Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-133

REYNOLDS-OLIVE #2 345 KV

180 MW Capacity / 300 MW Energy

July 2020

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1 Introduction

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

2 Preface

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

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

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.

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 along one of the following points of interconnection:

Primary POI: Olive – Reynolds (NIPSCO) 345 kV circuit #2.

To accommodate the interconnection on the Olive – Reynolds (NIPSCO) 345 kV circuit #2, a new three (3) circuit breaker 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Attachment 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.

Secondary POI: Olive – Reynolds (NIPSCO) 345 kV circuit #1.

To accommodate the interconnection on the Olive – Reynolds (NIPSCO) 345 kV circuit #2, a new three (3) circuit breaker 345 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Attachment 2). 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.

5 Cost Summary

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

Description	Total Cost
Total Physical Interconnection Costs	$19,777,000
Total System Network Upgrade Costs	$ 2,020,000
Total Costs	**$21,797,000**

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 onsite 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.

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

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the tables 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	**$1,081,000**

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 in a breaker and half bus arrangement but 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 – Reynolds T-Line Cut in	$1,210,000
Protection and Control settings review at Olive 345 kV substation	$45,000
Total Non-Direct Connection Facility Costs	**$1,255,000**

7 Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

8 Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after signing Agreement execution.

9 Interconnection Customer Requirements

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

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

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

10.2 Meteorological Data Reporting Requirements

Solar generation facilities shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter^2)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)
- Wind speed (meters/second) – (Accepted, not required)
- Wind direction (decimal degrees from true north) – (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

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

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

11 Summer Peak - Load Flow Analysis – Primary POI

The Queue Project AF2-133 was evaluated as a 300.0 MW (Capacity 180.0 MW) injection tapping the Reynolds to Olive 345kV line, ckt. 2 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 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

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
95284997	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P4_#6189_05HANG R 765_D1	breaker	2354.0	106.55	107.37	DC	39.03

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
95285411	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P1-2_#709	operation	2354.0	105.12	105.93	DC	39.1

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
95284997	1	05JEFRSO 345.0 kV - 06CLIFTY 345.0 kV Ckt Z1	**AEP** **AEPI0045a (1681) : Replace 4 Clifty Switches** **Project Type : FAC** **Cost : $2,000,000** **Time Estimate : 12-18 Months** **AEPI0045b (1682) : A Sag Study will be required on the 0.75 mile section of ACSR ~ 2156 ~ 64/19 ~ BLUEBIRD line to mitigate the overload . New Rating after the Sag Study: S/N: 2354 MVA S/E: 3212 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $20,000 (No remediations required just sag study) and 1.96 million (complete line reconductor/rebuild required). Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement.** **Project Type : FAC** **Cost : $20,000** **Time Estimate : 6-12 Months**	$2,020,000
			TOTAL COST	**$2,020,000**

11.6 Flow Gate Details - Primary POI

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

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95284997	242865	05JEFRSO	AEP	248000	06CLIFTY	OVEC	Z1	AEP_P4_#6189_05HANG R 765_D1	breaker	2354.0	106.55	107.37	DC	39.03

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243441	05CKG2	21.5468	50/50	21.5468
243442	05RKG1	71.7661	50/50	71.7661
243443	05RKG2	70.6787	50/50	70.6787
243859	05FR-11G C	0.4541	50/50	0.4541
243862	05FR-12G C	0.4471	50/50	0.4471
243864	05FR-21G C	0.4772	50/50	0.4772
243866	05FR-22G C	0.4564	50/50	0.4564
243870	05FR-3G C	0.9243	50/50	0.9243
243873	05FR-4G C	0.7158	50/50	0.7158
244130	05ST.JOE CTR	12.4444	50/50	12.4444
246909	05MDL-1G C	0.9511	50/50	0.9511
246910	05MDL-2G C	0.4708	50/50	0.4708
246976	05MDL-3G C	0.4803	50/50	0.4803
246979	05MDL-4G C	0.4684	50/50	0.4684
247556	T-127 C	0.4755	50/50	0.4755
247900	05FR-11G E	10.5157	50/50	10.5157
247901	05FR-12G E	10.3411	50/50	10.3411
247902	05FR-21G E	11.0529	50/50	11.0529
247903	05FR-22G E	10.5828	50/50	10.5828
247904	05FR-3G E	21.4343	50/50	21.4343
247905	05FR-4G E	16.7875	50/50	16.7875
247906	05MDL-1G E	22.0130	50/50	22.0130
247907	05MDL-2G E	11.0272	50/50	11.0272
247912	05MDL-3G E	11.0272	50/50	11.0272
247913	05MDL-4G E	11.0272	50/50	11.0272
247943	T-127 E	11.0272	50/50	11.0272
250163	Y3-099 BAT	0.2470	50/50	0.2470
250167	Y3-100 BAT	0.2470	50/50	0.2470
251823	Z1-065 BAT	0.6559	50/50	0.6559
274775	LINCOLN ;6U	1.3730	50/50	1.3730
274776	LINCOLN ;7U	1.3730	50/50	1.3730
274777	LINCOLN ;8U	1.3730	50/50	1.3730
922912	AB1-080	0.7374	50/50	0.7374
930041	AB1-006 C	0.6182	50/50	0.6182
930042	AB1-006 E	23.9842	50/50	23.9842
930461	AB1-087	93.7805	50/50	93.7805
930471	AB1-088	93.7805	50/50	93.7805
932601	AC2-080 C O1	3.4757	50/50	3.4757
932602	AC2-080 E O1	23.2603	50/50	23.2603
933281	AC2-140 C	4.1348	50/50	4.1348
933282	AC2-140 E	0.2176	50/50	0.2176
933441	AC2-157 C	12.9588	50/50	12.9588

