Generation Interconnection Impact Study Report

For

PJM Generation Interconnection Request Queue Position AD2-178

Wurno 138 kV

December 2019

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.

General

Blackbird Solar LLC proposes to install PJM Project #AD2-178, a 120 MW (72 MW Capacity) solar facility in Pulaski County, Virginia (see Figure 2). The primary point of interconnection will be a direct connection to AEP's Wurno 138 kV substation (see Figure 1). The secondary point of interconnection will be to the AEP's Wurno – Westglow 138 kV section of the Claytor – Peak Creek 138 kV circuit (see Figure 3).

The requested in service date is June 1, 2021.

Point of Interconnection

Primary Point of Interconnection (Wurno 138 kV)

To accommodate the interconnection at the Wurno 138 kV substation, the Wurno substation will have to be expanded to a new five (5) circuit breaker 138 kV substation physically configured in a breaker and half bus arrangement (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.

Cost Summary

The AD2-178 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 250,000
Direct Connection Network Upgrades	$ 6,750,000
Non Direct Connection Network Upgrades	$ 1,500,000
Allocation for New System Upgrades	$ 0
Contribution for Previously Identified Upgrades	$ 0
Total Costs	**$ 8,500,000**

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
138 kV Revenue Metering	$ 250,000
Total Attachment Cost Estimate	**$** 250,000

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
Expand the Wurno 138 kV substation to a new five (5) circuit breaker 138 kV substation physically configured in a breaker and half bus arrangement (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. (See Figure 1).	$ 6,750,000
Total Direct Connection Cost Estimate	**$ 6,750,000**

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
Peak Creek - Claytor 138 kV T-Line Cut In	$ 1,000,000
Upgrade line protection and controls at the Peak Creek 138 kV substation	$ 250,000
Upgrade line protection and controls at Claytor 138 kV substation	$ 250,000
Total Non-Direct Facilities Cost Estimate	**$** 1,500,000

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.

Interconnection Customer Requirements

It is understood that Blackbird Solar is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of Blackbird Solar generating plant and the costs for the line connecting the generating plant to the Wurno 138 kV substation are not included in this report; these are assumed to be Blackbird 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 AD2-178 was evaluated as a 120.0 MW (Capacity 72.0 MW) injection into the Wurno 138 kV substation in the AEP area. Project AD2-178 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-178 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Generator Deliverability

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

None.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None.

Short Circuit

(Summary of impacted circuit breakers)

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

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined during the Facilities Study Phase

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

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)

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.

1. (AEP - AEP) The 05WURNO-05W GLOW 138 kV line (from bus 242853 to bus 242841 ckt 1) loads from 61.5% to 106.23% (AC power flow) of its emergency rating (255 MVA) for the single line contingency outage of 'AEP_P1-2_#5387'. This project contributes approximately 120.0 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#5387'
OPEN BRANCH FROM BUS 242609 TO BUS 934750 CKT 1 / 242609 05CLYTR2 138 934750 AD1-102 TAP 138 1
END

2. (AEP - AEP) The 05WURNO-AD1-102 TAP 138 kV line (from bus 242853 to bus 934750 ckt 1) loads from 75.66% to 100.32% (AC power flow) of its emergency rating (251 MVA) for the single line contingency outage of 'AEP_P1-2_#311'. This project contributes approximately 62.65 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#311'
OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1
END

3. (AEP - AEP) The AD1-102 TAP-05CLYTR2 138 kV line (from bus 934750 to bus 242609 ckt 1) loads from 122.27% to 146.83% (AC power flow) of its emergency rating (251 MVA) for the single line contingency outage of 'AEP_P1-2_#311'. This project contributes approximately 62.65 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#311'
OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1
END

4. (AEP - AEP) The AD1-102 TAP-05CLYTR2 138 kV line (from bus 934750 to bus 242609 ckt 1) loads from 83.53% to 107.85% (AC power flow) of its normal rating (251 MVA) for non-contingency condition. This project contributes approximately 62.49 MW to the thermal violation.

Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

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

Duke, Progress & TVA Impacts:

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

OVEC Impacts:

None

Figure 1: Point of Interconnection (Wurno 138 kV)

Single-Line Diagram

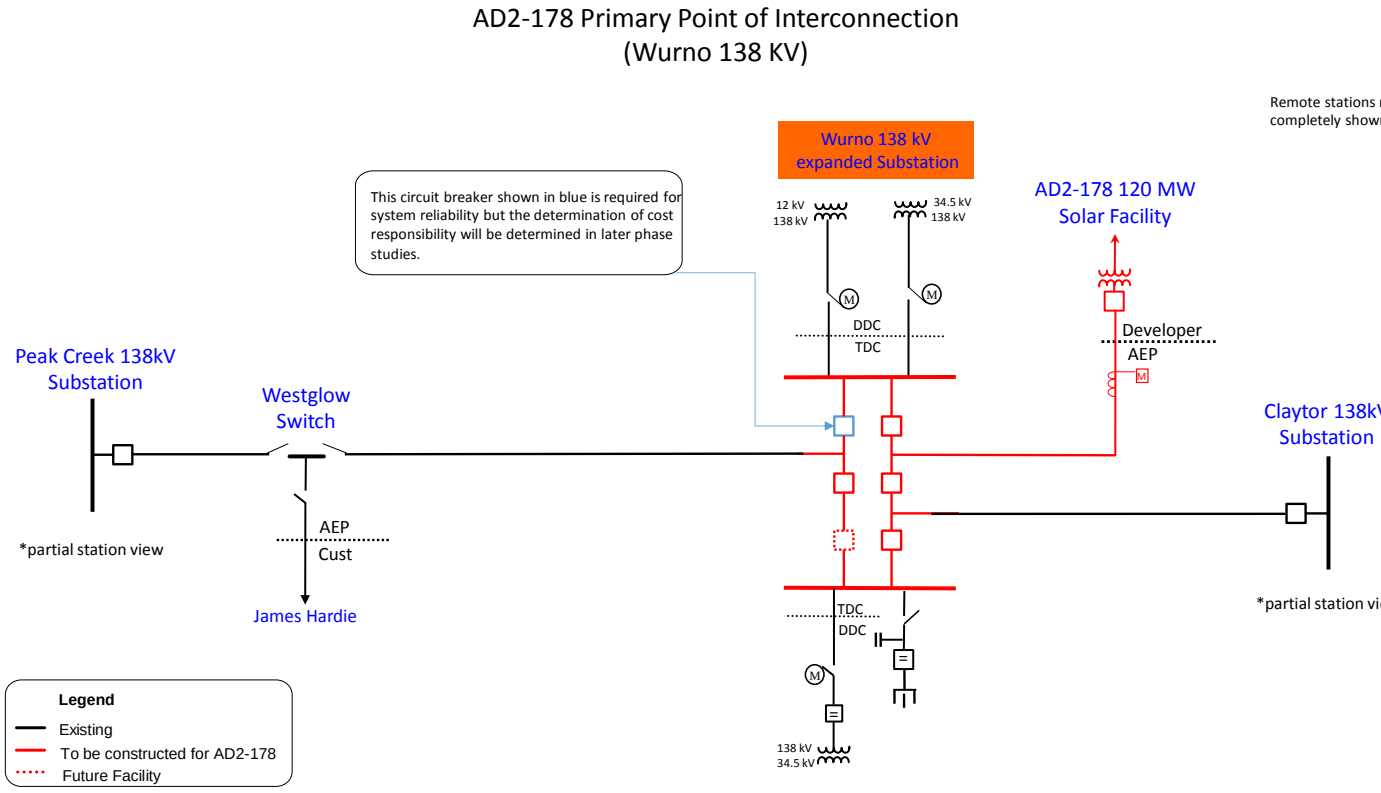

Figure 2: Point of Interconnection (Wurno 138 kV)