1984
958382	AF2-132 E O1	15.4656	50/50	15.4656
958391	AF2-133 C O1	23.5944	50/50	23.5944
958392	AF2-133 E O1	15.7296	50/50	15.7296
958401	AF2-134 C O1	7.4766	50/50	7.4766
958402	AF2-134 E O1	4.9844	50/50	4.9844
958971	AF2-188 C O1	9.4315	50/50	9.4315
958972	AF2-188 E O1	6.2877	50/50	6.2877
958981	AF2-189 C O1	13.6656	50/50	13.6656
958982	AF2-189 E O1	9.1104	50/50	9.1104
959141	AF2-205 C	15.9216	50/50	15.9216
959142	AF2-205 E	10.6144	50/50	10.6144
960681	AF2-359 C	8.0625	50/50	8.0625
960682	AF2-359 E	5.3750	50/50	5.3750
BLUEG	BLUEG	29.5294	Confirmed LTF	29.5294
CBM-W2	CBM-W2	26.3636	Confirmed LTF	26.3636
NY	NY	1.0795	Confirmed LTF	1.0795
WEC	WEC	3.0416	Confirmed LTF	3.0416
O-066	O-066	12.0355	Confirmed LTF	12.0355
CHEOAH	CHEOAH	0.9605	Confirmed LTF	0.9605
G-007	G-007	1.8658	Confirmed LTF	1.8658

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
MADISON	MADISON	36.3807	Confirmed LTF	36.3807
MEC	MEC	12.2544	Confirmed LTF	12.2544
CALDERWOOD	CALDERWOOD	0.9567	Confirmed LTF	0.9567
TRIMBLE	TRIMBLE	10.3025	Confirmed LTF	10.3025
LGE-GI-0012019	LGE-GI-0012019	20.3643	LTF	20.3643
CATAWBA	CATAWBA	0.6885	Confirmed LTF	0.6885
CBM-W1	CBM-W1	85.9812	Confirmed LTF	85.9812

10.7.2 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
98712585	264612	19MON12	ITCT	241901	02LALLENDORF	ATSI	1	ATSI-P7-1-TE-138-025T-A	tower	1702.0	112.28	112.29	AC	19.35

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	-0.1886	Adder	-0.22
244412	05WTRV SLR C	0.0400	50/50	0.0400
247528	05COVRT1	5.0703	50/50	5.0703
247529	05COVRT2	5.0703	50/50	5.0703
247530	05COVRT3	5.0703	50/50	5.0703
247531	05COVRT4	3.0431	50/50	3.0431
247532	05COVRT5	3.0431	50/50	3.0431
247533	05COVRT6	3.0431	50/50	3.0431
247604	X1-042	0.0537	50/50	0.0537
247966	05WTRV SLR E	0.2383	50/50	0.2383
247967	05OLIV SLR E	0.1700	Adder	0.2
247969	Z2-116 E	0.0911	Adder	0.11
274788	**SE CHICAG;5U (Deactivation : 01/06/2020)**	**2.1081**	**Adder**	**2.48**
274789	**SE CHICAG;6U (Deactivation : 01/06/2020)**	**2.1137**	**Adder**	**2.49**
274790	**SE CHICAG;7U (Deactivation : 01/06/2020)**	**2.1415**	**Adder**	**2.52**
274791	**SE CHICAG;8U (Deactivation : 01/06/2020)**	**2.1415**	**Adder**	**2.52**
274792	**SE CHICAG;9U (Deactivation : 01/06/2020)**	**2.1458**	**Adder**	**2.52**
274793	**SE CHICAG;0U (Deactivation : 01/06/2020)**	**2.1458**	**Adder**	**2.52**
274794	**SE CHICAG;1U (Deactivation : 01/06/2020)**	**2.1458**	**Adder**	**2.52**
274795	**SE CHICAG;2U (Deactivation : 01/06/2020)**	**2.1458**	**Adder**	**2.52**
274881	PILOT HIL;1E	7.5410	Adder	8.87
275149	KELLYCK ;1E	7.5410	Adder	8.87
276169	Z1-107 E	1.0639	Adder	1.25
910542	X3-005 E	0.3072	Adder	0.36
925961	AC1-072	0.4703	50/50	0.4703
927451	AC1-142A 1	1.7038	Adder	2.0

