Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-207

MEADOW LAKE-REYNOLDS 345 KV

38 MW Capacity / 200 MW Energy

January, 2020

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1 Preface

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

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

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

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

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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.

2 General

The Interconnection Customer (IC), has proposed a Wind generating facility located in White County, IN. The installed facilities will have a total capability of 200 MW with 38 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 12/31/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-207**
Project Name	MEADOW LAKE-REYNOLDS 345 KV
State	Indiana
County	White
Transmission Owner	AEP
MFO	200
MWE	200
MWC	38
Fuel	Wind
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-207 will interconnect with the AEP transmission system tapping the Meadow Lake to Reynolds 345 kV line.

To accommodate the interconnection on the Meadow Lake to Reynolds 345 kV circuit, 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 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.

2.2 Cost Summary

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$350,000
Direct Connection Network Upgrade	$8,000,000
Non Direct Connection Network Upgrades	$1,900,000
Total Costs	$10,250,000

In addition, this project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$56,000

Cost allocations for these upgrades will be provided in the System Impact Study Report.

3 Transmission Owner Scope of Work

4 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	$350,000
Total Attachment Facility Costs	$350,000

5 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
Construct 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 (See Figure 1). Installation of associated protection and control equipment, 345 kV line risers and SCADA will also be required.	$8,000,000
Total Direct Connection Facility Costs	$8,000,000

6 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
Upgrade line protections & Controls at the 345kV remote end Substation #1	$350,000
Upgrade line protections & Controls at the 345kV remote end Substation #2	$350,000
345 kV Transmission Line Cut In	$1,200,000
Total Non-Direct Connection Facility Costs	$1,900,000

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 is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to AEP's 345kV Facilities 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 American Electric Power 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 AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

11 Network Impacts

The Queue Project AF1-207 was evaluated as a 200.0 MW (Capacity 38.0 MW) injection tapping the Meadow Lake to Reynolds 345 kV line in the AEP area. Project AF1-207 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-207 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

12 Generation Deliverability

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

None

13 Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4352753 1	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8167_05OLIVE	breaker	1409.0	99.12	100.58	DC	20.57

14 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
435275 10	243918	05ELDERBERRY	345.0	AEP	938670	AE1-089 TAP	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	122.69	123.56	DC	27.03
435275 30	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	114.43	115.29	DC	27.03

15 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
4352778 6	243878	05MEADOW	345.0	AEP	255205	17REYNOLDS	345.0	NIPS	1	AEP_P1-2_#8807-B	operation	2246.0	129.83	135.8	DC	134.1

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
4352778 1	945420	AF1-207 TAP	345.0	AEP	255205	17REYNOLDS	345.0	NIPS	2	AEP_P1-2_#8695	operation	2246.0	129.87	136.62	DC	151.51

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
43527531,43527530	1	AE1-089 TAP 345.0 kV - 05DUMONT 345.0 kV Ckt 1	**AEP_AE1_REF_r0040** : 1) A Sag Study will be required on the 7.0 miles of conductor to mitigate the overload. The new ratings after sag study will be: S/N: 1409 MVA, S/E: 1888 MVA, Depending on the sag study results, the cost for this upgrade is expected to be between $28,000(no remediation required, just sag study) and $14.0 million (complete line Reconductor/rebuild). Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. **Project Type** : FAC **Cost** : $28,000 **Time Estimate** : 6-12 Months	$28,000
43527510	2	05ELDERBRYSS 345.0 kV - AE1-089 TAP 345.0 kV Ckt 1	**AEP_AE1_REF_r0021**: A Sag Study will be required on the 7.2 miles of ACSR ~ 954 ~ 45/7 ~ RAIL - Conductor section 1 conductor to mitigate the overload. The new ratings after sag study will be: S/N: 1409 MVA, S/E: 1888 MVA, Depending on the sag study results, the cost for this upgrade is expected to be between $28,800 (no remediation required, just sag study) and $14.4million (complete line Reconductor/rebuild). Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. **Project Type** : FAC **Cost** : $28,000 **Time Estimate** : 6-12 Months	$28,000
			TOTAL COST	**$56,000**

17 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

17.1 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
43527530	938670	AE1-089 TAP	AEP	243219	05DUMONT	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	114.43	115.29	DC	27.03

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
930042	AB1-006 E	19.0007
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
935271	AD1-137 C	6.2084
935272	AD1-137 E	41.5488
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
938671	AE1-089 C	93.2175
938672	AE1-089 E	127.9644
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940261	AE2-008	57.0792
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580

