Generation Interconnection
Feasibility Study Report
Queue Position AE1-012

The Interconnection Customer (IC) has proposed a 0.54 MW Energy (0.22 MW Capacity) solar generating facility to be located near the intersection of State St. and 64th Ave in Landover, Maryland. PJM studied the AE1-012 project into the Potomac Electric Power Company (PEPCO) system as an injection into the Tuxedo 115 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. AE1-012 was studied with a commercial probability of 53%. The planned in-service date, as requested by the IC, is September 30, 2019. This date may not be attainable due to required PJM studies and the Transmission Owner's construction schedule.

Point of Interconnection

The IC requested a distribution level interconnection with capacity given on the first available feeder within reasonable vicinity of the property that can accommodate the generation. As a result, the AE1-012 project will connect to the PEPCO distribution system at the Tuxedo 115/13 kV Substation via Feeder 14109.

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 limit for an existing circuit require an express circuit.

The maximum generator size for express circuits 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 MWs. 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 PHI'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

TO work required to accommodate 0.54 MW of generation on existing feeder 14109 from Tuxedo Substation:

1. A utility operated recloser equipped with the proper relaying and communications will be required, unless further studies note otherwise.
2. Utility grade primary metering will be required.
3. Generation telemetry and remote trip capability will be provided to the control center, unless further studies note otherwise.
4. A detailed, time-based study may be performed during later study phases.
5. Protection, Planning, and other engineering departments will perform studies, design work, and prepare engineering estimates.
6. The feeder 14109 will require a three-phase tap and extension of 477 AAC with necessary equipment from State St. along 64th Ave. to POI. The extension is approximately 0.1 miles long to the property line.

Estimated Costs			
Tuxedo Substation via 14109			
3-Phase Feeder Extension	0.1	miles	$50,000
Recloser & Metering			$60,000
SCADA Integration into EMS			$10,000
Various Departments Work			$30,000
Subtotal Cost			$150,000
Approximate Total Cost with 15% Contingency			$172,500

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 Interconnection Customer (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 PHI'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.

Inverter Requirements and Capabilities

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

electrical system integrity. The inverters shall be capable of operating at a fixed power factor value between 0.95 lead and 0.95 lag. The value is supplied below:

1. Operate inverters at a unity power factor ("PF") of (**1.00**)

Note: In the future, PEPCO reserves the right to issue new fixed power factor setting requirements (0.95 lead to 0.95 lag) if necessary.

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

PEPCO will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker, a line recloser, or other method depending upon the specific circumstances and the evaluation of PEPCO.

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 PEPCO Distribution Engineering. When the trip command is sent to customer equipment rather than a utility owned recloser, the customer must have a circuit breaker capable of locking out, a lockout relay, or inverter logic that does not allow the inverters to automatically reconnect. The IC is responsible for calling PEPCO System Operations before manually reconnecting with the grid. The phone number to System Operations should be clearly displayed next to the circuit breaker or inverter controls.

As the study was performed with the generator on the transformer that it will be served from during normal conditions, the IC will not be allowed to generate when the feeder either is served by an alternate transformer or is in an alternate configuration.

High Voltage Warning

Voltage received at the meter from the utility can be 105% of nominal. 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. Transformers with no load taps should be used to reduce the voltage by 2.5% to avoid the possibility of inverter trips. Failure to account for this may result in lost energy production.

Equipment Requirements

Any transformers on the Interconnection Customer's side must be Wye grounded on the utility side or alternatively 3 phase potential transformers and a relay capable of detecting over/under voltage shall be installed to detect an undesirable condition on the high side of the IC's transformer.

Additional Operating Requirements

1. Pepco 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 or Pepco signal to customer's generator breaker.

2. It is the IC's responsibility to send the data that PJM and Pepco require directly to PJM. The Interconnection Customer will grant permission for PJM to send Pepco the following telemetry that the Interconnection Customer sends to PJM: real time megawatts, megavars, phase voltages, phase currents, and generator breaker status.

3. The IC will be required to make provisions for a voice quality phone line within approximately 3 feet of each Pepco metering position to facilitate remote interrogation and data collection.

4. The IC will be required to submit a final Relay Coordination Study for review and approval by Pepco System Protection.

5. 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 Pepco Distribution Engineering.
6. Pepco 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 Pepco.

7. This study was performed with the generator on the transformer that it will be served from during normal conditions. IC will not be allowed to generate when the feeder is served by an alternate transformer.

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).

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