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Fri-Mo-Po.06-04: A European Phased RD&D Program for Quench Protection of Large-Scale HTS Magnets

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A European Research, Development & Demonstration (RD&D) program is being proposed by EUROfusion and partners to address key challenges and demonstrate the feasibility of safely quench-protecting large-scale High-Temperature Superconducting (HTS) magnets. This initiative is designed to pave the way for the development and deployment of HTS magnets in large tokamaks. The program is divided in three phase: Step 1 will test multiple quench detection schemes and determine their suitability and characteristics (e.g. response time, sensitivity, etc.); Step 2 will test a 10 MJ insulated coil to validate quench detection and protection strategies under realistic conditions; and Step 3 will scale up to a ˜250 MJ coil, demonstrating effective detection and protection under fusion-relevant conditions and scale (this being roughly the stored energy of the TF coils for the Volumetric Neutron Source - VNS). Each phase is based on insulated coil designs with indirect cooling. A key focus of the program is the development and testing of a high aspect ratio conductor concept. In contrast with multistage ITER cables, it is fully soldered, monolithic (without voids) and it has no cooling channel (dry conductor). The electrical insulation is placed between cable and jacket, so that it is protected by shearing stresses in large magnets. The paper provides an overview of the program objectives, its phased implementation strategy, and the innovative conductor and double pancake design to be employed in the model coil. Main parameters for the model coil and test facility are discussed, and early results in terms of hardware procurement and fabrication (first double pancake) will be presented.

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