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07
06-2019

SCIENCE & PROJECTS
HiPE-WiND

Universität Bremen

MULTIDIMENSIONAL LOADS ON THE HIGH-PERFORMANCE ELECTRONICS INCORPORATED IN WIND TURBINES

Fig. 1: Wind farm (source: ForWind)

What is the service life of power electronics in wind turbines? Which environmental and load conditions play a role during the service life? These questions are of great importance for the German energy industry since frequency converters of wind turbines are exposed to particularly harsh conditions and fail more frequently than models predict. The results of the running research project with the short name "HiPE-WiND" should lead to a significant increase in the service life of power electronics in wind turbines.

Wind converters have to sustain wind loads, grid loads as well as environmental stresses. Loads from the wind alternate due to the fluctuations in the wind characteristics, loads from the grid result from overvoltages and current peaks due to switching operations, short circuits, and lightning strikes. On top, there are environmental effects such as temperature gradients, high relative humidity, salty atmosphere etc. The converters are tested for most of these stresses but only individually. There is a good chance that the combination of environmental and electrical operating stresses is even more critical for the service life of the power electronics.

The aim of the HiPE-WiND research project is to investigate state-of-the-art power electronics for wind turbines under realistic stress conditions in order to explore the failure modes and mechanisms as well as to develop technical concepts to improve their robustness. Tailored testmethods are needed that expose the devices to multimodal load scenarios and also offer the application of accelerated stress test conditions in order to achieve suitably shortened test periods.

Testing of specimens ranging from power electronic component to the overall converter system requires a powerful test system that allows for the application of typical electrical loads, simulated disturbances and system interactions. A test facility that is adaptable in performance and operating voltage providing the necessary load functions is not yet available throughout Europe and will be developed, set up and put into operation at the University of Bremen. HiPE-WiND provides manufacturer-independent research and appropriate investigation of the power electronics of modern wind turbines.

Fig. 2: Failed wind converter power electronics module. Numerous of these modules are build into a wind converter system.

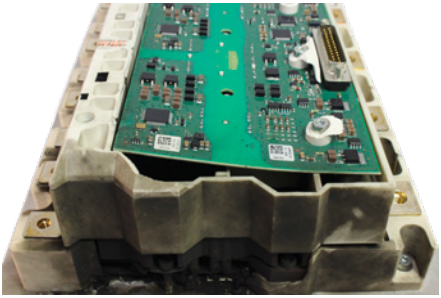

Fig. 3: Failed wind converter power electronics module during failure analysis.

The HiPE-WiND researchers work closely together with their industrial partners. In addition to the Institute for Electrical Drives, Power Electronics and Devices (IALB) and the Fraunhofer Institute for Wind Energy Systems (IWES), Enercon (Wobben Research and Development GmbH), Breuer Motoren GmbH and wpd windmanager GmbH & Co. KG are involved representing the relevant industry in the joint project.

The test facilities of the HiPE-WiND project enable entire converter systems for wind turbines rated up to 10 megawatts to be subjected to controlled environmental conditions. The examination of failure mechanisms under realistic multimodal environmental conditions as well as load conditions promotes the development of technical improvements increasing the robustness of the converter system.

HiPE-WiND

Funded within the 6th Energy Research Programme of the
Federal Ministry for Economic Affairs and Energy
(BMWi Grant 0324219A)
Principal Investigators: Bernd Orlik and Nando Kaminski (IALB)
Funding: 11.5 Mio €
(10.3 € Mio for the University of Bremen)
Funding period: 2017 – 2020

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages