Analysis on Solenoidal High Temperature Superconducting Magnet Using COMSOL Multiphysics®

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Abstract

Superconducting tapes are one of the advanced materials which show their candidacy in almost every electrical engineering applications starting from the energy/power generation (Superconducting Generators) to the household/industrial distributed systems (Superconducting Transformers). Also, superconducting tapes are being exploited in energy storage applications where such tapes can be wound to form a solenoidal or toroidal shaped magnet. It has been found that solenoidal magnet consumes less superconducting material compared to toroidal thus in the present analysis solenoidal configuration has been considered where an attempt has been made to design a magnet that can store 600kJ of energy. The magnet is designed to be cooled at 20K using Liquid Nitrogen. 1st Generation HTS tape (BSCCO-2223) has been considered whose critical current at 20K is found to be 624A. Analysis shows that it will be useful to use higher currents in order to minimize the total length of the superconducting wire needed to store 600kJ of energy. A reference field of 3.5T has been employed in the design of 600kJ HTS SMES having 355mm bore diameter and inductance of 0.574H. Also, it has been assumed that the evaluated perpendicular magnetic flux density should not exceed 3T.

Figures used in the abstract

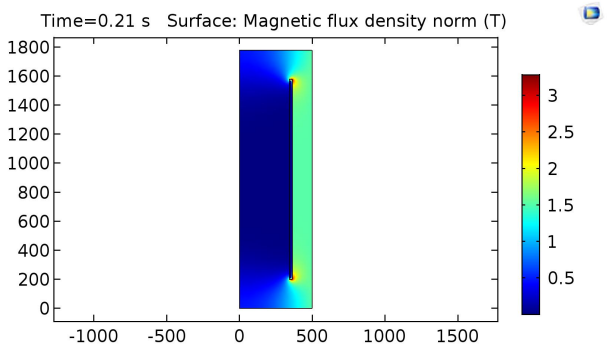

Figure 1: Surface Plot: Magnetic Flux Density (norm B) of 600kJ Superconducting Magnet