Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC2-047

Ashley-Millbrook Park 69 kV

August 2017

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. 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 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.

General

The Interconnection Customer proposes to interconnect PJM Project #AC2-047, an 18.3 MW (7.0 MW Capacity) solar generating facility in Wheelersburg, Ohio (see Figure 2). The primary point of interconnection is to AEP's Ashley – Millbrook Park 69 kV section of the Millbrook Park – Pedro 69 kV circuit (see Figure 1). The secondary point of interconnection is a direct connection to the 12 kV feeder at AEP's Ashley 69/12 kV substation (see Figure 2).

The requested in service date is 12/31/2018.

Attachment Facilities

Primary Point of Interconnection (Ashley – Millbrook Park 69 kV)

To accommodate the interconnection on the Ashley – Millbrook Park 69 kV section of the Millbrook Park – Pedro 69 kV circuit, 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 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.

New Switching Station Work:

- 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).
    - **Estimated Station Cost: $3,500,000**

Direct Connection Cost Estimate

The total preliminary cost estimate for Direct Connection work is given in the following tables below.

For AEP building Direct Connection cost estimates:

Description	Total Cost
Ashley-Millbrook Park 69 kV T-Line Cut In	**$700,000**
Total	**$700,000**

Table 1

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following tables below:

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
69 kV Revenue Metering	**$200,000**
Upgrade line protection and controls at the Millbrook Park 69 kV substation to coordinate with the new 69 kV switching station.	**$200,000**
Upgrade line protection and controls at the Pedro 69 kV substation to coordinate with the new 69 kV switching station.	**$200,000**
Total	**$600,000**

Table 2

Secondary Point of Interconnection (12 kV Feeder at the Ashley 69/12 kV Substation)

AEP distribution will provide the secondary point of interconnection.

Interconnection Customer Requirements

It is understood that the IC is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the new proposed 69 kV switching station are not included in this report; these are assumed to be the responsibility of the IC.

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.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

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

Option 1

Network Impacts

The Queue Project AC2-047 was evaluated as an 18.3 MW (Capacity 7.0 MW) injection tapping the Ashley – Millbrook 69 kV line in the AEP area. Project AC2-047 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-047 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	**Description**
5930_B2_TOR15138A_MOAB	CONTINGENCY '5930_B2_TOR15138A_MOAB' OPEN BRANCH FROM BUS 243501 TO BUS 243534 CKT 1 / 243501 05E.BEAV 138 243534 05LICK 138 1 OPEN BRANCH FROM BUS 243501 TO BUS 243034 CKT 1 / 243501 05E.BEAV 138 243034 05MARQUI 138 1 OPEN BRANCH FROM BUS 243501 TO BUS 243166 CKT 1 / 243501 05E.BEAV 138 243166 05E.BEAVER 69.0 1 OPEN BRANCH FROM BUS 243821 TO BUS 243166 CKT 1 / 243821 05BEAVER 69.0 243166 05E.BEAVER 69.0 1

	OPEN BRANCH FROM BUS 244928 TO BUS 243166 CKT 1 / 244928 05BEAVER 8 69.0 243166 05E.BEAVER 69.0 1 END

Table 3

Generator Deliverability

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

None

Multiple Facility Contingency

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

None

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

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

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

MISO Impacts:

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

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

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

Delivery of Energy Portion of Interconnection Request

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

AC2-047 Delivery of Energy Portion of Interconnection Request													
Contingency				Bus					Loading		Rating		
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.
1	N-1	5930_B2_TOR1 5138A_MOAB	AEP - AEP	AC2-035 TAP-05ECHO 8 69 kV line	931230	243603	1	DC	113	117	ER	50	2.12

Table 4

System Reinforcements

None

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.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the IC's 18.3 MW (7.0 MW Capacity) solar generating facility (PJM Project #AC2-047) 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 IC's generating facility.

Cost Breakdown for Primary Point of Interconnection (Ashley-Millbrook Park 69 kV)		
Attachment Cost	New 69 kV Switching Station	**$3,500,000**
Direct Connection Cost Estimate	Ashley-Millbrook Park 69 kV T-Line Cut In	**$700,000**
Non-Direct Connection Cost Estimate	69 kV Revenue Metering	**$200,000**
	Upgrade line protection and controls at the Millbrook Park 69 kV substation to coordinate with the new 69 kV switching station.	**$200,000**
	Upgrade line protection and controls at the Pedro 69 kV substation to coordinate with the new 69 kV switching station.	**$200,000**
	Total Estimated Cost for Project AC2-047	**$4,800,000**

Table 5

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.

