Generation Interconnection Feasibility Study Report Queue Position AE2-011

The Interconnection Customer (IC) has proposed a 3.1 MW Energy (1.3 MW Capacity) solar generating facility to be located at 403 Berlin Blue Anchor Road, Berlin, NJ (Latitude 39.7596050; Longitude -74.9131420). PJM studied the AE2-011 project into the Atlantic City Electric Company (ACE) system as an injection into the Tansboro 69/12 kV Substation (PSSE bus # 228620) at the T2 transformer and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. AE2-011 was studied with a commercial probability of 53%. The in-service date, as requested by the IC during the project kick-off call, is November 20, 2020. This date may not be attainable due to required PJM studies (System Impact and Facilities) and the Transmission Owner's construction schedule.

Point of Interconnection

The IC requested a distribution level Point of Interconnection. As a result, the AE2-011 project will interconnect with the Atlantic City Electric Company distribution system at the Tansboro 69/12 kV Substation T2 transformer as follows:

- 3.1 MWs of generation will connect to the 69/12 kV T2 transformer at the Tansboro Substation via a new express feeder.

Direct Connection Requirements

Criteria Limits for Distributed Energy Resource (DER) Connections to the ACE, DPL and Pepco Distribution Systems (less than 69kV)

1. Single Phase Limit

Any DER with a capacity that exceeds 100 kW shall be a balanced 3 phase system.

2. Voltage Limits

DER's are permitted to cause a voltage fluctuation of up to 2% at the Point of Interconnection, ½ the band width of any voltage regulator at its terminals, and ½ the net dead band of a switched capacitor bank at its connection point. When a DER is at maximum output, it shall not raise the feeder voltage above the ANSI C84.1 or state limit, whichever is more conservative.

3. Existing Distribution Circuit Capacity Limits

The aggregate limit of large (250 kW and over) generators running in parallel with a single, existing distribution circuit is 0.5 MWs on the 4kV, 3MWs on the 12 kV, 6 MWs on the 25 kV, and 10 MWs on the 34 kV.

4. Express Circuit Capacity Limits

Distributed generation installations which exceed the criteria limit for an existing circuit require an express circuit.

The maximum generator size for express circuits, depending on transformer capacity, shall be:

- 4 kV 0.5 MW

- 12 – 13.8 kV 10 MW
- 23 – 25 kV 10 MW
- 33.26 – 34.5 kV 15 MW

5. Distribution Power Transformer Limit
The aggregate limit of large (250 kW and over) generator injection to a single distribution transformer of 22.5 MVA nameplate or larger is 10 MW. Transformers with nameplate ratings lower than 22.5 MVA will be given lower ratings on an individual basis. If the transformer rating is significantly greater than 40 MVA it may be possible to consider a greater generation capacity.

Adding a new transformer will be considered if there is no availability on any of the existing transformers and space is available in an existing substation. Any proposed transformers would be ACE's standard distribution transformer.

6. Express Circuit Length Limit
If there is no space for an additional transformer at the closest substation, the next closest substation will be considered. The length of an express circuit is limited to 5 miles, or for the sake of the feasibility study, 3.8 straight line miles to the substation. This simplification is used because the feasibility study phase does not allow for the time and resources to examine routes in detail (including existing pole lines, easements, ROW, and environmental issues etc.)

7. When a New Substation is Required
If a distribution express circuit can't be built from an existing substation for a project, it will be necessary to construct a new distribution substation with a standard ring bus design. It will be supplied by extending existing transmission lines. It is the developer's responsibility to verify eligibility of this configuration for solar renewable energy certificates.
All limits, given above in MWs, are subject to more detailed study to ensure feasibility.

Transmission Owner Scope of Work

Transmission Owner scope of work required to accommodate 3.1 MW of generation via a new Express Feeder from Tansboro Substation T2:

1. Design and construct one new 12 kV feeder with 477 AAC from Tansboro Substation the generation site – approximately 1.4 miles.
2. Construct one new 12 kV feeder terminal position.
3. Install and operate a utility-owned recloser equipped with the proper relaying and communications.
4. Install and operate utility grade primary metering.
5. Install a direct transfer trip scheme. Approximately 1.4 miles of 48SM ADSS fiber optic cable was estimated for this report to provide the communication channel from Tansboro Substation to the PV site. (Secondary tree-trimming may also be required)
6. Establish generation telemetry and remote trip capability to be provided to the control center via fiber.

High Level Estimates			
Tansboro Substation T2			
477 AAC Express Feeder	1.4	mi.	$805,000
Fiber Installation	1.4	mi.	$173,075
Feeder Terminal			$575,000
Substation Relaying			$320,000
Telecommunications Equipment			$297,850
Recloser & Metering			$92,000
SCADA Integration into EMS			$11,500
Miscellaneous Engineering Costs			$69,000
Approximate Total Cost			$2,343,425

The estimated time to complete this work is **18 - 24 months** after receipt of a fully executed interconnection agreement.

Interconnection Customer Scope of Work

The IC is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report and is the responsibility of the IC.

Protective relaying and metering design and installation must comply with ACE's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

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.

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.

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 a unity power factor ("PF") of (**1.0**) not impacting Volt-ampere reactive ("VARs") continuously.

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 Interconnection Customer 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.

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. 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.

Summer Peak Analysis - 2022

Transmission Network Impacts

Potential transmission network impacts are as follows:

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

Summer Peak Load Flow Analysis Reinforcements

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

Short Circuit

No issues identified.

Stability and Reactive Power Requirement

To be performed during later study phases if required.

Light Load Analysis - 2022

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

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