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AC loss measurement of a tri-axial superconducting cable based on a digital compensation method

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A tri-axial high temperature superconducting cable has the advantages of small size, large transmission capacity, low AC loss and high economic efficiency in power transmission of urban city. The essential difference between superconducting cable and traditional cable lies in their unhindered current-carrying characteristics. But when carrying alternating current or changing electromagnetic field in the environment, the tri-axial superconducting cable could produce the alternating current (AC) transmission loss. The generation of AC loss would lead to the local temperature rise in the superconductors, accompanied by the reduction of the pinning performance and critical current, which brings huge safety risks to the tri-axial superconducting cable. Therefore, AC loss is an important factor affecting the reasonable design and stable operation of the tri-axial superconducting cable. A digital compensation method for AC loss measurement has been proposed, and a AC loss test platform consisted of a three-phase power supplier, a signal acquisition unit, a control system, a signal processing and compensation software system has been built as well. The AC loss of a 10 kV tri-axial superconducting sample cable is tested. These results show that the AC loss of each phase increases linearly with the increase of transmission current, the outer phase superconducting cable is affected by the magnetic field generated by the inner phase superconducting cable, so its critical current degenerates and the AC loss becomes larger.

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