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Advanced Design Approach to the High Temperature Superconducting magnet

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1. INTRODUCTION

The value of I_c(critical current) in HTS (High Temperature Superconductor) tape has a great influence on $B\perp$ (vertical field) [1]. Therefore, in shape design of HTS magnet, a method to reduce the $B\perp$ should be considered in order to maintain the stability and substantial improvement on the performance. This paper presents advanced racetrack type HTS magnet as field coil for the High Temperature Superconducting Generator (HTSG) and the approaches result is compared with that of the initial design model. On the basis of the magnetic field analysis, this paper deals with various field coil shape according to the iron plate to obtain small $B\perp$ by using Biot-Savart's law, image method and 2 Dimensional Finite Element Analysis (2D FEA) considering the stress condition of HTS. Moreover, the analysis is verified by comparison with experimental results. And this paper also presents the advanced method by using 3D FEA, in which flux density at armature is calculated in 5kVA class HTSG.

2. ANALYSIS AND EXPERIMENTAL

This paper deals with two approaches to reduce the $B\perp$ considering stress condition. At first, the initial model is optimized by using Response Surface Methodology (RSM). In this step, characteristics of magnetic flux distribution in the initial model (racetrack type HTS magnet with quadrangle cross section) are accurately analyzed according to the field coil shape, and the maximum $B\perp$ in the optimized model is compare with that of the initial model. And then, magnetic flux dis. itions of initial model, optimized model, initial model with iron plate and optimized model with iron plate are compared each other. The designed racetrack type HTS magnet for HTSG is manufactured and tested. The dimension of HTS tapes is about 3 x .25 mm^2. The specifications of initial racetrack type HTS magnet include 3-pancake coil and 467 total turn number. When handling HTS tapes, it is necessary to know the limiting values of loading, bending and tensile to avoid damage [2]. Thus, I_c vs. strain curve was measured to obtain stress condition. I-V test was conducted while the supply current was increasing at 0.5 A/sec rate at LN_2 temperature and no external field.

3. RESULTS AND DISCUSSION

The maximum $B\perp$ of initial model, optimized model and optimized model with iron plate are 0.445 T, 0.412 T and 0.369 T, respectively. Banding radius and tensile strain are determined as minimum 16mm and maximum 0.1% by using experimental results. Fig. 1 shows experimental results of I-V curve at top pancake coil (P3). At the initial model with iron plate, I_c of P3 is increased about 5 A compared with the initial model. It is expected that the initial model with iron plate will provide improved HTSG performance.

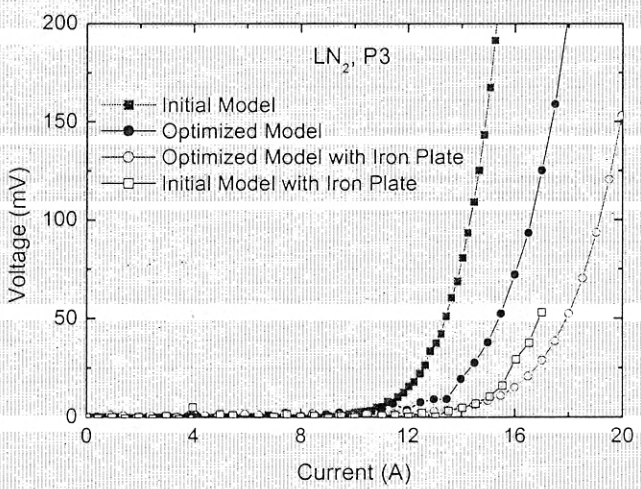

Figure 1. I-V curve according to the manufactured model

[REFERENCES]

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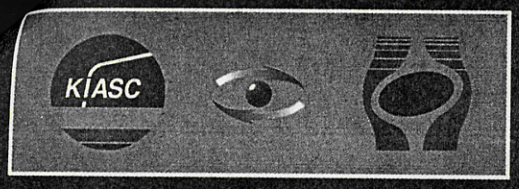

Workshop Abstracts

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