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Damping System for Torsional Resonances in Generator Shafts Using a Feedback Controlled Buffer Storage of Magnetic Energy at ASDEX Upgrade (P1-E-176)

Claus-Peter Kaesemann, Michel Huart, Peter Müller, Alexander Sigalov

Max-Planck-Institut für Plasmaphysik Boltzmannstr. 2 85748 Garching Germany

The electrical power and energy for ASDEX Upgrade (AUG) is provided by three separate pulsed networks based on flywheel generators. Major damages at couplings of the shaft of the synchronous generator EZ4 (220 MVA / 600 MWs) were discovered during a routine check. The damage can only be explained by torsional resonances in the generator shaft which are excited by active power transients from the converter loads.

For generator protection, torque sensors were installed near the coupling between the flywheel and the rotor. They cause an early termination of plasma experiments if a predefined torque level is exceeded. These terminations limited the achievable plasma current flattop time of AUG significantly.

Since a low natural damping of the torsional resonances was identified as a major cause of the phenomena observed, novel feedback controlled DC circuits were developed providing electromagnetic damping for the generator shafts in case of excitation.

Each damping circuit consists of a DC choke, acting as a buffer storage of magnetic energy, fed by a thyristor converter. The current reference for the converter is derived from the torque sensor signals. This enables the choke current to alternate with the measured natural frequency of the shaft assembly. Thus, with proper phasing, torsional resonances in generator shaft systems weighing more than 100 tons can be damped with little additional power.

Since April 2003, the damping circuits have been routinely operated during all plasma experiments. Despite the low damping power used, torsional resonances could be reduced to a value that avoids a trip signal from the torque sensors.

This paper describes the results from analysing, designing and testing of the feedback controlled buffer storage of magnetic energy, representing an effective and low cost solution for damping torsional resonances in electric power systems. It will present the layout, analyse the results of measurements obtained during commissioning and operation, compare them to the calculated (design) values and report on the experience on the AUG pulsed network improving the performance of plasma discharges and the safety of the equipment.