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High-temperature superconducting cable optimization design software based on 2-D electromagnetic thermal analysis model

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Compared with conventional power cables, high-temperature superconducting cables (HTS) have the advantages of large current capacity, low loss, compact structure, and no electromagnetic radiation. With the continuous improvement of electricity consumption in all of the world, HTS cables are of great significance to improving the transmission capacity of power systems. Because the HTS cable has a multi-layer structure, when AC current is applied, if its structural parameters are not well designed, uneven current distribution in each conductor layer may occur, which will cause partial quenching of the cable and increase the AC loss with affecting the safe and stable operation of the cable. This article aims to realize the uniform current distribution of the conductor layer of HTS cable, while using particle swarm optimization algorithm (PSO) to optimize the design of three commonly types of HTS cables (three-phase independent, three-in-one and three-phase coaxial) and write it into software that is convenient for designers to use to meet engineering needs. At the same time, the finite element simulation software 'Comsol'is used to establish 2-D electromagnetic thermal models of different configurations of HTS cables to verify the conductor layer current distribution and AC loss of the cable, and to realize the thermal analysis of the cable. And use this software to evaluate and verify the design case of AC high temperature superconducting cable with rated parameters of 10kV/2.5kA, and select the appropriate cable configuration and structural parameters.

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