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
933442	AC2-157 E	21.1432	50/50	21.1432
937041	AD2-138 C	4.7055	50/50	4.7055
937042	AD2-138 E	22.0305	50/50	22.0305
940581	AE2-045 C O1	15.7742	50/50	15.7742
940582	AE2-045 E O1	21.6562	50/50	21.6562
941341	AE2-130 C	151.2912	50/50	151.2912
941342	AE2-130 E	100.8608	50/50	100.8608
941571	AE2-154 C	4.4798	50/50	4.4798
941572	AE2-154 E	29.9802	50/50	29.9802
942601	AE2-276	8.5255	50/50	8.5255
944201	AF1-088 FTIR	170.5100	50/50	170.5100
945391	AF1-204 C O1	6.7014	50/50	6.7014
945392	AF1-204 E O1	20.1042	50/50	20.1042
945421	AF1-207 C	4.7318	50/50	4.7318
945422	AF1-207 E	20.3188	50/50	20.3188
945501	AF1-215 C O1	22.2516	50/50	22.2516
945502	AF1-215 E O1	14.8344	50/50	14.8344
946581	AF1-322 C	11.5786	50/50	11.5786
946582	AF1-322 E	15.9894	50/50	15.9894
957141	AF2-008 FTIR	85.2550	50/50	85.2550
957142	AF2-008 NFTI	170.5100	50/50	170.5100
957403	AF2-034 BAT	2.2148	50/50	2.2148
957841	AF2-078 C O1	16.7004	50/50	16.7004
957842	AF2-078 E O1	11.1336	50/50	11.1336
958381	AF2-132 C	23.0184	50/50	23.0184
958382	AF2-132 E	15.3456	50/50	15.3456
958391	AF2-133 C	23.4162	50/50	23.4162
958392	AF2-133 E	15.6108	50/50	15.6108
958401	AF2-134 C	7.4172	50/50	7.4172
958402	AF2-134 E	4.9448	50/50	4.9448
958971	AF2-188 C O1	9.3643	50/50	9.3643
958972	AF2-188 E O1	6.2429	50/50	6.2429
958981	AF2-189 C O1	13.5756	50/50	13.5756
958982	AF2-189 E O1	9.0504	50/50	9.0504
958991	AF2-190 C	20.0460	50/50	20.0460
958992	AF2-190 E	13.3640	50/50	13.3640
959141	AF2-205 C	15.8016	50/50	15.8016
959142	AF2-205 E	10.5344	50/50	10.5344
960621	AF2-353 C	176.5064	50/50	176.5064
960622	AF2-353 E	75.6456	50/50	75.6456
960681	AF2-359 C	7.9995	50/50	7.9995
960682	AF2-359 E	5.3330	50/50	5.3330
WEC	WEC	3.0105	Confirmed LTF	3.0105
CALDERWOOD	CALDERWOOD	1.0064	Confirmed LTF	1.0064
LGE-0012019	LGE-0012019	6.3129	LTF	6.3129
CBM-W2	CBM-W2	25.5446	Confirmed LTF	25.5446
NY	NY	1.1386	Confirmed LTF	1.1386
CBM-W1	CBM-W1	84.7928	Confirmed LTF	84.7928
O-066	O-066	12.7882	Confirmed LTF	12.7882
CHEOAH	CHEOAH	1.0105	Confirmed LTF	1.0105
G-007	G-007	1.9822	Confirmed LTF	1.9822
MADISON	MADISON	36.3807	Confirmed LTF	36.3807

