Generation Interconnection
Feasibility Study Report
Queue Position AD2-065

The Interconnection Customer (IC) has proposed a 5.22 MW (2.19 MWC) solar generating facility to be located in Evesham, Burlington County, New Jersey. PJM studied the AD2-065 project into the Atlantic City Electric Company (ACE) system as an injection into the Atco 12 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2021. AD2-065 was studied with a commercial probability of 53%. The planned in-service date, as requested by the IC during the project kick-off call, is December 1, 2019. This date may not be attainable due to additional required PJM studies and Transmission Owner construction schedules.

Point of Interconnection

The IC requested a distribution level Point of Interconnection. As a result, the AD2-065 project will interconnect with the Atlantic City Electric Company distribution system as follows:

- The first 2.65 MWs of generation will connect to the 69/13 kV T4 transformer at the Atco Substation via a tap of the existing feeder NJ0928.
- The remaining 2.57 MWs of generation will connect to the 69/13 kV T4 transformer at the Atco Substation via a tap of the existing feeder NJ0921.

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 100kW 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 2.65 MW of generation via NJ0928 Kettle Run from Atco Substation T4:

1. Reconductor approximately 1.2 miles of feeder NJ0928.
2. Install a utility operated recloser equipped with the proper relaying and communications.
3. Install utility grade primary metering.
4. Generation telemetry and remote trip capability will be provided to the control center.

High Level Estimates			
Atco Substation T4			
Feeder Reconductoring	1.2	mi.	$552,000
Telecommunications Equipment			$34,500
Recloser & Metering			$103,500
SCADA Integration into EMS			$11,500
Miscellaneous Engineering Costs			$69,000
Approximate Total Cost			$770,500

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

Transmission Owner (T.O.) Scope of Work

Transmission Owner scope of work required to accommodate 2.57 MW of generation via NJ0921 Kings Grant from Atco Substation T4:

1. The IC will be required to install a pole line of approximately 0.6 mi with 3-Phase 477 aluminum conductor to tap near grid location PN31567.
2. Install a utility operated recloser equipped with the proper relaying and communications.
3. Install utility grade primary metering.
4. Generation telemetry and remote trip capability will be provided to the control center.
5. Replace two fixed capacitor banks with switched voltage-controlled capacitor banks.

High Level Estimates			
Atco Substation T4			
Feeder Extension	0.6	mi.	$0
Distribution Line Work			$69,000
Telecommunications Equipment			$34,500
Recloser & Metering			$103,500
SCADA Integration into EMS			$11,500
Miscellaneous Engineering Costs			$69,000
Approximate Total Cost			$287,500

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 purchase and install all metering instrument transformers as well as construct a metering structure per ACE's specifications. The secondary wiring connections at the instrument transformers will be completed by the IC's contractors and inspected by ACE, while the secondary wiring work at the metering enclosure will be completed by ACE's Meter technicians. The metering control cable and meter cabinets will be supplied by ACE and installed by the IC's contractors. ACE's meter technicians will program and install two solid state multi-function meters (Primary & Backup) for the new metering position. Each meter will be equipped with load profile, telemetry, and form-c pulse outputs. The ownership of metering equipment purchased or installed by the IC shall be transferred to the Transmission Owner at Commercial Operation, unless the IC asserts its right to install, own and operate the metering system.

Inverter Requirements and Capabilities

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 shall operate in accordance with the latest IEEE 1547 series of standards that have been approved and use default settings except when specified otherwise by ACE. The PV owner/operator shall cooperate with ACE to implement these capabilities with settings acceptable to ACE. ACE reserves the right to request setting changes in the future if needed to maintain electrical system integrity.

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.

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.

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. The Company (Pepco, ACE, and DPL) 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 Interconnection Customer's responsibility to send the data that PJM and the Company requires directly to PJM. The Interconnection Customer will grant permission for PJM to send the Company the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator breaker status or inverter status, and interval MWH and MVARH.

3. The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each Company 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 Company Distribution Engineering.

5. Company reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering and telecommunications facilities, owned by Company.

Summer Peak Analysis - 2020

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.

Light Load Analysis - 2021

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

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. (PSEG - PSEG) The GLOUCSTR_2-CAMDEN 230 kV line (from bus 219110 to bus 219125 ckt 1) loads from 99.98% to 100.01% (**DC power flow**) of its emergency rating (700 MVA) for the single line contingency outage of 'PS_P1-2_C-2308'. This project contributes approximately 0.43 MW to the thermal violation.

   CONTINGENCY 'PS_P1-2_C-2308'/* CUTHBERT TO GLOUCESTER
   DISCONNECT BUS 219753/* CUTHBERTH SECTOIN 2
   END

Facilities Study Estimate
(If a Facilities Study is required, provide the estimated duration and cost estimate to perform Facilities Study)

If a study is required, the deposit will be $50,000 and will take approximately 8 months to complete.