Generation Interconnection

System Impact Study Report

for

Queue Project AF1-162

INEZ 138 KV

60 MW Capacity / 100 MW Energy

August, 2020

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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.

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 Storage uprate to a planned Solar generating facility located in Martin, Kentucky. This project is an increase to the Interconnection Customer's AF1-130 project, which will share the same point of interconnection. The AF1-162 queue position is a 100 MW Storage uprate (60 MW Capacity uprate) to the previous Solar project. The total installed facilities will have a capability of 300 MW with 193.9 MW of this output being recognized by PJM as Capacity.

The proposed in-service date for this uprate project is December 01, 2023. This study does not imply a TO commitment to this in-service date.

The objective of this System Impact Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the ITO transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required for maintaining the reliability of the ITO transmission system.

Queue Number	**AF1-162**
Project Name	INEZ 138 KV
State	Kentucky
County	Martin
Transmission Owner	AEP
MFO	300
MWE	100
MWC	60
Fuel	Storage
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

AF1-162 will interconnect with the AEP transmission system via a direct connection to the Inez 138 kV station as an uprate to the previous queue position AF1-130. AF1-162 will be utilizing the same generation lead to be constructed for PJM queue position AF1-130. The following table lists the requested generation for both queue positions:

Queue Position	Cumulative MFO	MWE	MWC
AF1-130	200	200	133.9
AF1-162	300	100	60

Note: It is assumed that the 138 kV revenue metering system, gen lead and Protection & Control Equipment that will be installed for AF1-130 will be adequate for the additional generation requested in AF1-162. Depending on the timing of the completion of the AF1-130 interconnection construction relative to the AF1-162 completion, there may (or may not) be a need to review and revise relay settings for the increased generation of AF1-162.

5 Cost Summary

The AF1-162 project will be responsible for the following costs:

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

*As your project progress through the study process, as things withdraw, then this may result in changes to your cost allocation.

This total 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

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
None	$0
Total Attachment Facility Costs	**$0**

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
None	$0
Total Direct Connection Facility Costs	**$0**

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
None	$0
Total Non-Direct Connection Facility Costs	**$0**

7 Incremental Capacity Transfer Rights (ICTRs)

None

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 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 the Interconnected Transmission Owner. The cost of the Interconnection Customer's generating plant and the costs for the line connecting the generating plant to the Interconnected Transmission Owner's Transmission circuit 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 the Interconnected 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.

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 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 Analysis

The Queue Project AF1-162 was evaluated as a 100.0 MW (Capacity 60.0 MW) injection at the Inez 138kV substation in the AEP area. Project AF1-162 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-162 was studied with a commercial probability of 100.0 %. 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)

None

11.4 Steady-State Voltage Requirements

None

11.5 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.

None

11.6 System Reinforcements

None

12 Light Load Analysis

The Queue Project AF1-162 was evaluated as a 100.1 MW (Capacity 60.0 MW) injection at the Inez 138kV substation in the AEP area. Project AF1-162 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-162 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

12.1 Light Load Deliverability

(Single or N-1 contingencies)

None

12.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies)

None

12.3 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

12.4 Steady-State Voltage Requirements

None

12.5 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.

None.

12.6 System Reinforcements

None

13 Short Circuit Analysis

The following Breakers are overdutied

Breaker D at Huff Creek Station which is in the vicinty of the POI is overdutied prior to the inclusion of the IPP. The breaker will be replaced by the PJM project s1997 (ISD: 9/2/21).

14 Stability and Reactive Power Requirements for Low Voltage Ride Through

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

To be evaluated during the Facilities Study Phase

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).

16 Attachment 1: One-Line Diagram and Point of Interconnection Map