

Comment on Proposal 4-246a (Log #CP416 NEC-P04)  
**690.11 Arc-Fault Circuit Protection (Direct Current).**

Comment submitted by: Greg Ball, BEW Engineering, on behalf of the PV Industry Forum 690.11 Task Group \*\*

Text of proposal 4-246a with proposed modification:

- (1) The system shall detect and interrupt arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system component in dc PV source and output circuits.
- (2) The system shall require that the disabled or disconnected equipment be manually restarted.
- (3) The system shall have an annunciator that provides a visual indication that the circuit interrupter has operated. This indication shall not reset automatically.

**Substantiation:**

The comment limits the arc-fault protection requirements in PV-DC systems to series arcs by re-inserting existing language from the 2011 NEC.

The PV Industry Forum Task Group welcomes the 4-246a proposed changes in clauses (1)-(3) to simplify language and to remove prescribed methods, thereby allowing alternate methods. We recommend however that arc-fault protection should be limited to series arcs and not include parallel arcs at this time for the following reasons:

- Parallel arc-fault protection technology has significant implementation implications and needs further development: Parallel arc-fault protection technology has much greater implications for the industry than series arc-fault technology, effectively requiring module level control or string/array short-circuiting. Module level methods have been developed and tested in limited settings, but still have complex control, communication, field-reliability, and therefore safety considerations that are of concern, especially for larger systems. String/array short-circuiting methods are known to have caused thermal overheating in modules, and possibly will be avoided altogether. We acknowledge and encourage the progress being made in parallel arc-fault protection technology, particular with detection, but believe that more research is needed on mitigation/implementation techniques before protection should be mandated by code.
  - Industry experience indicates that parallel arc-faults aren't causing problems: Industry data and experience indicates that PV failures leading to fire are overwhelmingly initiated by ground faults and series arcs, not parallel arcs. SEIA has collected data from several major U.S. integrators showing that of XX fire-related failures reported from installed fleets totaling over XXX MW, none(?) were initiated by parallel-arc faults. In XXX cases, there were line to line faults, but all were preceded by either a ground fault or a series arc fault.
  - The CMP is already (appropriately) tackling the important sources of failure:
    - Ground fault protection: The CMP has approved PV Industry Forum proposals addressing known deficiencies in PV ground-fault protection, the most important of which is 690.5.
    - Series-arc fault protection (expanded): We support proposal 4-251, which extends (series) arc-fault protection to all systems rather than building systems only, for the reasons described in the 4-251 proposal substantiation. Fires have occurred in building and ground mount systems alike as a result of series arcs, and protection is needed.
    - Although parallel arcing faults are rare, they are even less likely to occur with improved ground fault protection and series AF protection which would detect and mitigate those faults before they progress to a parallel arc fault.
  - By approving proposals 4-246a and 4-251 together, we believe the CMP is inadvertently extending module level control requirements to all systems, including ground mounted systems. This would have significant implications for the PV industry, and is not justified given the points described above.
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\*\* A SEIA/PV Industry Forum meeting was held at UL in Northbrook on August 27, 2012. A 690.11 task group was formed to develop this comment/proposal by consensus. The task group includes representatives from:

- BEW Engineering (Greg Ball)
- Brooks Engineering (Bill Brooks)
- Eaton (Charles Luebke)
- Enphase Energy (Mark Baldassari)
- First Solar (Michael Schenck)
- Outback Power (Phil Undercuffler)
- Sandia National Labs (Jay Johnson)
- SEIA (John Smirnow)
- SMA (Joerg Grosshennig)
- SunPower Corporation (Mark Albers)
- Suntech Power (Keith Davidson)
- UL (Tim Zgonena)