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
MEC	MEC	12.0955	Confirmed LTF	12.0955
BLUEG	BLUEG	29.7030	Confirmed LTF	29.7030
TRIMBLE	TRIMBLE	10.3576	Confirmed LTF	10.3576
CATAWBA	CATAWBA	0.7238	Confirmed LTF	0.7238

11.7 Queue Dependencies

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

Queue Number	Project Name	Status
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
AC2-080	Olive-Reynolds 345kV	Active
AC2-140	DC Cook Unit 2	Engineering and Procurement
AC2-157	Sullivan 345 kV	Active
AD2-138	Olive-Reynolds 345kV	Active
AE2-045	Olive-Reynolds 345 kV	Active
AE2-130	Rockport 765 kV	Active
AE2-154	Meadow Lake 345 kV (MLV VIII)	Active
AE2-276	Sullivan 345kV	Active
AF1-088	Sullivan 345 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
AF2-034	Kendall	Active
AF2-078	Reynolds-Olive #1 345 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
AF2-190	Olive-Reynolds #2 345 kV	Active
AF2-205	Olive-Reynolds #2 345 kV	Active
AF2-353	Rockport 765 kV	Active
AF2-359	Olive-University Park 345 kV	Active
Y3-099	Beckjord 2 MW-1	In Service
Y3-100	Beckjord 2 MW-2	In Service
Z1-065	Wiley 34.5kV	In Service

11.8 Contingency Descriptions - Primary POI

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

12 Light Load Analysis

Light Load Studies (As applicable)

No Applicable.

13 Short Circuit Analysis

The following Breakers are overdutied:

To be determined during later study phases.

14 Stability and Reactive Power Assessment

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

To be determined during later study phases.

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).

15 Summer Peak – Load Flow Analysis – Secondary POI

The Queue Project AF2-133 was evaluated as a 300.0 MW (Capacity 180.0 MW) injection tapping the Reynolds to Olive 345 kV line, ckt. 1 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 53.0 %. Potential network impacts were as follows:

15.1 Generation Deliverability

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

None

15.2 Multiple Facility Contingency

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

None

15.3 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	106.54	107.37	DC	39.06

15.4 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
95285411	242865	05JEFRSO	345.0	AEP	248000	06CLIFTY	345.0	OVEC	Z1	AEP_P1-2_#709	operation	2354.0	105.12	105.93	DC	39.14

15.5 Flow Gate Details - Secondary POI

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".

15.5.1 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	106.54	107.37	DC	39.06

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
243441	05CKG2	21.5468	50/50	21.5468
243442	05RKG1	71.7661	50/50	71.7661
243443	05RKG2	70.6787	50/50	70.6787
243859	05FR-11G C	0.4541	50/50	0.4541
243862	05FR-12G C	0.4471	50/50	0.4471
243864	05FR-21G C	0.4772	50/50	0.4772
243866	05FR-22G C	0.4564	50/50	0.4564
243870	05FR-3G C	0.9243	50/50	0.9243
243873	05FR-4G C	0.7158	50/50	0.7158
244130	05ST.JOE CTR	12.4444	50/50	12.4444
246909	05MDL-1G C	0.9511	50/50	0.9511
246910	05MDL-2G C	0.4708	50/50	0.4708
246976	05MDL-3G C	0.4803	50/50	0.4803
246979	05MDL-4G C	0.4684	50/50	0.4684
247556	T-127 C	0.4755	50/50	0.4755
247900	05FR-11G E	10.5157	50/50	10.5157
247901	05FR-12G E	10.3411	50/50	10.3411
247902	05FR-21G E	11.0529	50/50	11.0529
247903	05FR-22G E	10.5828	50/50	10.5828
247904	05FR-3G E	21.4343	50/50	21.4343
247905	05FR-4G E	16.7875	50/50	16.7875
247906	05MDL-1G E	22.0130	50/50	22.0130
247907	05MDL-2G E	11.0272	50/50	11.0272
247912	05MDL-3G E	11.0272	50/50	11.0272
247913	05MDL-4G E	11.0272	50/50	11.0272
247943	T-127 E	11.0272	50/50	11.0272
250163	Y3-099 BAT	0.2470	50/50	0.2470
250167	Y3-100 BAT	0.2470	50/50	0.2470
251823	Z1-065 BAT	0.6559	50/50	0.6559
274775	LINCOLN ;6U	1.3730	50/50	1.3730
274776	LINCOLN ;7U	1.3730	50/50	1.3730
274777	LINCOLN ;8U	1.3730	50/50	1.3730
922912	AB1-080	0.7374	50/50	0.7374
930041	AB1-006 C	0.6182	50/50	0.6182
930042	AB1-006 E	23.9842	50/50	23.9842
930461	AB1-087	93.7805	50/50	93.7805
930471	AB1-088	93.7805	50/50	93.7805
932601	AC2-080 C O1	3.4757	50/50	3.4757
932602	AC2-080 E O1	23.2603	50/50	23.2603
933281	AC2-140 C	4.1348	50/50	4.1348
933282	AC2-140 E	0.2176	50/50	0.2176
933441	AC2-157 C	12.9588	50/50	12.9588

