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Standards Contributing to Reliability of Photovoltaic Modules and Systems

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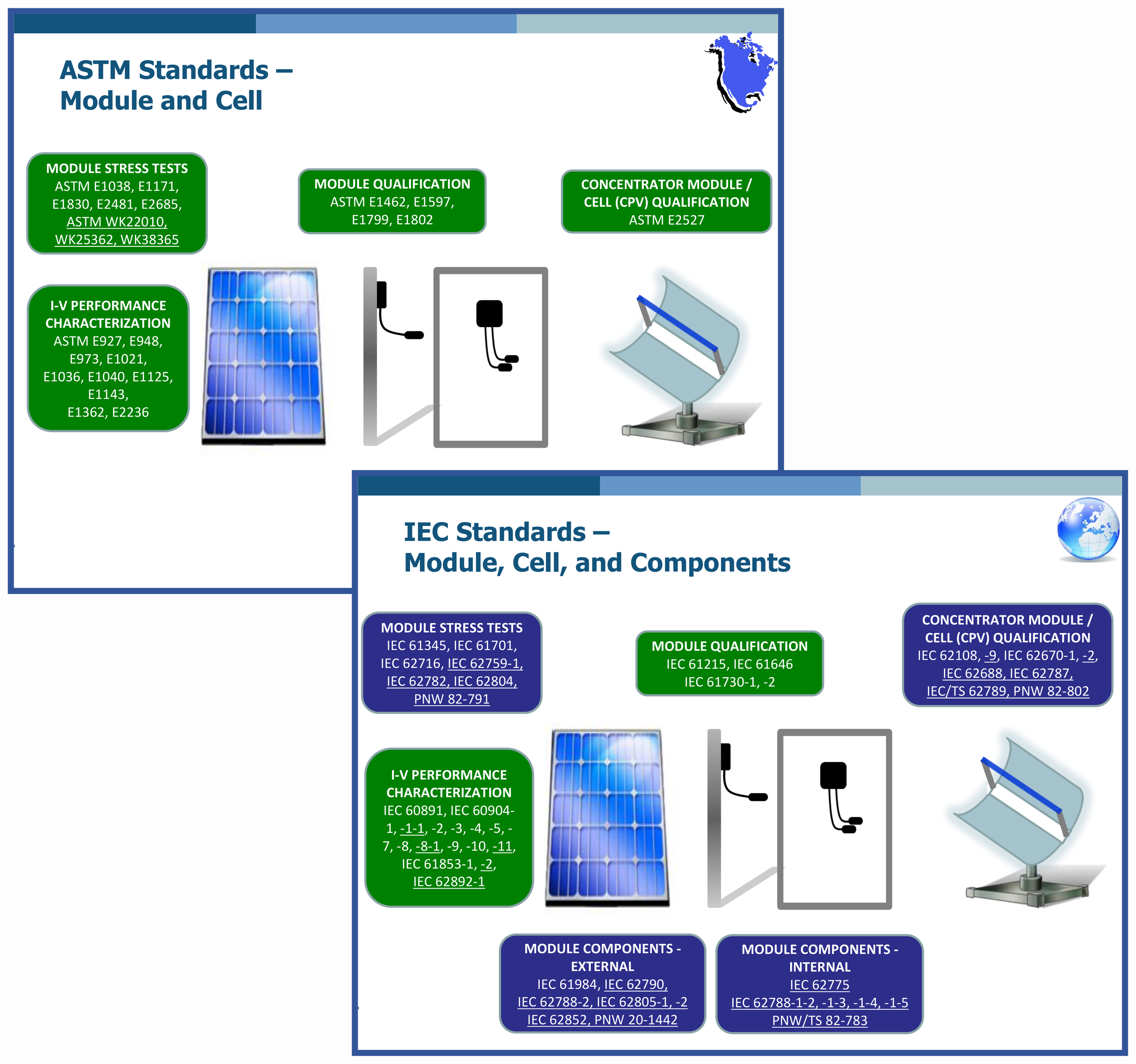
Introduction

- In assessing module reliability, stakeholders utilize a variety of methods, from conceptual failure mode analysis to qualitative and quantitative stress testing. The PV community has pooled its knowledge on the common failure modes to develop standardized test methods to screen for these failure modes. This poster examines, in visual form, the existing standards relating to both module-level and system-level issues, and highlights the areas still in development or without any activity. Participants can examine the areas which need work, including some which the QA Task Groups are addressing. By working with other stakeholders, these gaps can be addressed, thereby increasing module reliability.

