Comment on Proposal 4-214 (Log #3149 NEC-P04)
690.5 (A) Ground-Fault Detection and Interruption

Comment submitted by: Mark J. Albers, SunPower Corporation, on behalf of the PV Industry Forum 690.5 Task Group **

Text from proposal 4-214 with proposed modification:

(A) Ground-Fault Detection and Interruption. The ground-fault protection device or system shall:
(1) Determine the pv input circuit has isolation prior to export of current,
(1) Be capable of detecting a ground-fault in the PV array DC current carrying conductors and components, including any intentionally grounded conductors.
(2) Interrupt the flow of fault current, and
(3) Provide an indication of the fault.
(4) Be listed for providing PV ground fault protection

Automatically opening the grounded conductor for measurement purposes or to interrupt the ground-fault current path shall be permitted. If a grounded conductor is opened to interrupt the ground-fault current path, all conductors of the faulted circuit shall be automatically and simultaneously opened.

Legend: Black text is currently accepted language for the 2014 NEC. The red text is changes proposed in this comment.

Substantiation:
Undetected ground faults on grounded conductors have caused several fires in PV systems over the last half decade. Clearly ground fault protection (GFP) capabilities need to be improved in new PV systems. As result, we applaud and support the Code Making Panel in addressing this important issue. In the end, however, the ground fault protection sensitivity requirements in the standards, which are too lenient for modern PV systems, need to be updated to resolve this problem. The modifications proposed in this comment will help drive changes to the standards so as to eliminate this problem and will require that GFP used in PV systems comply with these new standards.

The modifications included in Proposal 4-214 successfully address several issues with the NEC requirements for GFP. First, the 2011 Code is sometimes interpreted to <u>require</u> a current based detection method because it reads GFP "…shall be capable of detecting a ground-fault current". Unfortunately, current based detection methods are not <u>always</u> the most effective GFP solutions for all PV system designs. Second, some inspectors view the 2011 Code as not allowing for insulation resistance measurements on grounded conductors in solidly grounded systems because it would require disconnecting these conductors from ground during the measurement. Insulation resistance measurements <u>can</u> be a very effective GFP method in <u>some</u> system designs and will help improve detection of grounded conductor ground faults. It is tremendous that the Code Making Panel has addressed both of these issues with Proposal 4-214 by removing current from requirement #2 and adding "for measurement purposes or" to the supporting paragraph.

Now then, the new 2014 language does raise a new problem as result of this proposal. It <u>requires</u> the use of insulation resistance measurements in <u>all</u> systems. This method is not universally effective and will not be the best GFP for all PV system designs. Furthermore, as new technologies come to market, GFP methods superior to insulation resistance measurements may emerge. We want the 2014 NEC to address the inadequacies of present GFP once and for all and not legislate the use of a specific solution. For this reason, we would request that you adapt 690.5(A) to read as modified above. This will stimulate UL 1741 to be updated to reflect the needs for improved GFP in PV systems and to ensure that the new functional requirements are met without requiring a specific implementation/solution.

Lastly, the statement of "… prior to the export of current" is not enforceable. It is unclear how frequently this test would have to be performed. It could be interpreted to be: 1) before the system is turned on for the first time; 2) every night; or 3) every time the inverter starts up.

** A SEIA/PV Industry Forum meeting was held at UL in Northbroook on August 27, 2012. A 690.5 task group was formed to develop this comment/proposal by consensus. The task group includes representatives from:

- BEW Engineering (Greg Ball)
- First Solar (Robert Rynar)
- REFUsol Incorporated (Tilak Gopalarathnam)
- SunPower Corporation (Mark Albers)
- UL (Tim Zgonena)