Generation Interconnection
Feasibility Study Report
Queue Position X4-029

The Interconnection Customer (IC) has proposed a 10 MW Energy only (0 MWC; 10 MW MFO) solar powered generating facility to be located in Upper Deerfield, Cumberland County, New Jersey. PJM studied X4-029 as a 10 MW injection into the Atlantic City Electric Company (ACE) system at the Carlls Corner substation and evaluated the project for compliance with reliability criteria for summer peak conditions in 2015. The planned in-service date, as stated in the Attachment N, is January 2, 2013.

Point(s) of Interconnection

The IC requested a Point of Interconnection (POI) for X4-029 at the 12.47 kV distribution level. As a result, the X4-029 project will interconnect with the Atlantic City Electric system at the Carlls Corner 69/12V substation as discussed below.

Direct Connection Requirements and Point(s) of Interconnection Conclusions

POI Discussion and Conclusions

Description of Atlantic City Electric (ACE) policy.

1. Existing 12kV Distribution Circuit

The aggregate limit of large (250 kW and over) generator injection to a single, existing 12kV distribution circuit is 3 MWs. This project exceeds this limit and the existing circuit will not be used for this reason.

2. Express Feeder

Distributed generation larger than 3 MW's interconnecting at 12 kV require an express feeder to avoid undesired interaction with automatic line equipment and so that other customers on the distribution system avoid experiencing any voltage and power quality issues that may exist. An express feeder is limited to 10 MW.

Laurel Street substation was identified as the closest substation based on the site location supplied in the application and/or kick-off call. Laurel Street substation has one 69/12 kV transformer. The aggregate limit of large (250 kW and over) generator injection to a single 22.5 MVA or larger distribution transformer is 10 MWs. The transformer at Laurel Street, which is smaller than 22.5 MVA, would be able to accommodate less than 10 MW.

As of when this report was created the T4 transformer at Laurel Street cannot accept any additional generation. 10 MW of a PJM project is being studied. This transformer must be replaced in order to accept 10 MW of generation.

Carlls Corner Substation was identified as the second closest substation based on the site location supplied in the application and/or kick-off call. Carlls Corner has two (2) 69/12 kV transformers. Both transformers are larger than 22.5 MVA.

The T3 and T4 transformers at Carlls Corner cannot accept the full amount of this project. On the T3 transformer, 8.5 MW of Net Energy Metering projects have requested to connect and 1.5 MW of other generation is installed. On the T4 transformer, a 250 kW Net Energy Metering project and a 4.8 MW generator are connected. 4.9 MW of availability remain on the T4 transformer. The addition of a new distribution transformer at Carlls Corner was determined to be feasible as part of this study. All new transformers built will be ACE's standard distribution transformer (37 MVA nameplate rating.)

As a result, the project will interconnect with the Atlantic City Electric system at Carlls Corner substation via a new 12 kV express feeder to the existing T4 transformer and a new 12 kV express feeder to a new 37 MVA transformer.

All injection limits, given above in MWs, are subject to more detailed study to ensure feasibility.

Direct Connection Requirements

Transmission Owner Scope of Work

The study will examine connecting 4.9 MWs of PV generation to the Carlls Corner T4 transformer and 5.1 MWs to a new transformer at the Carlls Corner Substation.

1. One (1) new 37 MVA 69/12 kV transformer will be added at Carlls Corner Substation. In order to add this connection, the 69 kV bus must be extended and a new high side 69 kV breaker will be added for protection.
2. One (1) new 12 kV feeder terminal position will be constructed on the T4 transformer.
3. One new 12 kV feeder will be constructed from Carlls Corner Substation to the PV site – a distance of approximately 3.25 miles. Though space does not permit the addition of an overhead line in this location, underground concrete duct bank with 1000 MCM Cu cable can be used.
4. The second 12 kV 1000 MCM Cu feeder would be installed in the same duct bank.
5. A utility operated recloser equipped with the proper relaying and communications will be installed for each feeder serving the PV generator.
6. Utility grade primary metering will be required for each feeder.
7. Generation telemetry and remote trip capability will be provided to ACE’s Energy Management System with future capability to adjust output and power factor if needed.
8. A detailed, time-based study may be performed during later study phases.
9. Protection, Planning, and other engineering departments will perform studies, design work, and prepare engineering estimates.
10. Transfer trip will be required. Approximately 3.25 miles of 48SM ADSS fiber optic cable is required to provide the communication channel from Carlls Corner Sub to the PV site.

The estimated cost to perform this work is:

Estimated Costs			
Carlls Corner Substation			
New Transformer and 69 kV Bus Upgrade*			$5,000,000
12 KV Feeder Terminal Installation on T4*			$400,000
UG Express Feeder #1			$6,000,000
UG Express Feeder #2			$3,000,000
Fiber Installation*	3.25	Miles	$162,500
Recloser w/ Relaying and Communications (2)			$100,000
Primary Meters (2)			$40,000
SCADA Integration into EMS			$10,000
Detailed Time Based Study			$30,000
Various Departments Work			$20,000
Subtotal Cost			$14,762,500
Subtotal Cost with 18% Overheads			$17,419,750
Approximate Total Cost with 15% Contingency			$20,032,713

*Standard estimates were used above which are not specific to this project.

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

Additional Operating Requirements

1. ACE will require the capability to remotely trip the generator from its System Operations facility. Such tripping may be facilitated by either a generator breaker, inverter (if so equipped), or a line recloser, depending upon the specific circumstances and the evaluation by ACE.

2. It is the Interconnection Customer's responsibility to send the data that PJM and ACE requires directly to PJM. The Interconnection Customer will grant permission for PJM to send ACE the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator/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 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 Engineering.

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.

The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. Protective relaying and metering design and installation must comply with ACE's Applicable Standards.

The Interconnection Customer 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 Interconnection Customer'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 Interconnection Customer'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.

Inverter Requirements and Capabilities

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

- Voltage flicker reduction through dynamic VAR response and fixed PF control
- 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 ACE to implement these capabilities with settings acceptable to ACE. Until such time, the inverters shall operate with a fixed power factor schedule as supplied by ACE.

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, Line with 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

Short Circuit

No issues identified.

Stability Analysis

Not required due to project size.

Dynamic Analysis

ACE will commence a time-based dynamic study during the System Impact Study phase to evaluate the project's impact on the ACE distribution system. Once complete, the results of the study will be reviewed and the proposed project will be evaluated for protection and coordination issues. Other required upgrades may be identified at that time.

System Protection

Protective relaying and metering design and installation must comply with ACE's applicable standards. Any other costs determined by system protection as a result of the short circuit studies will be supplied in the near future.

Other Charges

ACE reserves the right to charge the Interconnection Customer Operation and Maintenance expenses to maintain the Interconnection Customer's Attachment Facilities, including metering and telecommunications facilities which are owned by ACE.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts," initially caused by the addition of this project's generation)

None

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.

None

Potential Congestion due to Local Energy Deliverability

(PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full deliverability for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

These are ***not*** required reliability upgrades.

1. The CRLS CR2-SHRMAN#2 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 175.76% to 184.05% (DC power flow) of its rating (56 MVA) for the single line contingency ('NEWPORT-SM'). This project contributes approximately 5.23 MW to the thermal violation.