Generation Interconnection
Feasibility Study Report
W4-028

The Interconnection Customer (IC) has proposed a 20 MWE (7.6 MWC) solar powered generating facility consisting of ground mounted fixed panel solar arrays to be located in Quinton Township, Salem County, New Jersey. PJM studied W4-028 as a 20 MW injection into the Atlantic City Electric (ACE) system at the Quinton 69/12kV substation and evaluated the project for compliance with reliability criteria for summer peak conditions in 2014. The planned in-service date, as stated in the Attachment N, is June 30, 2012.

Point(s) of Interconnection

W4-028 will interconnect with the Atlantic City Electric system at a new 3 breaker ring bus 69/12kV substation to be constructed adjacent to the Deepwater-Quinton 69kV circuit.

Direct Connection Requirements

Transmission Owner Scope of Direct Connection Work

The scope of work and estimated costs for the direct connection facilities is as follows:

1. Design and construct a new 69/12 kV substation at the PV site. This substation will be built to the Company's (the "Company" referring to ACE, DPL, or PEPCO) specifications for a distribution substation and be owned and operated by the Company. *Note: There are no plans to serve any load from this substation, however it will be built so that it can serve load in the future. The developer shall supply adequate land for the installation of the substation. The land shall be in close proximity to roads and be on buildable high land.*
2. Create a transmission loop by cutting into the Deepwater-Quinton 69 kV line with an approximate total distance of 1 miles to the new substation.
3. Establish two new 12 kV feeders with PAC overhead conductor from the new substation to the PV site.
4. A utility operated recloser equipped with the proper relaying and communications will be required for each feeder serving the PV generator.
5. Utility grade primary metering will be required for each feeder.
6. Generation telemetry and remote trip capability will be provided to the control center.
7. Perform a detailed time based study.
8. Protection, Planning, and other engineering departments will perform studies, design work, and prepare engineering estimates.
9. Transfer trip may be required.

The estimated cost to perform this work is:

Estimated Costs			
New Substation			
New Substation (2 transformers)			$6,503,000
PAC Express Feeder (2)	0.2	Miles	$80,000
Transmission Feed 69 kV	1	Miles	$650,000
Transmission Feed 138 kV	0	Miles	$0
Fiber Installation (5 miles of fiber assumed)			$250,000
Recloser w/ Relaying and Communications		2	$100,000
Utility Grade Metering		2	$40,000
SCADA Integration into EMS		2	$20,000
Detailed Time Based Study			$30,000
Various Departments Work			$20,000
Subtotal Cost			$7,693,000
Subtotal Cost with 18% Overheads			$9,077,740
Approximate Total Cost with 15% Contingency			$10,439,401

The estimated time to complete this work is **24 - 36 months** after receipt of a fully executed Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (CSA).

Note: the above cost does not include the Contribution in Aid of Construction (CIAC) tax.

Special Operating Requirements

1. The Transmission Owner (TO) 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 of the TO.

2. The Interconnection Customer will grant its permission to PJM for PJM to send to the TO all telemetry that the Interconnection Customer sends to PJM. For generation larger than 10 MW connected to a single Point of Interconnection, a direct telemetry connection to PHI System Operations will be required via a radial connection to PHI's telecommunications system or a rented data circuit, at the Interconnection Customer's request.

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

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) assumes full responsibility for design and construction of all facilities associated with the W4-028 generating station. 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 Atlantic City Electric's Applicable Standards.

Inverter Requirements and Capabilities

The Interconnection Customer's inverter should have the following capabilities:

1. Voltage flicker reduction through dynamic VAR response
2. Ramp rate control
3. SCADA communications
4. Curtailment or other mitigation ability if high voltage were to occur
5. Low voltage and system disturbance ride through
6. Ability to receive and respond to a transfer trip or SCADA 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 Pepco Holdings, Inc. (ACE, DPL, and Pepco). Until such time, the inverters shall operate with a fixed power factor schedule as supplied by PHI.

