Solar America Board for Codes and Standards

Photovoltaic Module Grounding:

Addendum Report on corrosion testing

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PHOTOVOLTAIC MODULE GROUNDING:
ADDENDUM REPORT ON CORROSION TESTING

Report Overview

This report is an addendum to a two-part study addressing the electrical grounding of photovoltaic (PV) modules. The Solar America Board for Codes and Standards (Solar ABCs), with support from the U.S. Department of Energy, published an interim "Lay of the Land" report on the topic in the spring of 2011, which described the many issues facing industry stakeholders. A final report documenting guidelines, safety considerations, and recommended changes to existing codes and standards was published in April 2012.

This addendum provides updated information and recommendations related to corrosion testing of module grounding components and connections. It focuses on:

- parts and components that have not been adequately tested to demonstrate resistance to corrosion,
- the lack of adequate or appropriate test requirements in the module or component certification standards, and
- recommendations to improve the test requirements.

Why the Report is Important

The 2012 report addressed issues related to corrosion testing of PV module ground connections, but notes the need for subsequent updates given the level of activity occurring at the time of publication. The subject is an ongoing concern, and the industry has work to do to resolve issues of component reliability and certification. Newly published International Electrotechnical Commission (IEC) standards provide a good model for improving certification tests, and generalized findings from recent Underwriters Laboratories (UL) certification tests offer valuable direction and guidelines for product manufacturers and designers. Going forward:

- Tests should be modified to better reflect the actual environmental processes seen by PV modules in the field.
- Test results should be used to identify relative performance superiority or inferiority of methods and materials, rather than be relied upon as predictors of failure time or failure mode.
- Manufacturers should stay informed about the bonding material pairings that are or are not demonstrating success in UL 1703 and 2703 certification tests.

Issues

A 2011 UL paper by Wang, Yen, Wang, Ji, and Zgonena summarizes exploratory testing of different types of PV module grounding (bonding) devices in environmental chambers using both continuous damp heat and salt mist environmental exposure. The effects of current cycling, assembly force, and antioxidation coating application on grounding reliability were also evaluated in conjunction with aging tests.

That study was noteworthy for the dramatic failure of components during the salt-mist exposure tests. Although it provided a great deal of valuable information, the study raised questions about the appropriateness of the extreme conditions defined by the existing corrosion test standards in determining the performance of components in actual PV array field conditions.

Although it is widely acknowledged that tests need to be more rigorous to help reduce corrosion issues, many in the industry have expressed concern about using a testing approach employing continuous exposure to salt mist. The main issue is that the corrosion mechanisms induced by existing tests

often differ from those found in the field. Most stakeholders suggested that the tests were a welcome start, but additional tests are needed with greater participation by industry to define the scope.

Key Findings

In this addendum, we:

- recommend review of newly published salt-mist test procedures in International Electrotechnical Commission (IEC) Standard 61701,
- recommend adoption of procedures intended to address modules operating in highly corrosive wet atmospheres near agricultural or other industrial facilities published in IEC 62716 ("Ammonia corrosion testing of photovoltaic modules"), and
- identify information and lessons learned from ongoing UL 2703 certification testing of module grounding components. This effort:
  - o provides insight into the materials that are proving effective in corrosion testing as well as those that are not and
  - o identifies less ambiguous criteria for determining the compatibility of various dissimilar metals.

Information and practices will continue to evolve as manufacturers, test labs, and other stakeholders refine accelerated testing procedures. With that in mind, we suggest the following next steps:

- The Standards Technical Panels for UL 1703 and UL 2703 should review the IEC standard procedures outlined in this report. Possible outcomes include formal adoption of the IEC standards as U.S. ANSI standards or adoption of similar test procedures in the next revision of UL 1703 and UL 2703.
- Expanded exploratory testing that builds on the tests performed by UL in Taiwan should be encouraged to address industry recommendations and feedback.
- A forum similar to Solar ABCs should continue to help consolidate and circulate information from the field and from stakeholders working on corrosion analysis and mitigation.

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Download the full report:

www.solarabcs.org/grounding

About Solar America Board for Codes and Standards

The Solar America Board for Codes and Standards (Solar ABCs) is a collaborative effort among experts to formally gather and prioritize input from the broad spectrum of solar photovoltaic stakeholders including policy makers, manufacturers, installers, and consumers resulting in coordinated recommendations to codes and standards making bodies for existing and new solar technologies. The U.S. Department of Energy funds Solar ABCs as part of its commitment to facilitate widespread adoption of safe, reliable, and cost-effective solar technologies.

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