Solar America Board for Codes and Standards

Solar ABCs Interim Report

Flammability Testing of Standard Roofing Products

in the Presence of Stand-off Mounted PV Modules

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Overview

This fact sheet summarizes a Solar America Board for Codes and Standards (Solar ABCs) Interim Report that was developed in partnership with Underwriters Laboratories Inc. (UL) to investigate whether and how the presence of stand-off mounted PV arrays may affect the fire class rating of common roof covering materials. In particular, these tests were initiated in response to questions from stakeholders about the language in the UL Guide Card that stated that PV modules may or may not reduce the fire class rating of roof coverings when modules of a lower rating are installed above a roof covering with a higher rating. All tests were conducted by UL in Northbrook, IL, with assistance from representatives of Solar ABCs.

Key Findings

To assess flammability, "spread of flame" and "burning brand" tests were used. These are UL/ASTM standard tests that are conducted on all roofing systems (during UL 790 certification) as well as on all PV modules (during UL 1703 certification). However, flammability tests are ordinarily performed on either a roof covering or a PV module in isolation. The current tests applied fire and burning material to the roof covering while rack-mounted PV was present. Therefore, unlike UL 1703, which evaluates the properties of a PV module in isolation, the current tests were conducted to examine combined effects of modules and roof coverings as a system when exposed to fire and flame. Tests were designed to use the methods of UL 790 to evaluate different combinations of modules, standoff heights, and roofing materials

Burning Brand Tests

In all cases, when the burning brand was placed on top of either Class A or Class C modules (the standard test geometry from UL 1703) the roof system was found to remain compliant with Class A requirements. However, when the brand was placed on the Class A rated roof covering beneath Class C rated PV modules (a test geometry not defined in either UL 1703 or UL 790) the roof covering remained in compliance with Class A requirements in some cases and in some cases it did not. Multiple tests placing the brand on Class A-rated roof coverings beneath Class A rated PV modules resulted in the roof covering failing to meet the Class A requirements in all cases.

Spread of Flame Tests

During the spread of flame tests it was observed that any panel (even a noncombustible one) mounted at a range of gap heights (standoff) typical of many PV arrays increased the temperature and heat flux present at the roof surface when the flames were applied between the panel and roof. The increased temperature and heat flux are the result of a "channeling effect" through which the panel holds hot gases and flame closer to the roof surface not allowing them to dissipate as they do when not confined. Due to this effect, in all cases, the presence of either Class C or Class A modules mounted above Class A roof materials resulted in the roofing assemblies failing to meet the Class A spread of flame test requirements (i.e. flame spread of greater than 6 feet was observed).

When comparing spread of flame test results for Class A versus Class C modules, both types were found to fail the tests with the same frequency. It should be noted that spread of flame test failures due to the "channeling effect" would not occur for building integrated PV arrays or arrays that mount directly onto the roof surface with no gap.

Mitigation

Though not part of the initial test plan, a few methods were examined for their potential to prevent the channeling effect observed in the

spread of flame tests. Some of these experiments with noncombustible flashings and screening showed great promise, others none at all. Further tests to define and characterize mitigation methods will be conducted in the next phase of the effort.

The effect of varying the setback of the module leading edge from the leading edge of the roof was also studied. The greatest temperature rise was observed when the PV modules were placed in line with the leading edge of the roof. Increasing the setback distance resulted in lower surface temperature measured on the roof.

Solar America Board for Codes and Standards Recommendations

Further collaboration and research between the Solar ABCs, UL, the solar industry and fire safety officials will continue with more research aimed at PV safety improvements. Based on the current round of testing, reviews and comments by the PV flammability working group and the steering committee of the Solar ABCs, our recommendations are as follows:

1. At present, field experience and a thorough review of fire incident data do not indicate an urgent need to revise current practice with regard to code requirements. A major task in the next round of research will be to quantify the potential risk identified by the test results.

2. Further investigation is required to refine the pass/fail criteria for a fire performance test for systems that includes roofing materials as well as the PV array. In addition, tests should be conducted to identify effective means of mitigating fire spread by this roof/PV system. (These tests are presented in the Interim Report.)

3. Meetings should be held with fire safety authorities, the solar industry and other interested stakeholders to discuss these test results and determine future test requirements, as needed.

4. Results of these tests and of subsequent stakeholder meetings should be communicated to the UL 1703 Standards Technical Panel for their consideration regarding impact of these results on that test standard.

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Download the Full Report:

www.solarabcs.org/interimflammability

For more information, visit the Solar ABCs Web site:

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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 wide-spread adoption of safe, reliable, and cost-effective solar technologies.

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