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Quench protection of HTS coil composed of multiple pancake-coils by changing current distribution in pancake-coils

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Sure quench protection of HTS coils is essential for their sustainable operations. The most probable cause of quench damages is the over-heating at the highest temperature spot (hot-spot) of the coil wire during the quench protection sequence. Therefore, to avoid the damage, generated heat in the hot-spot of the coil conductor has to be decreased by quick decrease of a current flowing in the hot spot area. A common and basic method to protect an HTS coil from quench is a detect-and-dump type active method. By modifying this method, the authors propose a method to reduce hot spot temperature *THS* of a magnet composed of multiple pancake-coils by changing current distributions in the pancake coils at a quench event by a passive method. In a coil composed of multiple pancake-coils, amplitude of the perpendicular magnetic field components to wide faces of HTS tape wires is different by the position of a pancake coil in the whole coil. Critical current *Ic* of HTS wire is dominated by the perpendicular magnetic field component and *Ic* decreases for high perpendicular magnetic field component and a quench starts most probably in pancake coils of low *Ic*. When a quench is detected in a pancake coil of lower *Ic*, the current in the lower *Ic* coil is transferred to the other coils of higher *Ic* by resistive shorting the higher *Ic* coils. In the paper, current distributions of each of a pancake coil are analytically obtained and effectiveness of the method is investigated by a numerical simulation of a model coil. In the simulation study, it is shown that hot-spot temperature is decreased and that the coil can be safer from quench damages by the proposed method, comparing with the ordinal detect-and-dump method for a given value of quench detection voltage.

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