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
927461	AC1-142A 2	1.7038	Adder	2.0
930501	AB1-091 O1	29.6442	Adder	34.88
931951	**AB1-107 1 (Suspended)**	**-33.9403**	**Adder**	**-39.93**
931961	**AB1-107 2 (Suspended)**	**-110.4147**	**Adder**	**-129.9**
932601	AC2-080 C O1	1.3835	Adder	1.63
932602	AC2-080 E O1	9.2585	Adder	10.89
932791	AC2-103 C	-3.7441	Adder	-4.4
932931	AC2-117	2.5446	Adder	2.99
933281	AC2-140 C	2.3731	Adder	2.79
933282	AC2-140 E	0.1249	Adder	0.15
933411	AC2-154 C	1.0234	Adder	1.2
933412	AC2-154 E	1.6698	Adder	1.96
934252	AD1-052 E1	-0.5412	Adder	-0.64
934262	AD1-052 E2	-0.5412	Adder	-0.64
936141	AD2-020 C O1	4.9990	Adder	5.88
936142	AD2-020 E O1	3.0769	Adder	3.62
936371	AD2-047 C O1	1.8314	Adder	2.15
936372	AD2-047 E O1	8.9415	Adder	10.52
936461	AD2-060	1.0773	Adder	1.27
936601	AD2-075	20.2928	50/50	20.2928
936631	AD2-079 C O1	0.8396	Adder	0.99
936632	AD2-079 E O1	0.5597	Adder	0.66
937041	AD2-138 C	1.8730	Adder	2.2
937042	AD2-138 E	8.7690	Adder	10.32
938261	AE1-039	0.0851	50/50	0.0851
939351	AE1-166 C O1	4.1570	Adder	4.89
939352	AE1-166 E O1	3.8372	Adder	4.51
939391	AE1-170 C O1	4.8447	Adder	5.7
939392	AE1-170 E O1	6.6903	Adder	7.87
939631	AE1-193 C	3.6564	Adder	4.3
939632	AE1-193 E	24.4701	Adder	28.79
939641	AE1-194 C	3.6564	Adder	4.3
939642	AE1-194 E	24.4701	Adder	28.79
939651	AE1-195 C	3.6564	Adder	4.3
939652	AE1-195 E	24.4701	Adder	28.79
939681	AE1-198 C	10.8568	Adder	12.77
939682	AE1-198 E	9.2255	Adder	10.85
940581	AE2-045 C O1	4.4845	Adder	5.28
940582	AE2-045 E O1	6.1575	Adder	7.24
940752	AE2-062 E	0.0532	Adder	0.06
941551	AE2-152 C O1	4.7966	Adder	5.64
941552	AE2-152 E O1	3.1977	Adder	3.76
941561	AE2-153 C O1	1.8900	Adder	2.22
941562	AE2-153 E O1	8.8489	Adder	10.41
943001	AE2-323 C	3.8875	Adder	4.57
943002	AE2-323 E	1.9061	Adder	2.24
943021	AE2-325 C	2.5318	Adder	2.98
943022	AE2-325 E	1.6838	Adder	1.98
943781	AF1-046 C	1.8146	Adder	2.13
943782	AF1-046 E	1.2097	Adder	1.42
944161	AF1-084 C	4.5217	Adder	5.32
944162	AF1-084 E	2.5826	Adder	3.04