Bus #	Bus	MW Impact
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
945421	AF1-207 C O1	2.3133
945422	AF1-207 E O1	9.8619
945501	AF1-215 C O1	60.8760
945502	AF1-215 E O1	40.5840
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

17.2 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
43527510	243918	05ELDERBERRY	AEP	938670	AE1-089 TAP	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	122.69	123.56	DC	27.03

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
274881	PILOT HIL;1E	8.2812
275149	KELLYCK ;1E	8.2812
276169	Z1-107 E	1.1703
290021	O50 E	8.7870
293644	O22 E1	4.7213
293645	O22 E2	9.1649
910542	X3-005 E	0.3092
918052	AA1-018 E OP	7.9700
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
927091	AC1-204 1	32.3586
927101	AC1-204 2	32.3538
927451	AC1-142A 1	1.8912
927461	AC1-142A 2	1.8909
930042	AB1-006 E	19.0007
930501	AB1-091 O1	31.9490
930751	AB1-122 2O1	32.5801
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
933411	AC2-154 C	1.1240
933412	AC2-154 E	1.8340
934111	AD1-039 2	3.1928

Bus #	Bus	MW Impact
934871	AD1-116 C	0.4642
934872	AD1-116 E	0.7573
935271	AD1-137 C	6.2084
935272	AD1-137 E	41.5488
936291	AD2-038 C O1	1.1170
936292	AD2-038 E O1	7.4752
936371	AD2-047 C O1	2.0114
936372	AD2-047 E O1	9.8206
936461	AD2-060	0.6271
936511	AD2-066 C O1	3.8016
936512	AD2-066 E O1	2.5344
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
937321	**AD2-175 C (Withdrawn : 12/10/2019)**	**7.1418**
937322	**AD2-175 E (Withdrawn : 12/10/2019)**	**4.7612**
937401	AD2-194 1	3.4797
937411	AD2-194 2	3.4792
938511	AE1-070 1	4.0887
938521	AE1-070 2	3.7402
938851	AE1-113 C	3.6246
938852	AE1-113 E	12.8509
939321	AE1-163 C O1	2.8068
939322	AE1-163 E O1	17.2417
939351	AE1-166 C O1	2.3389
939352	AE1-166 E O1	2.1589
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940262	AE2-008 BAT	22.9208
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580
940621	AE2-049 C O1	2.1566
940622	AE2-049 E O1	1.4378
940631	AE2-050 C O1	2.9505
940632	AE2-050 E O1	1.9670
940752	AE2-062 E	0.0310
940762	**AE2-063 E (Withdrawn : 01/14/2020)**	**0.0310**
941551	AE2-152 C O1	2.6987
941552	AE2-152 E O1	1.7991
941561	AE2-153 C O1	2.1124
941562	AE2-153 E O1	9.8896
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
942421	AE2-255 C O1	1.3730
942422	AE2-255 E O1	4.1189
942651	AE2-281 C O1	0.4010
942652	AE2-281 E O1	2.4631

Bus #	Bus	MW Impact
942682	AE2-284 BAT	5.3182
942881	AE2-307 C O1	5.4092
942882	AE2-307 E O1	1.9670
942911	AE2-310 C O1	2.0941
942912	AE2-310 E O1	0.5626
943023	AE2-325 BAT	3.4447
944911	AF1-156 C	2.8625
944912	AF1-156 E	1.9083
944963	AF1-161 BAT	3.2995
945421	AF1-207 C O1	2.3133
945422	AF1-207 E O1	9.8619
945501	AF1-215 C O1	60.8760
945502	AF1-215 E O1	40.5840
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955821	J1067	15.9360
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

Affected Systems

18 Affected Systems

18.1 LG&E

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

18.2 MISO

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

18.3 TVA

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

18.4 Duke Energy Progress

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

18.5 NYISO

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

19 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P4_#8167_05OLIVE	CONTINGENCY 'AEP_P4_#8167_05OLIVE' OPEN BRANCH FROM BUS 243229 TO BUS 274804 CKT 1 / 243229 05OLIVE 345 274804 UNIV PK N;RP 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 END
AEP_P1-2_#8807-B	CONTINGENCY 'AEP_P1-2_#8807-B' OPEN BRANCH FROM BUS 945420 TO BUS 255205 CKT 2 / 945420 AF1-207 TAP 345 255205 17REYNOLDS 345 2 END
AEP_P4_#8165_05OLIVE 345_B1	CONTINGENCY 'AEP_P4_#8165_05OLIVE 345_B1' OPEN BRANCH FROM BUS 243215 TO BUS 243229 CKT 1 / 243215 05COOK 345 243229 05OLIVE 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 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

