

# Coupled Electromagnetic-Thermal Analysis of YBCO Bulk Magnets for the Excitation System of Low-Speed Electric Generators

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**Abstract** — This paper examines the use of YBCO HTS bulk magnets when operating in the magnetic environment of low-speed synchronous generators. A coupled electrothermal Comsol model of bulk YBCOs is first developed, tested and experimentally verified. Joule losses in the HTS magnet are then studied when under AC magnetic fields with frequency and amplitude ranges usually found in those generators. The YBCO capability in maintaining its magnetization level when subjected to those conditions was also analyzed since the objective is to replace the permanent magnets currently used.

The conditions for which superconductivity is lost are studied considering now the magnet submerged in liquid nitrogen. Using the model developed, it was possible to observe temperature rise effects in the superconductor and how temperature influences all its parameters.

**Keywords (Index Terms)** — Superconducting generators, high temperature superconductors, YBCO, HTS modelling.