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
933442	AC2-157 E	21.1432	50/50	21.1432
937041	AD2-138 C	4.7055	50/50	4.7055
937042	AD2-138 E	22.0305	50/50	22.0305
940581	AE2-045 C O1	15.7742	50/50	15.7742
940582	AE2-045 E O1	21.6562	50/50	21.6562
941341	AE2-130 C	151.2912	50/50	151.2912
941342	AE2-130 E	100.8608	50/50	100.8608
941571	AE2-154 C	4.4798	50/50	4.4798
941572	AE2-154 E	29.9802	50/50	29.9802
942601	AE2-276	8.5255	50/50	8.5255
944201	AF1-088 FTIR	170.5100	50/50	170.5100
945391	AF1-204 C O1	6.7014	50/50	6.7014
945392	AF1-204 E O1	20.1042	50/50	20.1042
945421	AF1-207 C	4.7318	50/50	4.7318
945422	AF1-207 E	20.3188	50/50	20.3188
945501	AF1-215 C O1	22.2516	50/50	22.2516
945502	AF1-215 E O1	14.8344	50/50	14.8344
946581	AF1-322 C	11.5786	50/50	11.5786
946582	AF1-322 E	15.9894	50/50	15.9894
957141	AF2-008 FTIR	85.2550	50/50	85.2550
957142	AF2-008 NFTI	170.5100	50/50	170.5100
957403	AF2-034 BAT	2.2148	50/50	2.2148
957841	AF2-078 C O2	16.7220	50/50	16.7220
957842	AF2-078 E O2	11.1480	50/50	11.1480
958381	AF2-132 C O2	22.9896	50/50	22.9896
958382	AF2-132 E O2	15.3264	50/50	15.3264
958391	AF2-133 C O2	23.4378	50/50	23.4378
958392	AF2-133 E O2	15.6252	50/50	15.6252
958401	AF2-134 C O2	7.4310	50/50	7.4310
958402	AF2-134 E O2	4.9540	50/50	4.9540
958971	AF2-188 C O2	9.3630	50/50	9.3630
958972	AF2-188 E O2	6.2420	50/50	6.2420
958981	AF2-189 C O2	13.4838	50/50	13.4838
958982	AF2-189 E O2	8.9892	50/50	8.9892
958991	AF2-190 C O2	19.5172	50/50	19.5172
958992	AF2-190 E O2	13.0114	50/50	13.0114
959141	AF2-205 C	15.8016	50/50	15.8016
959142	AF2-205 E	10.5344	50/50	10.5344
960621	AF2-353 C	176.5064	50/50	176.5064
960622	AF2-353 E	75.6456	50/50	75.6456
960681	AF2-359 C O2	8.1983	50/50	8.1983
960682	AF2-359 E O2	5.4655	50/50	5.4655
WEC	WEC	3.0105	Confirmed LTF	3.0105
CALDERWOOD	CALDERWOOD	1.0064	Confirmed LTF	1.0064
LGE-0012019	LGE-0012019	6.3129	LTF	6.3129
CBM-W2	CBM-W2	25.5446	Confirmed LTF	25.5446
NY	NY	1.1386	Confirmed LTF	1.1386
CBM-W1	CBM-W1	84.7928	Confirmed LTF	84.7928
O-066	O-066	12.7882	Confirmed LTF	12.7882
CHEOAH	CHEOAH	1.0105	Confirmed LTF	1.0105
G-007	G-007	1.9822	Confirmed LTF	1.9822
MADISON	MADISON	36.3807	Confirmed LTF	36.3807

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
MEC	MEC	12.0955	Confirmed LTF	12.0955
BLUEG	BLUEG	29.7030	Confirmed LTF	29.7030
TRIMBLE	TRIMBLE	10.3576	Confirmed LTF	10.3576
CATAWBA	CATAWBA	0.7238	Confirmed LTF	0.7238

15.6 Contingency Descriptions - Secondary POI

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

16 Light Load Analysis – Secondary POI

Light Load Studies (As applicable)

Not applicable.

17 Short Circuit Analysis – Secondary POI

The following Breakers are overdutied:

To be determined during later study phases.

18 Stability and Reactive Power Assessment – Secondary POI

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

To be determined during later study phases.

19 Affected Systems – Secondary POI

19.1 TVA

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

19.2 Duke Energy Progress

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

19.3 MISO

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

19.4 LG&E

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