Short Circuit

20 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue

21 Network Impacts

The Queue Project AF1-207 was evaluated as a 200.0 MW (Capacity 38.0 MW) injection tapping the Reynolds to Olive 345 kV line in the AEP area. Project AF1-207 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-207 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

22 Generation Deliverability

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

None

23 Multiple Facility Contingency

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

None

24 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
4352751	243918	05ELDERBERRY	345.0	AEP	938670	AE1-089 TAP	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	123.45	124.34	DC	27.71
4352753	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	115.18	116.07	DC	27.71
4352753	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P4_#8167_05OLIVE	breaker	1409.0	104.01	105.51	DC	21.11

25 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
4352796 2	938670	AE1-089 TAP	345.0	AEP	243219	05DUMONT	345.0	AEP	1	AEP_P1-2_#11219	operation	1409.0	101.52	103.6	DC	29.32

26 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

26.1 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
43527510	243918	05ELDERBERRY	AEP	938670	AE1-089 TAP	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	123.45	124.34	DC	27.71

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
274881	PILOT HIL;1E	8.2812
275149	KELLYCK ;1E	8.2812
276169	Z1-107 E	1.1703
290021	O50 E	8.7870
293644	O22 E1	4.7213
293645	O22 E2	9.1649
910542	X3-005 E	0.3092
918052	AA1-018 E OP	7.9700
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
927091	AC1-204 1	32.3586
927101	AC1-204 2	32.3538
927451	AC1-142A 1	1.8912
927461	AC1-142A 2	1.8909
930042	AB1-006 E	19.0007
930501	AB1-091 O1	31.9490
930751	AB1-122 2O1	32.5801
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
933411	AC2-154 C	1.1240
933412	AC2-154 E	1.8340
934111	AD1-039 2	3.1928

Bus #	Bus	MW Impact
934871	AD1-116 C	0.4642
934872	AD1-116 E	0.7573
935271	AD1-137 C	6.2084
935272	AD1-137 E	41.5488
936291	AD2-038 C O1	1.1170
936292	AD2-038 E O1	7.4752
936371	AD2-047 C O1	2.0114
936372	AD2-047 E O1	9.8206
936461	AD2-060	0.6271
936511	AD2-066 C O1	3.8016
936512	AD2-066 E O1	2.5344
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
937321	**AD2-175 C (Withdrawn : 12/10/2019)**	**7.1418**
937322	**AD2-175 E (Withdrawn : 12/10/2019)**	**4.7612**
937401	AD2-194 1	3.4797
937411	AD2-194 2	3.4792
938511	AE1-070 1	4.0887
938521	AE1-070 2	3.7402
938851	AE1-113 C	3.6246
938852	AE1-113 E	12.8509
939321	AE1-163 C O1	2.8068
939322	AE1-163 E O1	17.2417
939351	AE1-166 C O1	2.3389
939352	AE1-166 E O1	2.1589
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940262	AE2-008 BAT	22.9208
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580
940621	AE2-049 C O1	2.1566
940622	AE2-049 E O1	1.4378
940631	AE2-050 C O1	2.9505
940632	AE2-050 E O1	1.9670
940752	AE2-062 E	0.0310
940762	AE2-063 E	0.0310
941551	AE2-152 C O1	2.6987
941552	AE2-152 E O1	1.7991
941561	AE2-153 C O1	2.1124
941562	AE2-153 E O1	9.8896
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
942421	AE2-255 C O1	1.3730
942422	AE2-255 E O1	4.1189
942651	AE2-281 C O1	0.4010
942652	AE2-281 E O1	2.4631

Bus #	Bus	MW Impact
942682	AE2-284 BAT	5.3182
942881	AE2-307 C O1	5.4092
942882	AE2-307 E O1	1.9670
942911	AE2-310 C O1	2.0941
942912	AE2-310 E O1	0.5626
943023	AE2-325 BAT	3.4447
944911	AF1-156 C	2.8625
944912	AF1-156 E	1.9083
944963	AF1-161 BAT	3.2995
945391	AF1-204 C O2	2.6219
945392	AF1-204 E O2	7.8657
945421	AF1-207 C O2	2.3718
945422	AF1-207 E O2	10.1115
945501	AF1-215 C O2	60.6780
945502	AF1-215 E O2	40.4520
946521	AF1-316 C O2	1.5499
946522	AF1-316 E O2	2.3249
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955821	J1067	15.9360
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