Module Standards

- Module qualification and silicon solar cell characterization standards are well established
- Long-term reliability and durability testing are critical to identifying product design issues that may manifest in the field after several years, however they have been difficult to standardize. This is due to the long time required for field failures to appear and be translated into equivalent test-stresses, and the variety of field failures observed due to different factors, from the product design, components used, and manufacturing quality, to installation techniques and the outdoor environment.
- Module stress tests are in development by IEC Technical Committee TC82, to address specific issues that have been observed in the field. These include farm-environment pollution (ammonia), degradation of module performance in high voltage systems, shading, and component-specific aging.
- Concentrator module qualification and characterization tests are also in IEC development



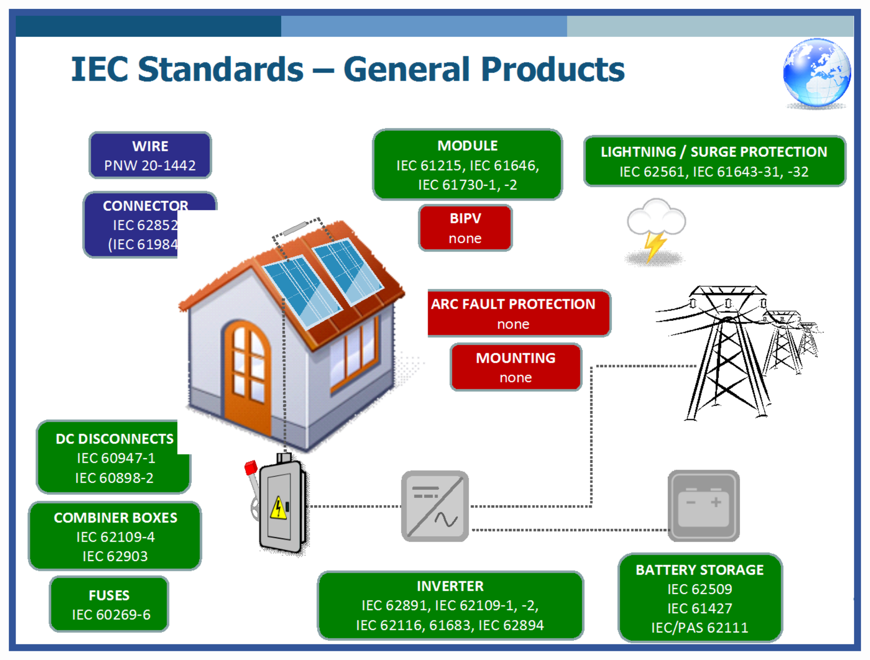
BIPV Standards

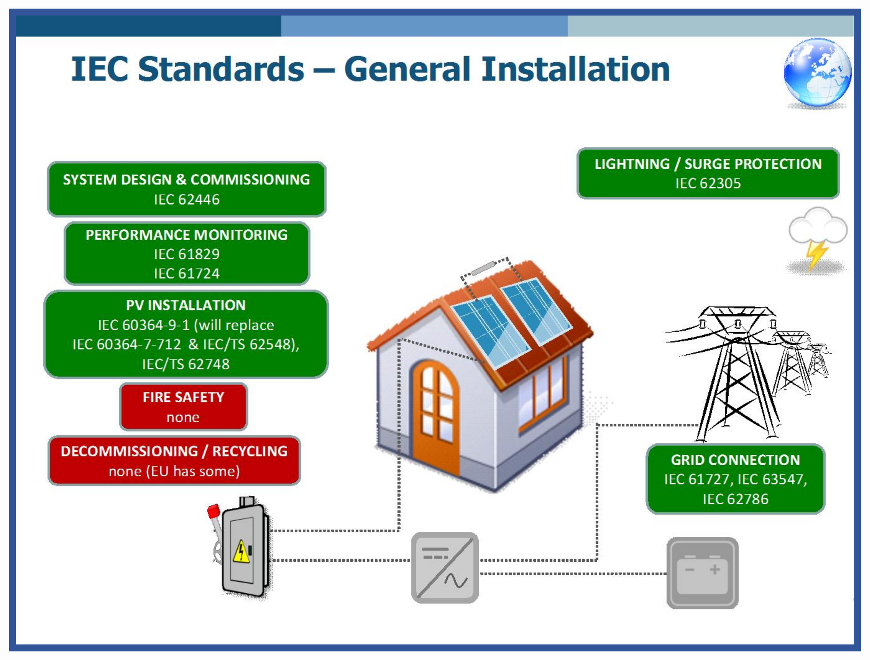
- Many varying standards and specifications are currently used to qualify BIPV components and functions, however there is not a harmonized set of requirements. The exact list depends on location.
- A main factor influencing BIPV reliability and durability is their high operating temperature, due to limited rear ventilation. Key reliability issues are wind resistance, roof water tightness, roof replacement and service loads[1] .
- Similarly for PV-Thermal (PVT), although normal operating temperatures may be lower, stagnation temperatures can exceed the recommended limits of certain components such as the encapsulation material. The PVT Roadmap[2] lists electric hazard protection, capacitive coupling to ground, corrosion from moisture, stagnation resistance, and thermal shock resistance as key issues, and measurement techniques, standards, and certification as a high priority item.