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944911	AF1-156 C	4.8325	Adder	5.69
944912	AF1-156 E	3.2217	Adder	3.79
944931	AF1-158 C O1	6.1590	Adder	7.25
944932	AF1-158 E O1	4.1060	Adder	4.83
944961	AF1-161 C	2.0190	Adder	2.38
944962	AF1-161 E	2.0190	Adder	2.38
945111	AF1-176 C O1	11.7203	Adder	13.79
945112	AF1-176 E O1	10.8651	Adder	12.78
945501	AF1-215 C O1	10.3856	Adder	12.22
945502	AF1-215 E O1	6.9238	Adder	8.15
950351	J466	7.2780	PJM External (MISO)	7.2780
950791	J201 C	0.8594	PJM External (MISO)	0.8594
950792	J201 E	3.4378	PJM External (MISO)	3.4378
950942	J325 E	1.0038	PJM External (MISO)	1.0038
952312	J646 E	0.4413	PJM External (MISO)	0.4413
952401	J752 C	3.6970	PJM External (MISO)	3.6970
952402	J752 E	20.0020	PJM External (MISO)	20.0020
952971	J793	362.9287	PJM External (MISO)	362.9287
953271	J701 C	1.7987	PJM External (MISO)	1.7987
953272	J701 E	9.7315	PJM External (MISO)	9.7315
953291	J796	47.7116	PJM External (MISO)	47.7116
953321	J799	53.3377	PJM External (MISO)	53.3377
953781	J833	27.3810	PJM External (MISO)	27.3810
955781	J1062	37.7295	PJM External (MISO)	37.7295
956011	J1088	4.4873	PJM External (MISO)	4.4873
956021	J1089	33.5971	PJM External (MISO)	33.5971
956741	J1172	10.9020	PJM External (MISO)	10.9020
957371	AF2-031 C O1	0.4444	Adder	0.52
957372	AF2-031 E O1	0.6666	Adder	0.78
957891	AF2-083 C O1	7.5539	Adder	8.89
957892	AF2-083 E O1	3.7770	Adder	4.44
958011	AF2-095 C O1	7.3256	Adder	8.62
958012	AF2-095 E O1	3.4473	Adder	4.06
958021	AF2-096 C	13.6878	Adder	16.1
958022	AF2-096 E	6.4413	Adder	7.58
958381	AF2-132 C O1	10.0429	Adder	11.82
958382	AF2-132 E O1	6.6953	Adder	7.88
958391	AF2-133 C O1	9.8670	Adder	11.61
958392	AF2-133 E O1	6.5780	Adder	7.74
958401	AF2-134 C O1	3.4619	Adder	4.07
958402	AF2-134 E O1	2.3079	Adder	2.72
959001	AF2-191 C O1	4.4925	Adder	5.29
959002	AF2-191 E O1	2.9950	Adder	3.52
959141	AF2-205 C	6.4923	Adder	7.64
959142	AF2-205 E	4.3282	Adder	5.09
960591	AF2-350 C O1	3.2319	Adder	3.8
960592	AF2-350 E O1	2.1546	Adder	2.53
960601	AF2-351 C O1	0.4309	Adder	0.51
960602	AF2-351 E O1	0.6464	Adder	0.76
960681	AF2-359 C	4.8106	Adder	5.66
960682	AF2-359 E	3.2071	Adder	3.77
960981	AF2-389 C	2.2662	Adder	2.67

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
960982	AF2-389 E	1.5108	Adder	1.78
961051	AF2-396 O1	15.7352	Adder	18.51
961501	AF2-441 C O1	4.4044	Adder	5.18
961502	AF2-441 E O1	6.6065	Adder	7.77
LGEE	LGEE	1.4804	Confirmed LTF	1.4804
CPLE	CPLE	0.3129	Confirmed LTF	0.3129
CBM-W2	CBM-W2	27.7641	Confirmed LTF	27.7641
NY	NY	1.0136	Confirmed LTF	1.0136
TVA	TVA	3.2774	Confirmed LTF	3.2774
WEC	WEC	1.8736	Confirmed LTF	1.8736
O-066	O-066	10.8797	Confirmed LTF	10.8797
CBM-S2	CBM-S2	4.7916	Confirmed LTF	4.7916
CBM-S1	CBM-S1	20.3458	Confirmed LTF	20.3458
G-007	G-007	1.6713	Confirmed LTF	1.6713
MADISON	MADISON	6.6044	Confirmed LTF	6.6044
MEC	MEC	7.8957	Confirmed LTF	7.8957
CBM-W1	CBM-W1	183.8845	Confirmed LTF	183.8845

