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Wed-Mo-Po3.11-05 [92]: Numerical and Experimental Analysis of Thermal Stability of Superconducting Windings Using a YBCO Core Cable

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High-temperature superconducting (HTS) device is a new application of superconducting technology in the electric power network. It shows several advantages, including small volume, light weight, high efficiency, strong capability of overload, and risk-free of fire. In this paper, we designed a core cable based on the adiabatic conditions, and then realized both numerical and experimental analysis to determine the minimum quench energy and quench propagation velocity of superconducting winding using the core cable.
Section I briefly introduces the background of YBCO cable application and stresses the quench analysis for the power system application. When HTS devices run in the power system, the superconductive tapes may quench due to power system fault and endure electromagnetism and mechanical stress caused by large or unbalanced current. In Section II, the structure of the prototype core cable is shown first and then the quench test facilities, as well as the experimental procedures, are presented.
Section III deals with the 3D transient modelling of this YBCO core cable using newly developed T-A formulation [1-2]. The numerical results are proposed to analyze the curves of temperature and voltage under quenching condition with different thermal disturbance. With the combination of the stability theory, we estimate the quench propagation velocity and analyze the factors affecting quench propagation velocity and minimum quench energy. It is obtained that the minimum quench energy of the core cable is related with the transmission current.
The paper is concluded in Section IV. The results show that the thermal stability of the core cable is related with transmission current and the longitudinal quench propagation velocity of core cables ten times as much as the velocity in superconducting tapes.

[1] Zhang Huiming, Zhang Min, Yuan Weijia. An efficient 3D finite element method model based on the T–A formulation for superconducting coated conductors[J]. Superconductor Science & Technology, 2017, 30(2):024005.

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