Generation Interconnection Feasibility Study Report Queue Position AE2-337

The Interconnection Customer (IC) has proposed a 2.4 MW Energy (1.0 MW Capacity solar generating facility to be located in Temple Hills, MD 20745, near the intersection of Wheeler Rd. and Wheeler Hills Rd. PJM studied AE2-337 as a 2.4 MW injection into the Potomac Electric Power Company's (PEPCO) distribution system at the Palmers 69 kV Substation (PSSE bus # 223999) and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. The Interconnection Customer's planned in-service date is December 2020. This date may not be attainable due to required PJM studies and the Transmission Owner's construction schedule.

Point(s) of Interconnection

The IC requested a distribution level interconnection. As a result, the AE2-337 project will connect to the PEPCO distribution system at the St. Barnabas 69/13 kV Substation via an express feeder to be built by a preceding queue project AD2-199 or AE2-337. Each Point of Interconnection, associated scope of work and cost estimates provided are distinct.

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 (TO) Scope of Direct Connect Work

TO work required to accommodate 2.4 MW of generation on express feeder 15xxx from St. Barnabas Substation:

1. A utility operated recloser equipped with the proper relaying and communications will be required.
2. Utility grade primary metering will be required.
3. Generation telemetry and remote trip capability will be provided to the control center.
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 pending express feeder 15xxx, to be built by a preceding queue project, will require a three-phase tap and extension from Wheeler Rd to POI on property line. The extension is approximately 0.09 miles long.
7. Direct Transfer Trip via Fiber from substation, along express feeder to POI will need to be implemented due to aggregate amount of generation.
8. If the voltage regulators in the substation are not properly equipped to handle the reverse power flow that the generator may cause, adjustments to their controllers or upgrades of the entire regulator will be required at the expense of the IC.

Approximate Cost Estimate			
Interconnection to St. Barnabas Substation			
3-Phase Feeder Extensions	0.1	miles	$80,000
*3-Phase Express Feeder	2.15	miles	$759,000
*DTT Fiber	2.15	miles	$215,000
Recloser & Metering			$60,000
SCADA Integration into EMS			$10,000
Dynamic Study			$30,000
Various Departments Work			$60,000
Subtotal Cost			$1,214,000
Approximate Total Cost with 15% Contingency			$1,396,100

Note: Shall circumstances change where the pending express feeder is removed from the scope of preceding queue projects AD2-199 and/or AE2-336 and existing feeders do not have 2.4MW capacity, AE2-337 will need to construct the express feeder.

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

Transmission Owner System Reinforcements

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Failed 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

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

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.

Interconnection Customer Scope of Direct Connection Work

Equipment Requirements

Any transformers on the 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 customer's transformer.

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
- Low voltage and system disturbance ride through
- 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

The inverter shall operate in accordance with the IEEE 1547 series of standards that have been approved. While inverters should be capable of voltage stabilization thru dynamic VAR response and capable of low voltage and system disturbance ride through, neither of these capabilities shall 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 PV owner/operator shall cooperate with the Company (the 'Company' referring to ACE, DPL, or PEPCO) to implement these capabilities with settings acceptable to the Company. It is the responsibility of the owner 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.

Additional Operating Requirements

1. The Company 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 and/or system generator output breaker.
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 megawatts, megavars, phase voltages, phase currents, and generator breaker status.
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. The Interconnection Customer will be required to submit a final Relay Coordination Study for review and approval by Company 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 Company Distribution Engineering.
6. 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.
7. Study was performed with the generator on the transformer(s) that it will be served from during normal conditions. Customer will not be allowed to generate when the feeder is served by an alternate transformer.