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Cryogenic design of the 43 T LNCMI Grenoble hybrid magnet

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The association of two inner copper alloy resistive coils (polyhelix and Bitter) producing 34.5 T with an outer NbTi superconducting coil producing 8.5 T to obtain a 43 T hybrid magnet is a technical challenge. Accidental failure modes leading to complex electromagnetics behaviors and large transient dynamical forces should be anticipated. These considerations lead to a reinforced design of the SC coil, of the cryostat and of the coil protection system. To reduce the probability of quench occurrence of the SC coil in case of the disruption of the resistive inserts, the eddy current shield already developed for the last project is reused between the SC coil and the Bitter coils. The cryostat has been designed with sophisticated thermo-mechanical supports sustaining the coil at 1.8 K and the eddy current shield at 30 K, both being possibly overloaded by high dynamic forces in the worst accidental failure case. The 1100 liters superfluid helium pressurized bath at 1.8 K atmospheric pressure is produced in an external cryogenic satellite located in a limited magnetic stray field area. The CEA-CNRS French collaboration for the LNCMI 43 T hybrid test facility project works actively to finalize the last studies recently reviewed by an external committee.

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