Generation Interconnection

Impact Study Report

for

Queue Project AE1-091

WEST NEWTON-LYNN 138 KV

46.93 MW Capacity / 110 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.

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.

2 General

Invenergy Solar Development North America LLC proposes to install PJM Project #AE1-091, a 110.0 MW (46.93 MW Capacity) solar facility in Hardin County, Ohio (see Figure 2). The point of interconnection will be to the AEP West Newton - Lynn 138 kV section of the East Lima – South Kenton 138 kV circuit (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	**AE1-091**
Project Name	WEST NEWTON-LYNN 138 KV
Interconnection Customer	Invenergy Solar Development North America LLC
State	None
County	Hardin
Transmission Owner	AEP
MFO	110
MWE	110
MWC	46.93
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE1-091 will interconnect with the AEP[transmission system along the West Newton - Lynn 138 kV line

Point of Interconnection (West Newton – Lynn 138 kV)

To accommodate the interconnection on the West Newton - Lynn 138 kV section of the East Lima – South Kenton 138 kV circuit, a new three (3) circuit breaker 138 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, 138 kV line risers, SCADA, and 138 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

The AE1-091 project will be responsible for the following costs:

Based upon the results of this Feasibility Study, the construction of the 110.0 MW (46.93 MW Capacity) solar generating facility of Invenergy Solar Development North America (PJM Project #AE1-091) 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 Invenergy Solar Development North America generating Facility.

Description	Total Cost
Attachment Facilities	$500,000
Direct Connection Network Upgrade	$6,000,000
Non Direct Connection Network Upgrades	$1,500,000
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	$8,000,000

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

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
Install attachment facility line and associated hardware to accept the Interconnection Customer generator lead line terminating at the AE1-091 Interconnection substation.	$250,000
138 kV Revenue Metering	$250,000
Total Attachment Facility Costs	$500,000

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 138 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, 138 kV line risers and SCADA will also be required.	$6,000,000
Total Direct Connection Facility Costs	$6,000,000

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
West Newton – Lynn 138 kV T-Line Cut In	$1,000,000
Upgrade line protection and controls at the East Lima 138 kV substation	$250,000
Upgrade line protection and controls at the South Kenton 138 kV substation	$250,000
Total Non-Direct Connection Facility Costs	$1,500,000

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 agreement.

9 Interconnection Customer Requirements

It is understood that Invenergy Solar Development North America is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of Invenergy Solar Development North America's generating plant and the costs for the line connecting the generating plant to the West Newton – Lynn 138 kV line are not included in this report; these are assumed to be Invenergy Solar Development North America'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 AE1-091 was evaluated as a 110.0 MW (Capacity 46.9 MW) injection into a tap of the West Newton – Lynn 138 kV line in the AEP area. Project AE1-091 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-091 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.

None

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 AE1-091	NUN
			TOTAL COST	$0		

None

19 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, 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.

Affected Systems

20 Affected Systems

20.1 LG&E

None

20.2 MISO

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

20.3 TVA

None

20.4 Duke Energy Progress

None

20.5 NYISO

None

Short Circuit

21 Short Circuit

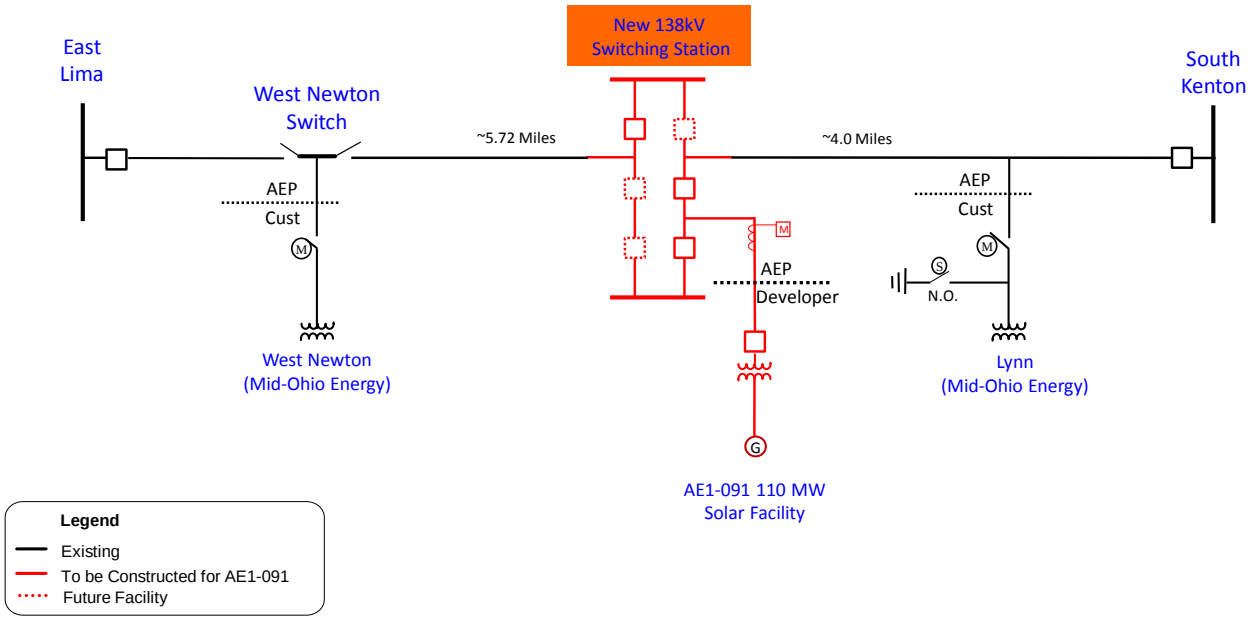
The following Breakers are overduty

None

22 Figure 1: AE1-091 Point of Interconnection (West Newton – Lynn 138 kV)

Single-Line Diagram

AE1-091 Point of Interconnection
(West Newton - Lynn 138 KV)



23 Figure 2: AE1-091 Point of Interconnection (West Newton – Lynn 138 kV)