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Numerical study of the thermal behavior of a Nb₃Sn high field magnet in He II

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The High Field Magnet (HFM) project, within the European project EuCARD, aims at constructing an Nb₃Sn high field accelerator magnet, Fresca 2, to serve as a test bed for future high field magnets and to upgrade the vertical CERN cable test facility. The Fresca 2 block coil type magnet will be operated at 1.9 K or 4.2 K and is designed to produce about 13.5 T. To study the thermal behavior of the magnet in He II, i.e. to calculate the temperature margin and the evolution of temperature due to quench within the magnet a simplified 3D numerical model was developed. The model is derived from the original two-fluid model and consisted of a conventional continuity equation, a modified momentum equation for the total fluid and an energy equation including the Gorter-Mellink internal convection term. The paper presents the numerical model, the assumptions taken for the calculations and several results of the simulation for the quench heating and temperature distributions due to several cases of heat loads.

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