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Design of a Medium-Voltage High-Power Drive and Converter Test Facility at E.ON ERC

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2 Executive Summary

Currently, research in the area of high-speed medium-voltage machines and generators in the intended power range (1 - 10 MW) at universities in Europe is non-existent. To change this, a high-speed high-power drive system will be built at E.ON ERC. This project is on the design of a test bench with respect to flexibility and safety features. The test bench will allow experimental research in the field of high-speed machines and medium-voltage converters at E.ON ERC.

The concept of the test bench is based on the recuperation of the mechanical energy in electrical energy and the feedback of that energy to the driving machine. Thus, tests at high power levels are possible with highly reduced energy consumption, as only the losses of the components have to be compensated. The well-proven concept is based on several smaller test benches (up to 160 kW) developed and built at the “Institute for Power Electronics and Electrical Drives” ISEA – RWTH Aachen. The latter has been copied by several drive manufacturers and automotive companies.

Further objectives of the test bench at E.ON ERC are research on medium-voltage dc-ac inverters and dc-dc converters, that are used for instance in high-power photovoltaic converters and future offshore wind farms.

The designed high-power test bench will enable E.ON ERC to cooperate with partners from industry, universities and research centers to develop and test new machine concepts, medium-voltage converters, medium-voltage switches and power cables.

In the present project, the equipment necessary for operation of the test bench has been specified in cooperation with manufacturers of converters and high-speed electrical machines. The power hardware consisting of input stage, output stage and electrical machine and the control hardware have been selected. Appropriate measurement equipment has been chosen for acquiring torque, speed and electrical quantities during tests and experiments.

As a malfunction of the test bench represents a considerable danger, the safety of the test bench deserved special attention during the project. Possible faults have been analyzed and measures to reduce the safety risk have been taken, e.g. different possibilities for decelerating the test bench in case of a fault have been invetigated. For safe processing of all safety relevant signals, a fail-safe programmable logic control (PLC) has been selected.

The test bench has been simulated in MATLAB Simulink / SimPowerSystems and a low-power model has been built. An industrial PC that controls the test bench, the selected torque and speed measurement evaluation unit and the safety hardware have been commissioned and the communication via CAN with the control PC and LabVIEW has been tested.



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