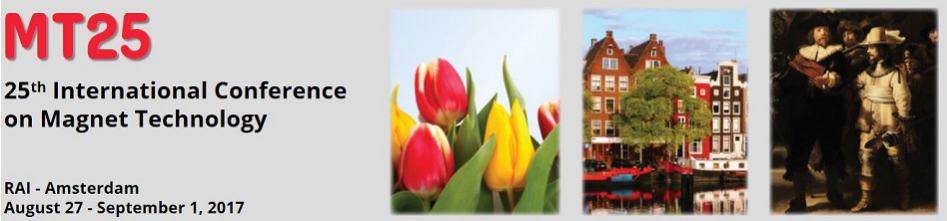

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Performance of the quench protection system of the first LARP-CERN quadrupole magnet models

Wednesday 30 August 2017 15:00 (15 minutes)

CERN and LARP (LHC Accelerator Research Program) are jointly developing Nb3Sn quadrupole magnets to be installed in the LHC for its upgrade to higher luminosity. The quench protection system of these magnets will include a combination of quench heaters attached to the coil surface and CLIQ units electrically connected to the coils. This solution provides an effective reduction of the coil's hot-spot temperature after a quench and increased redundancy against component failures. The different quench protection elements, quench heaters and CLIQ, have been characterized separately and simultaneously on two 1.2 meter long model quadrupole magnets, tested at FNAL and CERN, and one 4 meter long mirror magnet tested at BNL. The time required to initiate a quench using quench heaters was measured and found in good agreement with simulations. The variation of this parameter for quench heater strips attached to different coils was analyzed. Furthermore, it was verified that the target energy density deposited by the quench heaters is well above the measured minimum energy density to initiate a quench even at low current. Three different CLIQ connection schemes were tested, confirming that the configuration selected as the baseline achieves the best performance in terms of lower hot-spot temperature and voltage to ground. Various magnet discharges were initiated by triggering quench heaters, CLIQ, or combinations of those. These experimental results constitute a wealth of information crucial to validate and refine the magnet's electrical, magnetic and thermal model. Simulations performed with the LEDET program are in very good agreement with the experimental results. The same software is used to predict the performance of the quench protection system as installed in the LHC.

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