LIQHYSMES – a 48 GJ Toroidal MgB_2-SMES for Buffering Minute and Second Fluctuations

Michael Sander, Rainer Gehring and Holger Neumann

Abstract - Recently, a new hybrid energy storage concept, LIQHYSMES, has been proposed which combines the use of liquid hydrogen (LH2) as the bulk energy carrier with much faster and efficient superconducting magnetic energy storage (SMES). Here, an example for a large-scale plant potentially addressing the electricity transmission system, is discussed: stored energies are about 125 GWh for the H2 part and 48 GJ for the SMES at power levels of 200 MW to 1 GW. Imbalances between the varying supply of renewable energies and the customers' demand are simulated. The response of the storage plant is analyzed concerning its capability of buffering variations on time scales from hours down to seconds. Losses of the whole hybrid storage plant are provided with a specific focus on the LIQHYSMES Storage Unit (LSU) which integrates the H2 liquefier, the LH2 storage tank and the MgB2 SMES. Some implications of the operating conditions for the SMES as regards field, ramping losses, currents and voltages are addressed. Cost estimates indicate that the LSU could become an economically viable component in future H2 supply networks for utilizing excess renewable energy.

Keywords - AC Loss, Energy Storage, High-Temperature Superconductors, Hydrogen, Superconducting Magnets.

IEEE/CSC & ESAS European Superconductivity News Forum (ESNF) No. 23 January 2013; Category 6.
The published version of this preprint appeared in *IEEE Transactions on Applied Superconductivity* 23, 5700505 (June 2013).