Generation Interconnection
Feasibility Study Report
W4-041

The Interconnection Customer (IC) has proposed a 20 MWE (7.6 MWC) solar powered generating facility consisting of ground mounted, fixed panel, solar photovoltaic arrays. The project is to be located in Upper Deerfield Township, Cumberland County, New Jersey. PJM studied W4-041 as a 20 MW injection into the Atlantic City Electric (ACE) system at the Carlls Corner 69kV substation. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2014. The proposed in-service date, as stated in Attachment N, is September 1, 2012.

Point of Interconnection

W4-041 will interconnect with the Atlantic City Electric transmission system at the Carlls Corner 69kV substation.

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:

Substation Engineering Estimate:
Scope: Construct a new 69kV terminal at existing Carlls Corner Substation
Estimate: $800,000
Construction Time: 24 – 36 months

Transmission Engineering Estimate:
Scope: Install a self-supporting 69kV steel pole with a concrete foundation, motor operated disconnects and a short span to PHI substation
Estimate: $125,000
Construction Time: 24 months.
Note: If location of generator is greater than 500 feet from substation, circuit breaker will be necessary

Note: Additional costs upon further engineering review may result. Additionally, Contribution in Aid of Construction (CIAC) tax will be included upon further study.

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) is responsible for all design and construction related 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. The Interconnection Customer will be responsible for contributing to future O & M costs associated with the direct connect facilities.

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. PHI will require the capability to remotely trip the generator from its System Operations facility. The interconnected customer will grant its permission for PJM to send PHI all telemetry that the Interconnection Customer sends to PJM. The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each PHI metering position to facilitate remote interrogation and data collection.

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 Carlls Corner-Sherman 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 99.47% to 113.04% (DC power flow) of its emergency rating (56 MVA) for the single contingency 'CARLL-LAUR'. This project contributes approximately 7.60 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.*

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)

1. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 209.05% to 209.6% (DC power flow) of its emergency rating (54 MVA) for the tower contingency 'AE12TOWER'. This project contributes approximately 1.83 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 153.36% to 153.91% (DC power flow) of its emergency rating (54 MVA) for the tower contingency 'AE12TOWER'. This project contributes approximately 1.83 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 249.11% to 254.04% (DC power flow) of its emergency rating (60 MVA) for the tower

contingency 'AE11TOWER'. This project contributes approximately 2.96 MW to the thermal violation.

Short Circuit

Any other costs determined by system protection as a result of the short circuit studies will be supplied in the near future.

Stability Analysis

Not required due to project size.

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 Carlls Corner-Sherman #2 69kV line overload will require the replacement of 7.90 miles of conductor with a conductor rated at least 1300A. The estimated cost to perform this work is **$5,500,000** and will take **18 to 24 months** to complete.

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 the reconductoring of 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 reinforcement in item 1 above.

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 to 36 months** to compete.

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-W2-035TAP1 69 kV line (from bus 228259 to bus 902480 ckt 1) loads from 111.19% to 119.05% (DC power flow) of its emergency rating (58 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 4.56 MW to the thermal violation.

2. (AE) The Laurel-Woodstown 69 kV line (from bus 228218 to bus 228360 ckt 1) loads from 101.58% to 107.97% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'D/W-QUINT'. This project contributes approximately 6.90 MW to the thermal violation.

3. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 180.80% to 181.32% (DC power flow) of its emergency rating (54 MVA) for the operational contingency 'MICK-BRIDG'. This project contributes approximately 1.71 MW to the thermal violation.

4. (AE) The W3-163TAP-Clayton 69 kV line (from bus 904820 to bus 228405 ckt 1) loads from 188.04% to 188.64% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 1.64 MW to the thermal violation.

5. (AE) The W3-018TAP1-Deepwater 69 kV line (from bus 903370 to bus 228323 ckt 1) loads from 107.35% to 110.56% (DC power flow) of its emergency rating (72 MVA) for the operational contingency 'CLAY-WOOD_W3-163B'. This project contributes approximately 2.31 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 122.47% to 127.32% (DC power flow) of its emergency rating (54 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 2.62 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 121.61% to 122.22% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 1.64 MW to the thermal violation.

8. (AE) The Fairton-Newport 69 kV line (from bus 228214 to bus 228219 ckt 1) loads from 159.93% to 173.04% (DC power flow) of its emergency rating (48 MVA) for the operational

contingency 'CARLL-SHERM'. This project contributes approximately 6.29 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 116.10% to 127.54% (DC power flow) of its emergency rating (55 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 6.29 MW to the thermal violation.

