Generation Interconnection

Impact Study Report

for

Queue Project AE1-102

MADDOX CREEK 345 KV

15.6 MW Capacity / 26 MW Energy

August, 2019

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1 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.

2 General

Aurora Solar LLC proposes to install PJM Project #AE1-102, a 26.0 MW (15.6 MW Capacity) Solar generating facility in Van Wert County, OH (see Figure 2). The Solar facility is connecting to the existing Blue Creek Wind Farm (R60) Collector Station 34.5 kV bus. The project is connecting 10 MW on one side of the 34.5 kV bus, and the additional 16 MW on the other side of the 34.5 kV collector bus. The point of interconnection will be a direct connection to AEP's Maddox Creek 345 kV substation (see Figure 1).

The requested in service date is December 31, 2021. This study does not imply AEP's commitment to this in-service date.

Queue Number	**AE1-102**
Project Name	MADDOX CREEK 345 KV
Interconnection Customer	Aurora Solar LLC
State	None
County	Van Wert
Transmission Owner	AEP
MFO	26
MWE	26
MWC	15.6
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE1-102 will interconnect with the AEP transmission system at the existing Maddox Creek 345 kV Substation.

Point of Interconnection (Maddox Creek 345 kV Substation)

The attachment facilities would be part of the Interconnection Customer scope of work because the physical connection would be made within the existing facilities of the Blue Creek Wind Farm collector station.

2.2 Cost Summary

The AE1-102 project will be responsible for the following costs:

Based upon the results of this Feasibility Study, the construction of the 26.0 MW (15.6 MW Capacity) Solar generating facility of Aurora Solar (PJM Project # AE1-102) will require the following additional interconnection charges. This plan of service will interconnect the proposed Solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Aurora Solar generating facility.

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$100,000
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	$100,000

The estimates 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.

3 Transmission Owner Scope of Work

4 Attachment Facilities

There are no Attachment Facilities are required to support this interconnection.

5 Direct Connection Cost Estimate

There are no Direct Connection Facilities are required to support this interconnection.

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 protection and control settings at the R.P. Mone 345 kV substation.	$50,000
Upgrade line protection and control settings at the East Lima 345 kV substation.	$50,000
Total Non-Direct Connection Facility Costs	$100,000

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 be between 24 to 36 months after signing an interconnection Agreements.

9 Interconnection Customer Requirements

It is understood that Aurora Solar is responsible for all costs associated with this interconnection. The Aurora Solar's generating plant costs are not included in this report; these are assumed to be Aurora Solar'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.

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 AE1-102 was evaluated as a 26.0 MW (Capacity 15.6 MW) injection into the Maddox Creek 345 kV substation in the AEP area. Project AE1-102 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-102 was studied with a commercial probability of 1.00. 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)

None

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)

None

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	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
339534	246931	05BLUECK	AEP	246930	05BLUECK	AEP	1	Base Case	operation	350.0	105.93	112.99	AC	25.99

16 Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined during the Facilities Study Phase

17 Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined during the Facilities Study Phase

18 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost	Cost Allocated to AE1-102	NUN
			TOTAL COST	$0		

None

Affected Systems

19 Affected Systems

19.1 LG&E

None

19.2 MISO

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

19.3 TVA

None

19.4 Duke Energy Progress

None

19.5 NYISO

None

Short Circuit

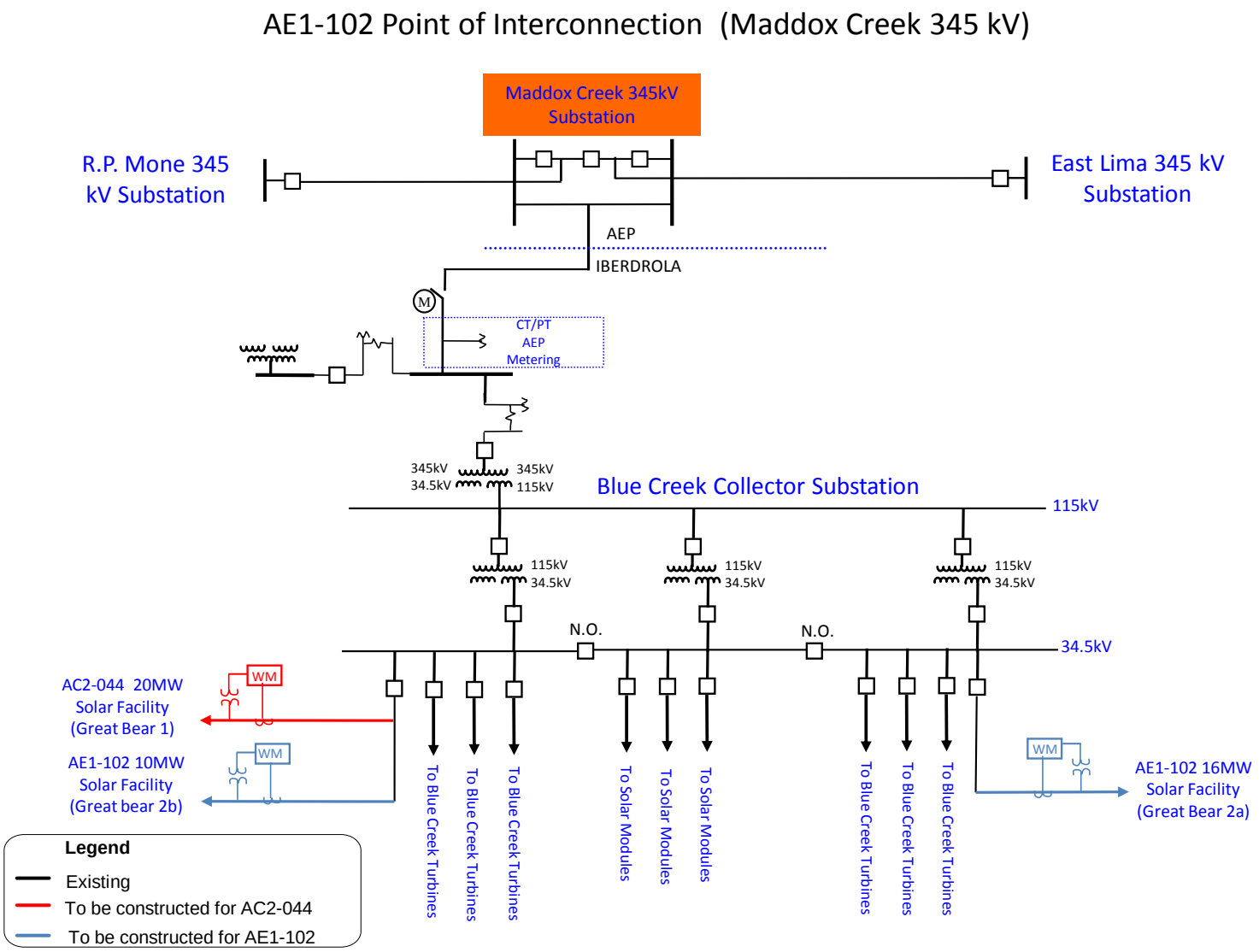
20 Short Circuit

The following Breakers are overduty

None

21 Figure 1: AE1-102 Point of Interconnection (Maddox Creek 345 kV)

Single-Line Diagram



22 Figure 2: AE1-102 Point of Interconnection (Maddox Creek 345 kV)