26.2 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
43527530	938670	AE1-089 TAP	AEP	243219	05DUMONT	AEP	1	AEP_P4_#8165_05OLIVE 345_B1	breaker	1409.0	115.18	116.07	DC	27.71

Bus #	Bus	MW Impact
244130	05ST.JOE CTR	53.0772
247900	05FR-11G E	7.4788
247901	05FR-12G E	7.3546
247902	05FR-21G E	7.8608
247903	05FR-22G E	7.5265
247904	05FR-3G E	15.2441
247905	05FR-4G E	11.9393
247906	05MDL-1G E	17.4392
247907	05MDL-2G E	8.7360
247912	05MDL-3G E	8.7360
247913	05MDL-4G E	8.7360
247943	T-127 E	8.7360
274808	UNIV PK N;4U	0.9159
274809	UNIV PK N;5U	0.9159
274811	UNIV PK N;7U	0.9159
274812	UNIV PK N;8U	0.9159
274814	UNIV PK N;0U	0.9159
274815	UNIV PK N;XU	0.9159
922912	AB1-080	3.1453
926581	AC1-141	-5.7494
930042	AB1-006 E	19.0007
932601	AC2-080 C O1	5.4340
932602	AC2-080 E O1	36.3660
932931	AC2-117	5.4979
935271	AD1-137 C	6.2084
935272	AD1-137 E	41.5488
937041	AD2-138 C	7.3568
937042	AD2-138 E	34.4432
938671	AE1-089 C	93.2175
938672	AE1-089 E	127.9644
939631	AE1-193 C	6.0040
939632	AE1-193 E	40.1807
939641	AE1-194 C	6.0040
939642	AE1-194 E	40.1807
939651	AE1-195 C	6.0040
939652	AE1-195 E	40.1807
939681	AE1-198 C	17.8273
939682	AE1-198 E	15.1486
940261	AE2-008	57.0792
940581	AE2-045 C O1	24.6620
940582	AE2-045 E O1	33.8580

Bus #	Bus	MW Impact
941571	AE2-154 C	1.8810
941572	AE2-154 E	12.5880
945391	AF1-204 C O2	2.6219
945392	AF1-204 E O2	7.8657
945421	AF1-207 C O2	2.3718
945422	AF1-207 E O2	10.1115
945501	AF1-215 C O2	60.6780
945502	AF1-215 E O2	40.4520
946581	AF1-322 C	4.8616
946582	AF1-322 E	6.7136
951811	J513 C	1.2368
951812	J513 E	6.6916
952581	J740 C	3.4510
952582	J740 E	18.6710
953161	J837 C	3.4528
953162	J837 E	18.6803
953171	J838 C	1.7255
953172	J838 E	9.3355
954421	J913 C	17.6976
954941	J968 C	3.4510
954942	J968 E	18.6710
955741	J1058	24.7860
955841	J1069 C	3.4510
955842	J1069 E	18.6710
LGEE	LGEE	0.4364
WEC	WEC	1.9165
CBM-W2	CBM-W2	22.1539
NY	NY	0.8135
CBM-W1	CBM-W1	23.9191
TVA	TVA	1.9446
O-066	O-066	9.5357
CBM-S1	CBM-S1	10.8460
G-007	G-007	1.4716
MADISON	MADISON	10.7110
MEC	MEC	7.6526
CATAWBA	CATAWBA	0.0364

Affected Systems

27 Affected Systems

27.1 LG&E

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

27.2 MISO

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

27.3 TVA

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

27.4 Duke Energy Progress

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

27.5 NYISO

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

28 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P4_#8167_05OLIVE	CONTINGENCY 'AEP_P4_#8167_05OLIVE' OPEN BRANCH FROM BUS 243229 TO BUS 274804 CKT 1 / 243229 05OLIVE 345 274804 UNIV PK N;RP 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 END
AEP_P1-2_#11219	CONTINGENCY 'AEP_P1-2_#11219' OPEN BRANCH FROM BUS 243207 TO BUS 255204 CKT N1 / 243207 05GRNTWN 765 255204 17REYNOLDS 765 N1 END
AEP_P4_#8165_05OLIVE 345_B1	CONTINGENCY 'AEP_P4_#8165_05OLIVE 345_B1' OPEN BRANCH FROM BUS 945100 TO BUS 243229 CKT 1 / 945100 AF1-175 TAP 345 243229 05OLIVE 345 1 OPEN BRANCH FROM BUS 243229 TO BUS 243353 CKT 2 / 243229 05OLIVE 345 243353 05OLIVE 138 2 END

Short Circuit

29 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue