Generation Interconnection

System Impact Study Report

for

Queue Project AG1-499

LAMBS 12.47 KV

6 MW Capacity / 10 MW Energy

August 2021

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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 AEC.

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.

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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Gloucester County, New Jersey. The installed facilities will have a total capability of 10 MW with 6 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 30, 2020. This study does not imply a TO commitment to this in-service date.

Queue Number	**AG1-499**
Project Name	LAMBS 12.47 KV
State	New Jersey
County	Gloucester
Transmission Owner	AEC
MFO	10
MWE	10
MWC	6
Fuel	Solar
Basecase Study Year	2024

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

AG1-499 will interconnect with the AEC distribution system at the Lambs Substation 69/12.47 kV transformer via a new express feeder.

5 Cost Summary

The AG1-499 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$3,877,143
Allocation towards System Network Upgrade Costs (PJM Identified - Summer Peak)*	$0
Allocation towards System Network Upgrade Costs (PJM Identified - Light Load)*	$0
Allocation towards System Network Upgrade Costs (TO Identified)*	$0
Total Costs	$3,877,143

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

This 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 88-129. 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

Transmission Owner scope of work required to accommodate 10 MW of generation via express feeder to Lambs T1 Substation:

1. Install approximately 500ft of overhead three phase 477AAC from Lambs Substation out to Lambs Rd.
2. Reconductor approximately 0.6 miles of existing retired 34.5 kV to make double deck distribution line along Lambs Rd to Rt. 322.
3. Reconductor approximately 0.3 miles of existing retired 34.5kV line to make double deck distribution line along Lambs Rd to Rt. 322.
4. Reconductor approximately 2.4 miles of existing three phase distribution pole line to include a second deck of three phase distribution primary along Harrisonville Rd to Bridgeton Pike.
5. Rebuild approximately 800ft existing three phase distribution pole line to include a top deck of three phase distribution primary along Bridgeton Pike to solar site.
6. Install a utility operated recloser equipped with the proper relaying and communication.
7. Install utility grade primary metering.
8. Generation telemetry and remote trip capability will be provided to the control center.
9. Connect solar express feeder to an existing 'future' feeder position on the #1-12kV bus. A new 12kV circuit breaker will be installed along with all associated relaying.
10. A detailed, time-based study may be performer during later study phases.
11. Direct transfer trip will be required. Approximately 4 miles of 48SM ADSS cable from Lambs substation to solar site was estimated for this report to provide the communication channel from Union Substation to the PV site (note: *this may require secondary zone tree trimming and railroad permit*).

High Level Estimates			
Lambs T1			
Express Feeder	3	mi.	$3,000,000
Substation Feeder Terminal & Relay			$347,960
Telecommunication			$356,683
Recloser & Metering			$92,000
SCADA Integration into EMS			$11,500
Miscellaneous Engineering Costs			$69,000
Approximate Total Cost			$3,877,143

Assumptions

1. Environment and site permitting requirements will be required.

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of 18-24 months after the signing of an Interconnection Construction Service Agreement (or "Interconnection Agreement" if non-FERC) and construction kickoff call to complete the installation of the physical connection work. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined interconnection work, and that all system outages will be allowed when requested.

8 Transmission Owner Analysis

None

9 Interconnection Customer Requirements

High Voltage Warning

Typically, voltage received at the meter from the utility can be up to 105% of nominal (without generation on). Normal operating procedures dictate that voltage at the substation be raised to the higher end of an acceptable bandwidth in order to provide adequate supply to distant customers. It is recommended that transformers with no load taps should be used to adjust secondary voltage to avoid the possibility of inverter trips. Failure to account for this may result in lost energy production.

Additional Operating Requirements:

1. ACE will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. This will be accomplished with a line recloser.
2. It is the IC's responsibility to send the data that PJM and ACE requires directly to PJM (or in some cases to ACE directly). The IC will grant permission for PJM to send ACE the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator/status, and interval MWH and MVARH.
3. The IC will be required to make provisions for a voice quality phone ("plain old telephone", or "POT") line within approximately 3 feet of each ACE metering position to facilitate remote interrogation and data collection.
4. A mutually acceptable means of interrupting and disconnecting the generator with a visible break, able to be tagged and locked out, shall be worked out with ACE Distribution Engineering.
5. ACE reserves the right to charge the IC operation and maintenance expenses to maintain the IC attachment facilities, including metering and telecommunications facilities, owned by ACE.

Power Factor Requirement

The generators used for this project shall be capable of operating at a power factor (or schedule) specified by ACE in the range of 0.95 leading to 0.95 lagging. It is the responsibility of the developer/customer to obtain equipment that can operate with these requirements while also meeting all applicable requirements of IEEE and UL standards such as, but not limited to, IEEE 1547 and UL 1741.

For this project, operate inverters at unity power factor of (1) continuously until another value is provided by ACE.

Inverter Requirements (if applicable):

The inverter at the DG location shall have the following capabilities:

- Voltage flicker reduction through dynamic VAR or fixed PF response
- Ramp rate control
- SCADA communications
- Curtailment or other mitigation ability if high voltage were to occur.
- Disturbance Ride through for both Voltage and Frequency
- Ability to receive and respond to a transfer trip signal.
- Ability to adjust PF or VARs based on utility signal.
- Ability to Adjust Real Power Output based on utility signal.
- Ability to operate on a Volt/VAR schedule
- Ability to maintain a voltage schedule.

The inverter(s) shall operate in accordance with both the IEEE 1547 and UL 1741 series of standards that have been approved and use default settings except when specified otherwise by ACE. While inverters should be capable of voltage stabilization through dynamic VAR response and capable of low voltage and system disturbance ride through, neither of these capabilities will be implemented until such time that the IEEE 1547 series of standards are revised and approved to include standards for these capabilities. At such time as these revised standards become available, the generation owner/operator shall cooperate with ACE to implement these capabilities with settings acceptable to ACE. Until such time, the inverters shall operate with a fixed power factor value between 0.95 lead and 0.95 lag as specified by ACE.

Security Requirements

It is the responsibility of the owner to secure the generator or inverter from any unauthorized access (including physical and remote access) which could alter settings or adversely affect its ability to operate as required. Security measures should include utilizing secure password settings and/or physical locks on cabinet doors.

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 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)

10.3 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/

The net interchange of electrical energy will be measured by the new revenue meter, owned by ACE, located at the Point of Interconnection. This will be the official measurement of megawatt hours ("MWH") and megavar hours ("MVARH") received into and delivered by ACE's Electric System by the net generation and load behind the meter. These revenue meters will be the source for reporting generation output to PJM.

ACE Meter Department will construct a 12 kV three phase primary metering cluster mount with installed metering devices equipped with load profile, telemetry, and I/O's, including DNP outputs. An ACE contractor or overhead line crew will put the cluster mount assembly into service, and Meter Department technicians will complete the secondary wiring and related meter work at the base of the metering pole. A meter technician will assist the contractor or ACE overhead line crew in energizing this equipment. The meter technician will also program and install two solid state multi-function meters (Primary & Backup) for the new metering position.

ACE will supply a wireless modem for MV90 interrogation. In the event that a wireless modem is unable to reliably communicate, the Interconnection Customer will be required to make provisions for a POTS (Plain Old Telephone Service) line or equivalent technology approved by ACE within approximately three feet of the ACE metering position to facilitate remote interrogation and data collection.

The Interconnection Customer will provide 120V power to the meter cabinet from an uninterruptable power source.

Metering will conform to the requirements of Company's metering standards and with PJM Manuals M-01, M-14A, M-14B and M-14D. The Company work scope will include providing, installing, operating and owning all components of the POI metering system.

11 Summer Peak Analysis

The Queue Project AG1-499 was evaluated as a 10 MW (Capacity 6 MW) injection at the LAMBS 12.9 kV in the AEC area. Project AG1-499 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-499 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

To be determined

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

11.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

None

11.8 Queue Dependencies

None

11.9 Contingency Descriptions

None

12 Short Circuit Analysis

The following Breakers are overdutied:

None

12.1 System Reinforcements - Short Circuit

None

13 Stability and Reactive Power

Not required for AG1-499

14 Affected Systems

None

15 Attachment 1: One Line Diagram

AG1-499

Lambs 69/12 kV Sub
10 MW PV Generator