



**Generation Interconnection  
System Impact Study Report  
for**

**Queue Project AF2-014**

**MADDOX CREEK 345 KV**

**90 MW Capacity / 150 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 Van Wert County, Ohio. The installed facilities will have a total capability of 150 MW with 90 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AF2-014</b>
<b>Project Name</b>	MADDOX CREEK 345 KV
<b>State</b>	Ohio
<b>County</b>	Van Wert
<b>Transmission Owner</b>	AEP
<b>MFO</b>	150
<b>MWE</b>	150
<b>MWC</b>	90
<b>Fuel</b>	Solar
<b>Basecase Study Year</b>	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

AF2-014 will interconnect with the AEP transmission system via a direct connection to the Maddox Creek 345 kV station.

To accommodate the interconnection of the Maddox Creek 345 kV station, one (1) new 345 kV circuit breaker will be installed (see Attachment 1). Installation of associated protection and control equipment, 345 kV 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 AF2-014 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 Maddox Creek 345 kV station fence to which the AEP and AF2-014 transmission line conductors will attach.

## 5 Cost Summary

The AF2-014 project will be responsible for the following costs:

Description	Total Cost
<b>Total Physical Interconnection Costs</b>	\$3,589,000
<b>Allocation towards System Network Upgrade Costs*</b>	\$0
<b>Total Costs</b>	<b>\$3,589,000</b>

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

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 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	\$485,000
Generator lead first span exiting the POI station, including the first structure outside the fence	\$651,000
<b>Total Attachment Facility Costs</b>	<b>\$1,109,000</b>

### 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
Expand the Maddox Creek 345 kV substation: Install one (1) additional 345 kV circuit breaker (Attachment 1). Installation of associated protection and control equipment, 345 kV line risers and SCADA will also be required.	\$2,390,000
<b>Total Direct Connection Facility Costs</b>	<b>\$2,390,000</b>

### 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.

<b>Description</b>	<b>Total Cost</b>
Review line protections and controls at the 345 kV remote end East Lima	\$45,000
Review line protections and controls at the 345 kV remote end R.P. Mone	\$45,000
<b>Total Non-Direct Connection Facility Costs</b>	<b>\$90,000</b>



## 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/meter<sup>2</sup>) - (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 AF2-014 was evaluated as a 150.0 MW (Capacity 90.0 MW) injection at the Maddox Creek 345 kV substation in the AEP area. Project AF2-014 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-014 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)

None

### 10.4 Steady-State Voltage Requirements

None

### 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
95174882	242933	05RPMONE	345.0	AEP	243211	05ALLEN	345.0	AEP	1	AEP_P1-2_#6463	operation	897.0	92.15	108.55	AC	149.59

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC/D C	MW IMPACT
95174874	242935	05E LIMA	345.0	AEP	242945	05SW LIM	345.0	AEP	1	AEP_P1-2_#11144-B	operation	971.0	96.45	99.32	AC	27.96
95174854	945620	AF1-227 TAP	345.0	AEP	242939	05MARYS V	345.0	AEP	1	Base Case	operation	897.0	94.69	97.06	AC	21.46

## 10.6 System Reinforcements

None

## 10.7 Contingency Descriptions

Contingency Name	Contingency Definition
Base Case	
AEP_P1-2_#6463	CONTINGENCY 'AEP_P1-2_#6463' OPEN BRANCH FROM BUS 242935 TO BUS 246929 CKT 1 / 242935 05E LIMA 345 246929 05MADDOX 345 1 END
AEP_P1-2_#11144-B	CONTINGENCY 'AEP_P1-2_#11144-B' OPEN BRANCH FROM BUS 945620 TO BUS 242939 CKT 1 / 945620 AF1-227 TAP 345 242939 05MARYSV 345 1 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

AF2-014 Point of Interconnection Maddox Creek 345 kV Station  
Single-line Diagram (remote stations not completely shown)





