Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-234

LIBERTY CENTER-BUCKEYE TAP 69 KV

24.1 MW Capacity / 35 MW Energy

July 2019

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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 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.

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 has proposed a Solar generating facility located in Warren, Huntington County, Indiana. The installed facilities will have a total capability of 35 MW with 24.1 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 07/31/2021. This study does not imply a TO commitment to this in-service date.

The Feasibility Study includes Short Circuit and Peak Load steady state power flow analyses. The conduct of power flow studies at other load levels, stability analysis, and coordination with non-PJM Transmission Planners, as required under the PJM planning process, is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of these additional analyses which shall be performed following execution of the System Impact Study agreement.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP transmission system. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required maintaining the reliability of the AEP transmission system. Stability analysis is not included as part of this study.

Queue Number	**AE2-234**
Project Name	LIBERTY CENTER-BUCKEYE TAP 69 KV
State	Indiana
County	Huntington
Transmission Owner	AEP
MFO	35
MWE	35
MWC	24.1
Fuel	Solar
Basecase Study Year	2022

2.1 Primary Point of Interconnection

AE2-234 will interconnect with the AEP Sub transmission system via a new station cut into the Liberty Center to Buckeye Tap 69kV section of the Liberty Center to Van Buren 69kV circuit.

To accommodate the interconnection at the Liberty Center – Buckeye Tap 69kV section of Liberty Center to Van Buren 69kV circuit, a new three (3) circuit breaker 69kV 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, 69 kV line risers, SCADA, and 69 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.

The AE2-234 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 3,500,000
Direct Connection Network Upgrade	$ 700,000
Non Direct Connection Network Upgrades	$ 800,000
Total Costs	$ 5,000,000

In addition, the AE2-234 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$0

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**
▪ Construct a new three (3) circuit breaker 69 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus. Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required (see Figure 1).	$ 3,500,000
Total Attachment Facility Costs	$ 3,500,000

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
Liberty Center – Buckeye Tap 69kV T- Line Cut In	$ 700,000
Total Direct Connection Facility Costs	$ 700,000

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
69kV Revenue Metering	$ 200,000
Upgrade Line protection & Controls at the Liberty Center 69kV substation	$ 200,000
Upgrade line protection & Controls at the Buckeye Tap 69kV switch	$200,000
Upgrade line Protection & Controls at the Van Buren 69kV substation	$ 200,000
Total Non-Direct Connection Facility Costs	$ 800,000

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 Agreement execution.

9 Transmission Owner Analysis

None

10 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 the Liberty Center to Buckeye Tap 69kV section of the Liberty Center – Van Buren 69kV 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 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.2 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

12 Network Impacts

The Queue Project AE2-234 was evaluated as a 35 MW (Capacity 24.1 MW) injection via a new station cut into the Liberty Center – Buckeye Tap 69kV section of the Liberty Center to Van Buren 69kV circuit in the AEP area. Project AE2-234 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-234 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

13 Generation Deliverability

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

None

14 Multiple Facility Contingency

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

None

15 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

16 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

17 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
			TOTAL COST	$0

18 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

19 Affected Systems

19.1 LG&E

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

19.2 MISO

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

19.3 TVA

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

19.4 Duke Energy Progress

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

19.5 NYISO

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

Short Circuit

20 Short Circuit

The following Breakers are overduty

None

22 Secondary Point of Interconnection (Buckeye Tap 69kV (Heartland REMC)):

To accommodate the interconnection at the Heartland REMC side of Buckeye Tap 69kV, Installation of three (3) additional 69 kV circuit breakers will be required (see Figure 3) at the existing Buckeye Tap 69kV. Installation of associated protection and control equipment, 69kV line risers, SCADA, and 69 kV revenue metering will also be required. Note that the Heartland REMC facilities are governed by the Service Agreement and Local Delivery between AEP Service Corporation and Wabash Valley Power Association, Inc. Modifications to the delivery point facilities would also require study under the terms of that Agreement.

23 Option -2 : Network Impacts

The Queue Project AE2-234 was evaluated as a 35 MW (Capacity 24.1 MW) injection at the Buckeye Tap (REMC) 69kV substation in the AEP area (Figure 3). Project AE2-234 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-234 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

24 Generation Deliverability

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

None

25 Multiple Facility Contingency

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

None

26 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

27 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

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

28.4 Duke Energy Progress

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

28.5 NYISO

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

Short Circuit

29 Short Circuit

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None