Snow loads on sloping roofs: New test method from TÜV Rheinland offers first reliable damage simulation for photovoltaic modules

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Through the performance of extensive test series, TÜV Rheinland has developed a new test bench and corresponding test program that plug a significant gap in the inspection of quality requirements for solar systems. For the first time, it is possible to realistically simulate snow loads on photovoltaic systems mounted on sloping roofs. At its laboratory in Cologne, the world's leading provider of testing services for the solar industry now offers manufacturers the option of testing their modules – in particular the glass and frame elements – and mounting systems to see how they respond to these specific loads. "With the aid of the new test program, we can now offer reliable design qualification for modules and systems for different snow loads – particularly with regard to the influence of forces applied on inclines," summarizes Jörg Althaus, Business Field Manager for Solar Energy at TÜV Rheinland. These results are relevant not only for the manufacturers themselves but also for others such as system and structural engineers and stress analysts. Overall, the new test method from TÜV Rheinland was in development for around two years.

Excessive snow pressure is actually one of the most important damage categories for photovoltaic systems, alongside storm damage and damage due to theft, overvoltage, hail or fire. The problem: Especially on sloping roofs, the snow load on photovoltaic systems is unevenly distributed. In fact, the snow slides down to the bottom part of the module frame, causing extreme loads on the modules and mounting parts here. The consequence: “This causes an increased occurrence of serious damage especially to the frame and glass surfaces of the modules – and not just in mountainous regions, but also in flat areas,” explains Althaus.

The new test procedure (TÜV Rheinland designation: 2 PfG 2310/11.12) was developed by the experts in line with Eurocode 1 (EN 1990, EN 1991-1-3), which is standardized across Europe and covers impacts on building structures. The aim was to simulate actual snow loads as realistically as possible as the standards used as the basis for the type approval of photovoltaic modules (IEC 61215/61646) cover only mechanical load tests that are carried out in a horizontal position. The standards specify uniform tensile loads and pressure loads of 2,400 or 5,400 N/m² in three cycles, each lasting one hour.

TÜV Rheinland has now added a key new option to the existing mechanical load tests, based on the actual snow loads that occur on sloping roofs. The test specimens are the modules or modules with the special mounting system. First, they are preconditioned by exposing them to moisture and heat in a climate chamber to expose potential weaknesses in the adhesive bonds. The manufacturer’s intended substructure is used for the subsequent snow load tests. The modules are inclined by 37 degrees Celsius on the test bench and then subjected to the loads at room temperature. The pressure with which the load is applied to the test specimen is gradually increased toward the bottom of the test specimen, with the pressure increased to up to

four times its initial value at the bottom of the module frame. Overall, the load is only applied to the bottom two thirds of the module surface. This complicated configuration is designed to simulate a situation in which the snow slips down to the bottom area and accumulates there, resulting in an increased load that is not present in the upper part. After a 20-minute test cycle, the overall pressure is increased further until destruction of the module is observed. Various sensors are used to monitor the deformation.

In the test, five identical modules of a particular type are subjected to loads until they are destroyed. Potential reasons for failure include breakage of the glass, deformation of the module frame, separation of joints or breakage of the frame. On the basis of these different test series, it is possible to determine the statistical load-bearing capacity of each module type. Jörg Althaus: “Manufacturers, insurance companies and professionals have long needed this information in order to improve planning reliability and avoid damage. For the first time, we are now also able to supply these load values for unevenly distributed loads on solar modules – and the results are directly comparable.”

In order to demonstrate the electrical safety and suitability for use, a further module is tested with a load value that is reduced by a factor and then evaluated in line with IEC 61215 or IEC 61646.

The one-of-a-kind test method from TÜV Rheinland was developed with the support of photovoltaic system provider IBC Solar. The work required for the development of the new test program was sponsored in part by the European Union and the German state of North Rhine-Westphalia within the framework of the InnoPV research program.

TÜV Rheinland is an internationally leading testing service provider for the solar industry. The company first started laboratory-scale technical testing of solar components back in 1985. TÜV Rheinland's network of experts for the solar industry now comprises specialists in seven laboratories worldwide. As a global market leader for the testing and certification of solar systems, TÜV Rheinland operates test laboratories in Bangalore (India), Gyeongsan (Korea), Cologne (Germany), Shanghai (China) and Taichung (Taiwan), as well as at TÜV Rheinland PTL in Tempe (USA) and Yokohama (Japan). Across the world, well over 500 manufacturers of photovoltaic products are customers of the independent testing service provider, TÜV Rheinland. The specialists not only test modules and components but also develop new test methods, collaborate on R&D projects for the use of solar energy and assist customers worldwide with the construction of solar power plants.

More information about test programs for photovoltaic components can be found at www.tuv.com/pv

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