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)*

1. (AE) The Wheaton Alt Tap-Second Street #1 69 kV line (from bus 228233 to bus 228225 ckt 1) loads from 99.22% to 100.2% (DC power flow) of its emergency rating (74 MVA) for the single contingency 'SO MIL-BUT_W2-39B'. This project contributes approximately 0.73 MW to the thermal violation.

Multiple Facility Contingency

*(Double Circuit Tower Line, Line with Failed Breaker and, Bus Fault contingencies for the **Full** energy output.*

2. (AE) The Pennsgrove-Oldman 69 kV line (from bus 228328 to bus 228327 ckt 1) loads from 99.93% to 100.3% (DC power flow) of its emergency rating (75 MVA) for the tower contingency 'AE12TOWER'. This project contributes approximately 1.74 MW to the thermal violation.

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)

1. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 205.19% to 209.05% (DC power flow) of its emergency rating (54 MVA) for the tower contingency 'AE12TOWER'. This project contributes approximately 2.09 MW to the thermal violation.

2. (AE) The Woodstown #1-W3-163TAP 69 kV line (from bus 228332 to bus 904820 ckt 1) loads from 149.50% to 153.36% (DC power flow) of its emergency rating (54 MVA) for the tower contingency 'AE12TOWER'. This project contributes approximately 2.09 MW to the thermal violation.

3. (AE) The W1-085TAP1-South Millville 69 kV line (from bus 901640 to bus 228228 ckt 1) loads from 245.33% to 249.11% (DC power flow) of its emergency rating (60 MVA) for the tower contingency 'AE11TOWER'. This project contributes approximately 2.27 MW to the thermal violation.

Short Circuit

None

Stability Analysis

Not required due to project size.

Dynamic Analysis

A time-based dynamic study will commence during the System Impact Study phase of the project. 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.

Other Charges

It is anticipated that the Interconnection Customer will be charged for ongoing operation and maintenance of the attachment facilities. The methodology of calculating this charge is still under development.

New System Reinforcements

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

1. To mitigate the Wheaton Alt Tap-Second Street #1 69 kV line (from bus 228233 to bus 228225 ckt 1) load will require an adjustment to a relay limit. The cost and duration to make the adjustment is under review and will be provided in the System Impact Study.

2. To mitigate the Pennsgrove-Oldman 69 kV line overload will require upgrading the Oldmans 477 Al strand bus to 1200 amp minimum at the Pennsgrove substation. The estimated cost to perform this work is **$120,000** and will take an estimated **12 to 18 months** to perform.

Contribution to Previously Identified System Reinforcements

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

1. To mitigate the Woodstown-W3-163Tap-Clayton 69kV line overload will require reconductoring the circuit from the intersection of Route 77 and the Woodstown-Clayton 69 kV line (proposed location of connection of W3-163) to the Clayton substation, a distance of 9.5 miles with 795 ACSR. The estimated cost to perform this work is **$3,300,000** and will take **18 to 24 months** to complete.

2. See item 1 above for reinforcement.

3. To mitigate the W1-085TAP1-South Millville 69kV line overload will require the reconductoring of approximately 2.9 miles of circuit with 795 ACSR conductor. The estimated cost to perform this work is **$1,500,000** and will take **24-36 months** to complete.

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. (AE) The Laurel-Woodstown 69 kV line (from bus 228218 to bus 228360 ckt 1) loads from 94.50% to 101.58% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'D/W-QUINT'. This project contributes approximately 7.64 MW to the thermal violation.

2. (AE) The Laurel-Laurel 69 kV line (from bus 228259 to bus 228218 ckt 1) loads from 116.52% to 122.2% (DC power flow) of its emergency rating (149 MVA) for the operational contingency 'USLC-SM_V4-036B_WITH_W1-085B'. This project contributes approximately 8.47 MW to the thermal violation.

3. (AE) The W2-035TAP1-Laurel 69 kV line (from bus 902480 to bus 228259 ckt 1) loads from 76.53% to 111.02% (DC power flow) of its emergency rating (58 MVA) for the operational contingency 'D/W-QUINT'. This project contributes approximately 20.00 MW to the thermal violation.

4. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 180.28% to 180.8% (DC power flow) of its emergency rating (54 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 1.75 MW to the thermal violation.

5. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 187.43% to 188.04% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 1.66 MW to the thermal violation.

6. (AE) The Woodstown #1-W3-163TAP 69 kV line (from bus 228332 to bus 904820 ckt 1) loads from 118.53% to 122.47% (DC power flow) of its emergency rating (54 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 2.12 MW to the thermal violation.

7. (AE) The Woodstown #1-W3-163TAP 69 kV line (from bus 228332 to bus 904820 ckt 1) loads from 121.01% to 121.61% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 1.66 MW to the thermal violation.

8. (AE) The Fairton-Newport 69 kV line (from bus 228214 to bus 228219 ckt 1) loads from 152.29% to 159.93% (DC power flow) of its emergency rating (48 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 3.67 MW to the thermal violation.

9. (AE) The Newport-Us Silica Tap 69 kV line (from bus 228219 to bus 228222 ckt 1) loads from 109.43% to 116.1% (DC power flow) of its emergency rating (55 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 3.67 MW to the thermal violation.

10. (AE) The W4-083 TAP-W2-035TAP1 69 kV line (from bus 905730 to bus 902480 ckt 1) loads from 48.95% to 83.43% (DC power flow) of its emergency rating (58 MVA) for the operational contingency 'D/W-QUINT'. This project contributes approximately 20.00 MW to the thermal violation.

11. (AE) The Sherman-Sherman #1 69 kV line (from bus 228226 to bus 228256 ckt 1) loads from 88.30% to 91.79% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'USLC-SM_V4-036B_WITH_W1-085B'. This project contributes approximately 3.76 MW to the thermal violation.

12. (AE) The Us Silica Tap-V4-036TAP1 69 kV line (from bus 228222 to bus 900350 ckt 1) loads from 100.00% to 104.13% (DC power flow) of its emergency rating (89 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 3.67 MW to the thermal violation.

13. (AE) The Us Silica Tap-V4-036TAP1 69 kV line (from bus 228222 to bus 900350 ckt 1) loads from 95.43% to 98.54% (DC power flow) of its normal rating (65.6999969482 MVA) for non contingency condition. This project contributes approximately 2.04 MW to the thermal violation.

14. (AE) The V4-036TAP1-W1-085TAP1 69 kV line (from bus 900350 to bus 901640 ckt 1) loads from 146.44% to 150.29% (DC power flow) of its normal rating (53 MVA) for non contingency condition. This project contributes approximately 2.04 MW to the thermal violation.

15. (AE) The Carlls Corner-Sherman 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 199.08% to 208.46% (DC power flow) of its emergency rating (56 MVA) for the operational contingency 'NEWPORT-SM'. This project contributes approximately 5.25 MW to the thermal violation.

16. (AE) The Carlls Corner-Sherman 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 144.63% to 153.92% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 4.09 MW to the thermal violation.

17. (AE) The Woodstown-Woodstown #1 69 kV line (from bus 228360 to bus 228332 ckt 1) loads from 130.16% to 133.45% (DC power flow) of its emergency rating (74 MVA) for the operational contingency 'USLC-SM_V4-036B_WITH_W1-085B'. This project contributes approximately 2.43 MW to the thermal violation.

18. (AE) The Quinton-Deepwater 69 kV line (from bus 228329 to bus 228323 ckt 1) loads from 95.48% to 112.16% (DC power flow) of its emergency rating (72 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 12.01 MW to the thermal violation.

19. (AE) The Quinton-Deepwater 69 kV line (from bus 228329 to bus 228323 ckt 1) loads from 78.63% to 98.0% (DC power flow) of its normal rating (58 MVA) for non contingency condition. This project contributes approximately 11.23 MW to the thermal violation.

20. (AE) The W1-085TAP1-South Millville 69 kV line (from bus 901640 to bus 228228 ckt 1) loads from 261.54% to 265.39% (DC power flow) of its normal rating (53 MVA) for non contingency condition. This project contributes approximately 2.04 MW to the thermal violation.