Through-wall Excitation of a Magnet Coil by an External-rotor HTS Flux Pump

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Abstract — The Coupling-Loss-Induced Quench (CLIQ) is an innovative system for the protection of superconducting magnets. Its energy-deposition mechanism, based on coupling loss generated directly in the superconductor, is by principle faster than heat diffusion, upon which conventional quench-heater based systems rely. Its electrical design relies on simple and robust components, easy to install and to replace in the case of damage. After being successfully tested on model magnets of different geometries and types of superconductor, CLIQ is now applied for the first time for the protection of a full-scale dipole magnet. For this purpose, a 14 meter long LHC twin-aperture dipole magnet is equipped with CLIQ terminals and two 80 mF, 500 V CLIQ unit are connected to its coil. Experimental results obtained under various operating conditions convincingly show that a CLIQ-based quench protection can effectively protect large-scale magnets by quickly and homogeneously transferring to the normal state voluminous regions of the winding packs. A developed dedicated simulation code correctly reproduces the complex electro-thermal transient occurring during a CLIQ discharge. The successful test completes the development program of CLIQ quench protection systems, which has convincingly demonstrated the maturity and readiness of the system for application in large-scale magnet systems.

Keywords (Index Terms) — Accelerator magnet, circuit modeling, CLIQ, quench protection, superconducting coil.