10. (AE) The Sherman-Sherman #1 69 kV line (from bus 228226 to bus 228256 ckt 1) loads from 91.79% to 98.53% (DC power flow) of its emergency rating (108 MVA) for the operational contingency 'USLC-SM_V4-036B_WITH_W1-085B'. This project contributes approximately 7.29 MW to the thermal violation.

11. (AE) The Wheaton Alt Tap-Second Street #1 69 kV line (from bus 228233 to bus 228225 ckt 1) loads from 218.57% to 222.19% (DC power flow) of its emergency rating (74 MVA) for the operational contingency 'SO MIL-BUT_W2-39B'. This project contributes approximately 2.68 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 104.13% to 111.19% (DC power flow) of its emergency rating (89 MVA) for the operational contingency 'CARLL-SHERM'. This project contributes approximately 6.29 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 98.54% to 102.9% (DC power flow) of its normal rating (65.6999969482 MVA) for non contingency condition. This project contributes approximately 2.86 MW to the thermal violation.

14. (AE) The Roadstown Tap-Quinton 69 kV line (from bus 228223 to bus 228329 ckt 1) loads from 117.66% to 125.81% (DC power flow) of its emergency rating (56 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 4.56 MW to the thermal violation.

15. (AE) The Roadstown Tap-Quinton 69 kV line (from bus 228223 to bus 228329 ckt 1) loads from 95.22% to 101.81% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 2.90 MW to the thermal violation.

16. (AE) The W2-035TAP1-W4-083 TAP 69 kV line (from bus 902480 to bus 905730 ckt 1) loads from 123.46% to 131.32% (DC power flow) of its emergency rating (58 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 4.56 MW to the thermal violation.

17. (AE) The V4-036TAP1-W1-085TAP1 69 kV line (from bus 900350 to bus 901640 ckt 1) loads from 150.29% to 155.69% (DC power flow) of its normal rating (53 MVA) for non contingency condition. This project contributes approximately 2.86 MW to the thermal violation.

18. (AE) The Carlls Corner-Sherman 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 208.46% to 226.79% (DC power flow) of its emergency rating (56 MVA) for the operational contingency 'NEWPORT-SM'. This project contributes approximately 10.26 MW to the thermal violation.

19. (AE) The Carlls Corner-Sherman 69 kV line (from bus 228252 to bus 228226 ckt 1) loads from 153.92% to 173.53% (DC power flow) of its normal rating (44 MVA) for non contingency condition. This project contributes approximately 8.63 MW to the thermal violation.

20. (AE) The Woodstown-Woodstown #1 69 kV line (from bus 228360 to bus 228332 ckt 1) loads from 133.45% to 138.7% (DC power flow) of its emergency rating (74 MVA) for the operational contingency 'USLC-SM_V4-036B_WITH_W1-085B'. This project contributes approximately 3.88 MW to the thermal violation.

21. (AE) The Quinton-Deepwater 69 kV line (from bus 228329 to bus 228323 ckt 1) loads from 112.16% to 118.49% (DC power flow) of its emergency rating (72 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 4.56 MW to the thermal violation.

22. (AE) The Quinton-Deepwater 69 kV line (from bus 228329 to bus 228323 ckt 1) loads from 98.00% to 103.0% (DC power flow) of its normal rating (58 MVA) for non contingency condition. This project contributes approximately 2.90 MW to the thermal violation.

23. (AE) The W4-083 TAP-Roadstown Tap 69 kV line (from bus 905730 to bus 228223 ckt 1) loads from 123.44% to 131.3% (DC power flow) of its emergency rating (58 MVA) for the operational contingency 'WOOD-LAUR'. This project contributes approximately 4.56 MW to the thermal violation.

24. (AE) The W1-085TAP1-South Millville 69 kV line (from bus 901640 to bus 228228 ckt 1) loads from 265.39% to 270.79% (DC power flow) of its normal rating (53 MVA) for non contingency condition. This project contributes approximately 2.86 MW to the thermal violation.

25. (AE) The South Millville-Ball Foster North Tap 69 kV line (from bus 228228 to bus 228215 ckt 1) loads from 224.68% to 228.4% (DC power flow) of its emergency rating (72 MVA) for the operational contingency 'SO MIL-BUT_W2-39B'. This project contributes approximately 2.68 MW to the thermal violation.