

***Generation Interconnection  
System Impact Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AC1-083***

***Smith Mountain-Bearskin 138 kV***

**April 2018**

## 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: (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. 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 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 or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

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.

## General

Maplewood Solar I, LLC (Maplewood Solar) proposes to install PJM Project #AC1-083, a 100.0 MW (38.0 MW Capacity) solar generating facility in Pittsylvania County, Virginia (see Figure 2). The point of interconnection is to AEP's Smith Mountain – Bearskin 138 kV section of the East Danville – Smith Mountain 138 kV circuit (see Figure 1).

The requested Backfeed date is September 1, 2019.

The requested in service date is October 1, 2019.

## Attachment Facilities

### Point of Interconnection (Smith Mountain – Bearskin 138 kV Line)

To accommodate the interconnection on the Smith Mountain – Bearskin 138 kV section of the East Danville – Smith Mountain 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.

#### New Switching Station Work:

- 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. Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required (see Figure 1).
- **Estimated Station Cost: \$5,000,000**

## 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
Smith Mountain-Bearskin 138 kV T-Line Cut In	\$1,000,000
<b>Total</b>	<b>\$1,000,000</b>

**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
138 kV Revenue Metering	\$250,000
Install protection and controls at the new 138 kV switching station	\$950,000
Upgrade line protection and controls at the Smith Mountain 138 kV substation to coordinate with the new 138 kV switching station.	\$250,000
Upgrade line protection and controls at the East Danville 138 kV substation to coordinate with the new 138 kV switching station.	\$250,000
<b>Total</b>	<b>\$1,700,000</b>

**Table 2**

## Interconnection Customer Requirements

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

## **Network Impacts**

The Queue Project AC1-083 was evaluated as a 100.0 MW (Capacity 38.0 MW) injection into a tap of the Smith Mountain – Bearskin 138 kV line in the AEP area. Project AC1-083 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-083 was studied with a commercial probability of 100%. Potential network impacts were as follows:

### **Base Case Used**

Summer Peak Analysis – 2020 Case

### **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)*

None

### **Stability and Reactive Power Requirement**

*(Results of the dynamic studies should be inserted here)*

To be determined – Pending PJM results

### **Affected System Analysis & Mitigation**

#### **LGEE Impacts:**

None

#### **MISO Impacts:**

None

#### **Duke, Progress & TVA Impacts:**

None

#### **OVEC Impacts:**

None

### **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.

None

### **New System Reinforcements**

*(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)*

None

### **Contribution to Previously Identified System Reinforcements**

*(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

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 Backfeed Date is shorter than usual and may be difficult to achieve.

### **Conclusion**

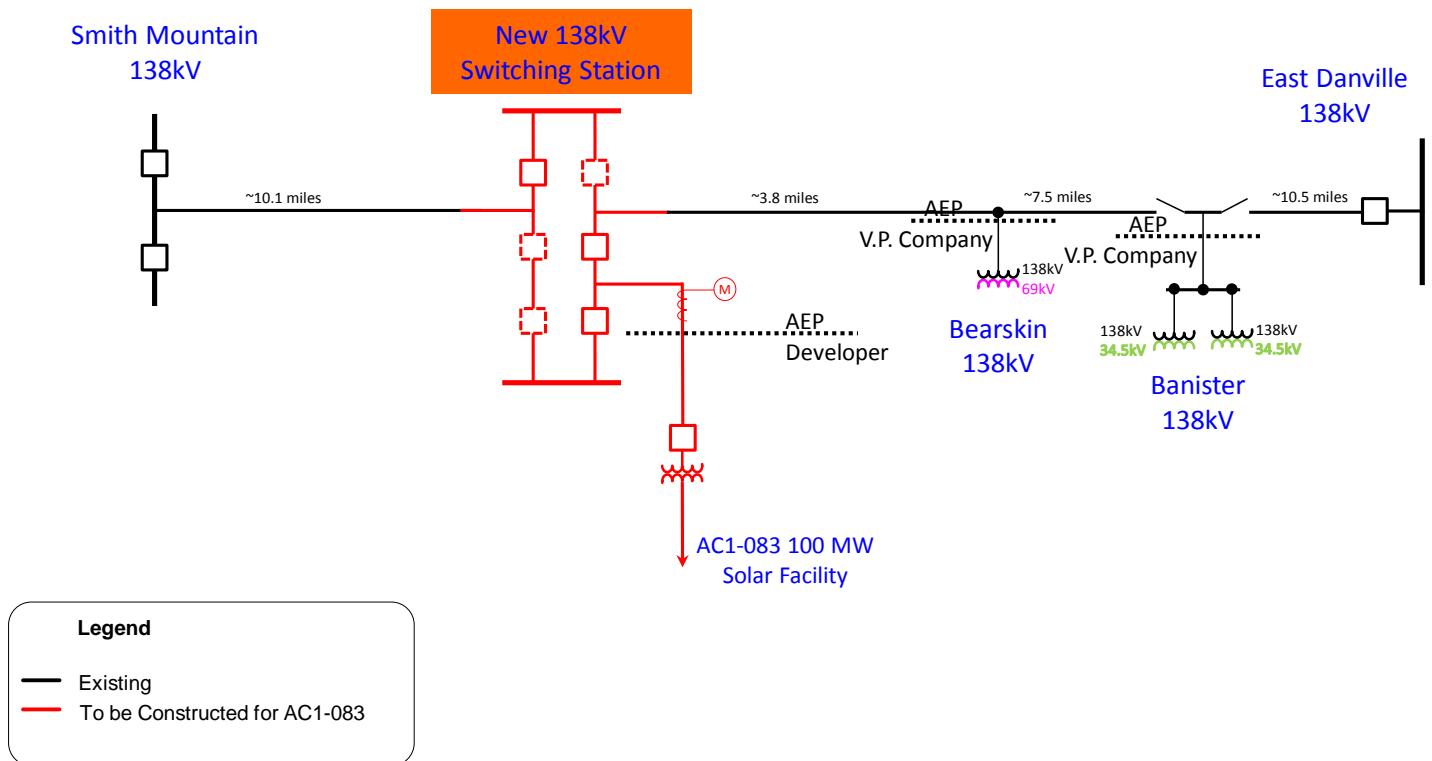
Based upon the results of this System Impact Study, the construction of the 100.0 MW (38.0 MW Capacity) solar generating facility of Maplewood Solar (PJM Project #AC1-083) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Maplewood Solar generating facility.

<b>Cost Breakdown for Point of Interconnection (Smith Mountain-Bearskin 138 kV)</b>		
<b>Attachment Cost</b>	New 138 kV Switching Station	\$5,000,000
<b>Direct Connection Cost Estimate</b>	Smith Mountain-Bearskin 138 kV T-Line Cut In	\$1,000,000
<b>Non-Direct Connection Cost Estimate</b>	138 kV Revenue Metering	\$250,000
	Install protection and controls at the new 138 kV switching station.	\$950,000
	Upgrade line protection and controls at the Smith Mountain 138 kV substation to coordinate with the new 138 kV switching station.	\$250,000
	Upgrade line protection and controls at the East Danville 138 kV substation to coordinate with the new 138 kV switching station.	\$250,000
	<b>Total Estimated Cost for Project AC1-083</b>	<b>\$7,700,000</b>

**Table 7**

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.

**Figure 1: Point of Interconnection (Smith Mountain - Bearskin 138 kV)**  
**Single-Line Diagram**





**Figure 2: Point of Interconnection (Smith Mountain – Bearskin 138 kV)**