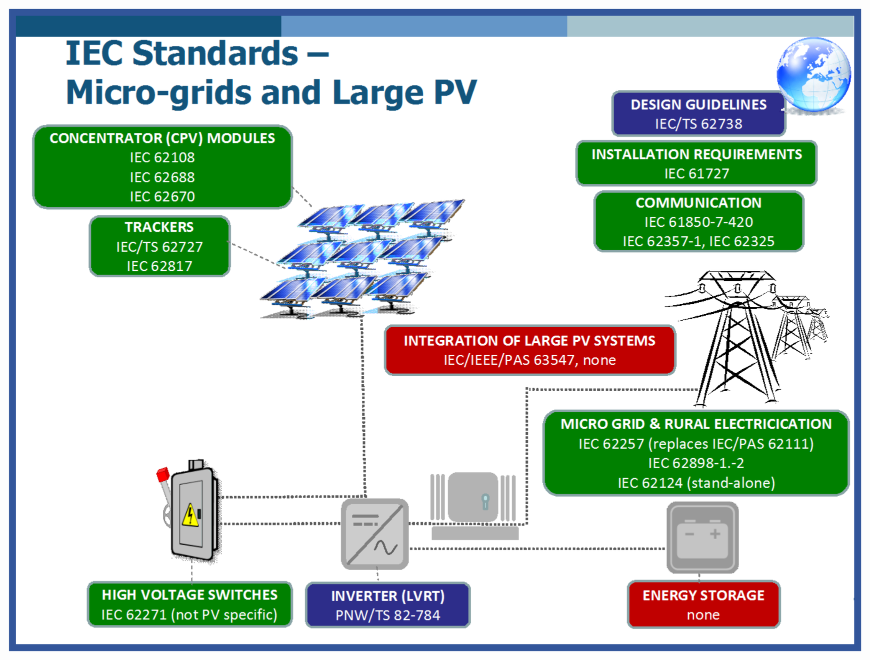
EcoTerra House in Quebec demonstrating BIPV. System design issues such as low 30° tilt, textured PV surface, and roof soffits, led to snow retention in winter. Trees also led to shading in summer – ideal for cooling the house, but not BIPV module reliability.

Installation Standards

- Module handling, system design, and Balance-of-System (BoS) components can play a key part in module reliability, either by creating additional stress on the module (for example, accidental impact, shading, and high operating voltages), or ideally reducing the overall stress on the modules (for example, protective fuses and strain relieving).
- General system design, commissioning, and installation standards exist through the IEC and ASTM. Grid interconnection IEC and IEEE standards also exist, including IEC guidance for micro-grids and rural electrification. As well, various committees have developed standards for specific BoS components, leading to an overall increase in PV system reliability, and array protection.
- Based on international experience, particularly in Europe, new inverter standards are being developed to address higher-PV-penetration concerns impacting grid stability. Large-scale PV arrays and energy storage (not limited to batteries) are also being explored.







References & Legend

[1] Pike Research, 2012, "Building Integrated Photovoltaics – BIPV and BAPV: Market Drivers and Challenges, Technology Issues, Competitive Landscape, and Global Market Forecasts", Navigant BIPV report, Boulder.

[2] PV Catapult, 2006, "PVT Roadmap A European Guide for the Development and Market Introduction of PV-Thermal Technology."

ASTM standards are available via: www.astm.org

IEC standards are available via: www.iec.ch

IEEE standards are available via: www.ieee.org

PUBLISHED STANDARD | NO STANDARD | STANDARD UNDER DEVELOPMENT

Acknowledgements:
Véronique Delisle, Lisa Dignard-Bailey, Dave Turcotte, and Yves Poissant

2014-028 (PP-PPR) 411-PVUSCL

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