Option 2

Network Impacts

The Queue Project AC2-047 was evaluated as an 18.3 MW (Capacity 7.0 MW) injection at the Ashley 69 substation in the AEP area. The interconnection request is to the 12 kV feeder at the Ashley 69/12 kV substation but for simulation purposes the injection was modeled at the Ashley 69 kV substation to see the effects on the transmission system. Project AC2-047 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-047 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Option 2	
Contingency Name	**Description**
5930_B2_TOR15138A_MOAB_B	CONTINGENCY '5930_B2_TOR15138A_MOAB_B' OPEN BRANCH FROM BUS 931320 TO BUS 243534 CKT 1 / 931320 AC2-046 TAP 138 243534 05LICK 138 1 END

Table 6

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

None

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

None

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

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

None

Short Circuit
(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

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

MISO Impacts:

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

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

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Contingency				Bus					Loading		Rating		
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.
1	N-1	5930_B2_TOR15 138A_MOAB_B	AEP - AEP	AC2-035 TAP-05ECHO 8 69 kV line	931230	243603	1	DC	115	119	ER	50	2.32

Table 7

Figure 1: Primary Point of Interconnection (Ashley – Millbrook Park 69 kV)

Single-Line Diagram

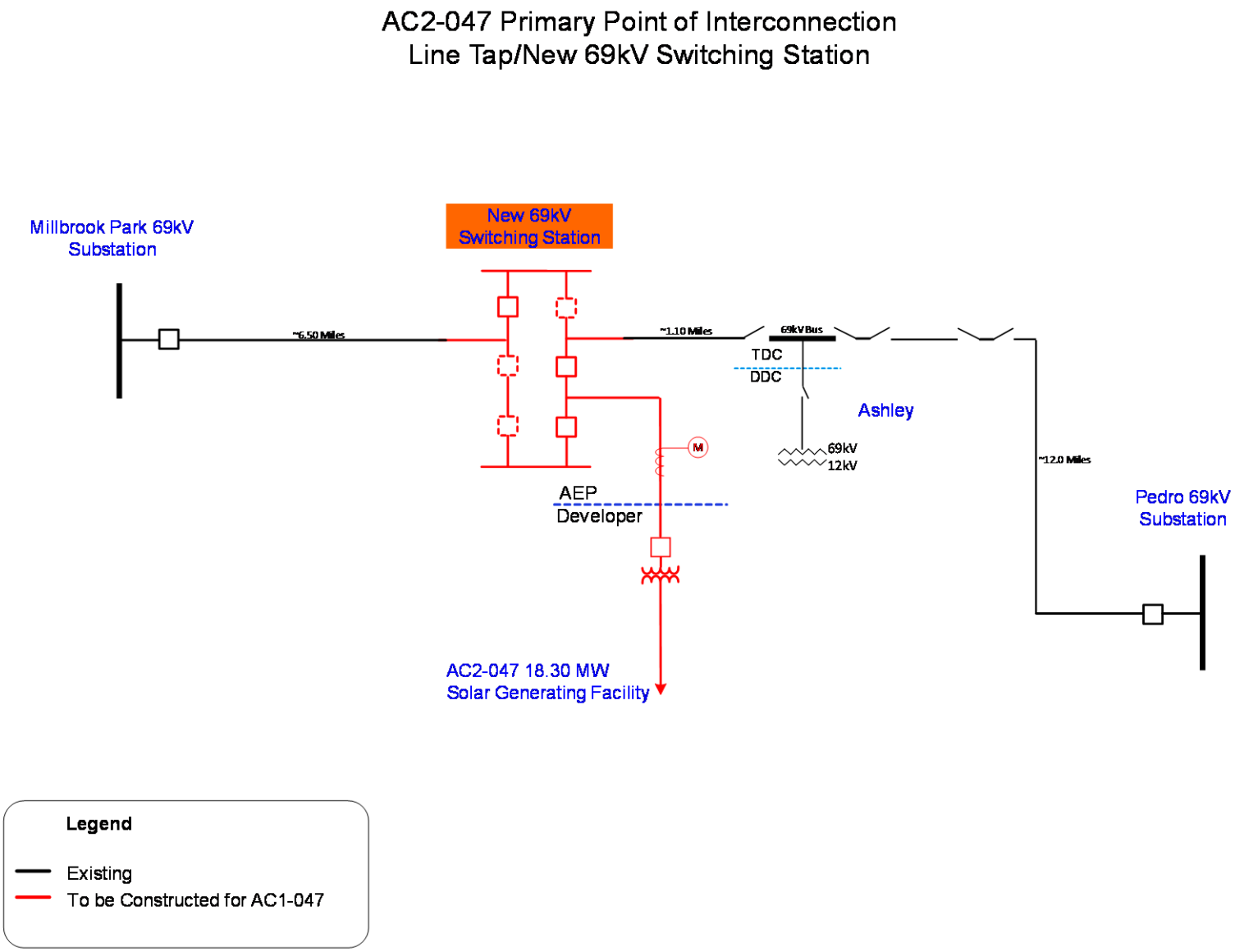

Figure 2: Primary Point of Interconnection (Ashley – Millbrook Park 69 kV)