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
AB1-006	Meadow Lake 345kV	In Service
AB1-080	Dumont-Olive 345kV	In Service
AB1-087	Sullivan 345kV #1	Active
AB1-088	Sullivan 345kV #2	Active
AB1-091	Davis Creek 345kV	Active
AB1-107	Bayshore-GM Powertrain 138 kV & Lallendorf 345kV	Suspended
AC1-072	Segreto (Covert) 345kV	In Service
AC1-142A	Joliet	Active
AC2-080	Olive-Reynolds 345kV	Active
AC2-103	Beaver-Davis Besse 345 kV I	Engineering and Procurement
AC2-117	University Park North	Engineering and Procurement
AC2-140	DC Cook Unit 2	In Service
AC2-154	Davis Creek 138kV	Active
AC2-157	Sullivan 345 kV	Active
AD1-052	Freemont Energy Center	Under Construction
AD2-020	Valley 138 kV	Active
AD2-047	Davis Creek 138 kV	Active
AD2-060	Davis Creek 138kV	Active
AD2-075	Segreto 345kV	Active
AD2-079	Capitol Ave 34.5kV	Active
AD2-138	Olive-Reynolds 345kV	Active
AE1-039	West Street (Orchard Hills) 12.47 kV	In Service
AE1-166	Loretto-Wilton & Braidwood-Davis Creek	Active
AE1-170	Kenzie Creek-Colby 138 kV	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
AE2-045	Olive-Reynolds 345 kV	Active
AE2-062	Romeoville 12 kV	Active
AE2-130	Rockport 765 kV	Active
AE2-152	Loretto-Wilton & Braidwood-Davis Creek	Active
AE2-153	Braidwood-Davis Creek	Active
AE2-154	Meadow Lake 345 kV (MLV VIII)	Active
AE2-276	Sullivan 345kV	Active
AE2-323	Twin Branch-Guardian 138 kV	Active
AE2-325	Valley 138 kV	Active
AF1-046	Twin Branch-Guardian 138 kV	Active

Queue Number	Project Name	Status
AF1-084	East Hartford-Murch 69 kV	Active
AF1-088	Sullivan 345 kV	Active
AF1-156	Braidwood-Davis Creek	Active
AF1-158	Edison-Gravel Pit 138 kV	Active
AF1-161	Valley 138 kV	Active
AF1-176	Corey 138 kV	Active
AF1-204	Eugene 345 kV	Active
AF1-207	Reynolds–Olive #1 345 kV	Active
AF1-215	Reynolds-Olive 345 kV	Active
AF1-322	Meadow Lake 345 kV	Active
AF2-008	Sullivan 345 kV	Active
AF2-031	River E.C.	Active
AF2-033	Miami Fort GT 138 kV	Active
AF2-078	Reynolds-Olive #1 345 kV	Active
AF2-083	Ed Lowe-Kenzie Creek 138 kV	Active
AF2-095	Wilmington-Davis Creek	Active
AF2-096	Braidwood-East Frankfort 345 kV	Active
AF2-132	Reynolds-Olive #1 345 kV	Active
AF2-133	Reynolds-Olive #2 345 kV	Active
AF2-134	Reynolds-Olive #2 345 kV	Active
AF2-188	Reynolds-Meadow Lake #1 345 kV	Active
AF2-189	Greentown 138 kV	Active
AF2-191	New Carlisle 138 kV	Active
AF2-205	Olive-Reynolds #2 345 kV	Active
AF2-350	Kensington 138 kV	Active
AF2-351	Kensington 138 kV	Active
AF2-359	Olive-University Park 345 kV	Active
AF2-389	Pokagon-Corey 69 kV	Active
AF2-396	Stinger 138 kV	Active
AF2-441	Burnham 138kV	Active
X1-042	Watervliet	In Service
X3-005	Wildwood 12kV	In Service
Y1-054	Rochelle 138kV	In Service
Y3-099	Beckjord 2 MW-1	In Service
Y3-100	Beckjord 2 MW-2	In Service
Z1-065	Wiley 34.5kV	In Service
Z1-107	Joliet 34kV	In Service
Z2-116	Twin Branch 12.47kV	In Service
J1062	MISO	MISO
J1088	MISO	MISO
J1089	MISO	MISO
J1172	MISO	MISO
J201	MISO	MISO
J325	MISO	MISO
J466	MISO	MISO
J646	MISO	MISO
J701	MISO	MISO
J752	MISO	MISO
J793	MISO	MISO
J796	MISO	MISO
J799	MISO	MISO
J833	MISO	MISO

10.9 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P7-1-TE-138-025T-A	CONTINGENCY 'ATSI-P7-1-TE-138-025T-A' /* ALLEN-MAJ-MONROE & LEMO-MAJESTIC 345KV DISCONNECT BRANCH FROM BUS 264594 TO BUS 256583 CKT 1 /* 19LULU 345 18LENAWEE 345 DISCONNECT BRANCH FROM BUS 264594 TO BUS 264839 CKT 1 /* 19LULU 345 19MILAN 345 DISCONNECT BRANCH FROM BUS 264594 TO BUS 955720 CKT 1 /* 19LULU 345 J1056 TAP 345 DISCONNECT BRANCH FROM BUS 238889 TO BUS 955620 CKT 1 /* 02LEMOYN 345 19MAJTC 345 END
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

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