

# **ENGINEERING REPORT**

WCP Solar

Naperville, Illinois

PERFORMED BY:  
HIGH VOLTAGE ELECTRIC  
CHICAGO GROUP

**PROJECT: C12049**

July 19, 2012

WCP Solar, Ground-Fault Capacity Testing

Attention: Mr. David Lewenz,

Subject: Solar Array Ground Fault Capacity Testing

PROJECT: #C12049

Enclosed is the Engineering report detailing the project that **HIGH VOLTAGE ELECTRIC CORP – HVE** recently completed at the WCP SOLAR facility in Naperville, Illinois. HVE is a full service independent testing company and appreciates the opportunity to provide your system review and engineering services.

Our mission is to provide an independent technical service to enhance the safety, reliability and efficiency of electrical systems and provide a one-stop solution for quality electrical services locally.

Thank you for the opportunity to provide this service. Please contact us if you have any questions or wish to know more about HVE services.

Respectfully Submitted,

HVE Corporation  
Chicago Group

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Naperville, IL

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Project **#C12049** Solar Array Ground Fault Capacity Testing

**SECTION 1**      **SCOPE; PURPOSE; PROCEDURE;  
APPRAISAL AND RECOMMENDATIONS**

**SECTION 2**      **Test Report Data**

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Solar Array Ground Fault Capacity Testing

SECTION I

**SCOPE:**

On July 17, 2011, *HIGH VOLTAGE ELECTRIC* provided Electrical Testing and inspections at the WCP SOLAR array in Naperville, IL. All testing and inspections were performed according to manufacturer, NETA and UL (2703, 1703) recommendations.

Detailed inspection notes and observations documented during the execution of this project are contained in the Test Data section and recommendation section of this engineering report. This summary contains data for the completed inspections.

**PURPOSE:**

The purpose of this testing and subsequent report is to provide information relative to the operation of the Grounding and bonding capabilities of the WCP SOLAR array equipment listed above. This report is intended to assist you in planning for upgrades or changes to the electrical system, increase the safety of the electrical system through inspections and testing, and provide recommendations for future equipment usage at the facility. It is not intended to imply that other equipment issues or recommendations not covered in this scope may exist at the time of the inspection.

**PROCEDURE:**

All inspections and recommendations are performed in accordance with HVE's standard procedures including, but not limited to, selected specifications from the following: International Electrical Testing Association (NETA), National Electrical Code (NEC), National Fire Protection Association 70B-Electrical Equipment Maintenance (NFPA 70B), Institute of Electrical and Electronic Engineers (IEEE), American Society for Testing and Materials (ASTM), National Electrical Manufacturer's Association (NEMA), Occupational Safety and Health Administration (OSHA), unless otherwise noted.

**INSPECTIONS:** The Solar Array equipment associated with the grounding and bonding equipment was inspected for installation according to standard NEC practices, appropriate sizing and connections. Equipment inspections included the inter-panel ground bonds, connection to the grounding electrode and bolted connection integrity.

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**APPRAISAL AND RECOMMENDATIONS: Ground bonding systems consist of aluminum solar panel support structures bonded via aluminum straps with stainless steel hardware.**

- 1) The WCP Solar - Photovoltaic Array consists of 644 Canadian solar panels rated at 230 watts each. The style (CS6P-230P) is capable of an output power combination of 29.8VDC at 7.78 amperes. The short circuit output rating of the panel was specified as 8.34 amperes. Series fusing is specified at 15A.
- 2) Photo-Voltaic array grounding connections were inspected for bonding patterns, tightness and connection to the main grounding electrode. Grounding connections consist of aluminum conductors bonded with stainless steel bolts using tooth washers. SolarRac2 has two attachment systems. An inner row connection bar as tested and a aluminum strut system that connects to the ballast tray. The grounding components operate with either system based on the use of stainless steel hardware, bolts, star washers, and nuts torqued to 6-12 foot-lbs. Grounding systems were found to be acceptable for continued operation.
- 3) Fault Current Testing was performed using an AVO DDA1600 Current injection test set. Injected current magnitudes were measured using the calibrated test set metering in the RMS setting. Approximately 50 injection locations were needed for testing due to KVA limitations of the test equipment, and series resistance of the solar array grounding/bonding conductors.
- 4) Bonding tests were performed via injection of current through solar array support trays (aluminum) and aluminum jumpers between rows of support trays. Current injection magnitude was based upon the series fuse rating multiplied by the number of panels (644) in the Photo-Voltaic array. Injected current magnitudes of 9660 Amperes or greater was achieved at approximately fifty (50) locations to ensure maximum expected fault withstand capability.
- 5) Bonding resistances (interconnects) were measured at all locations between the solar panel metallic surrounds, support trays and interconnect straps between support trays. Bonding resistance measurements were found to be less than 340 micro-ohms at all locations using a 100A digital low resistance Ohm-meter (DLRO). UL 2703 and UL 1703 indicate a maximum allowable resistance measurement of 100 milli-

Ohms using a current source rated for two times (30A) the series fuse rating.

- 6) Two point resistance measurement of the solar array bonding trays was performed at each array location (two sections). Two-point measurements indicate the overall resistance found between each test lead. Resistance measurement of the east array was found to be 49 milli-Ohms, while the west array was found to be 38 milli-Ohms. Overall resistance (all panels included) was found to be 22 milli-Ohms using the two point method.
- 7) Bolt torque values were not inspected at all locations due to the large number of bolted connections. Random locations inspected for bolt torque indicate that the connections were torqued to a range between 7 and 12 foot-lbs.
- 8) Accelerated aging and Corrosion resistance tests were not performed at this location.