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# Current and temperature distributions in HTS coils with and without insulation in a layer-wound configuration

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The use of high temperature superconducting (HTS) materials is promising for both DC and AC power applications and for high field magnets. However, HTS coils must be carefully protected against quench, since the formation of hot spots can damage the materials even more severely than in the case of low temperature superconducting coils. A possible solution to this issue is offered by the use of No-Insulation (NI) coils, wound without electrical insulation between turns. As compared to insulated configurations, NI coils allow a current redistribution, as well as an improved heat exchange, from the regions which turn normal due to a thermal disturbance to the neighboring turns in radial direction, which greatly improves the coils thermal stability.
In this work, the electro-thermal behavior of two layer-wound coils, realized with and without electrical insulation, is compared. Both coils are wound from the same BSCCO tape, and have a very similar geometry, with the same number of turns and layers. A heat input is applied to both coils, by tuning the current supplied to resistive heaters realized through stainless steel tapes wound on the mandrel at the inner surface of both coils. The heaters are in contact with one full inner turn of the winding. The coils are cooled in a liquid nitrogen bath, and the heaters are supplied with a constant current. Then, the windings are charged until the tape critical current is exceeded, and the tests are repeated for different heat loads. The signals acquired through voltage taps, suitably soldered at the same locations in both windings, are compared at the same working conditions. Finally, the current and temperature distributions in the windings are analyzed by comparing the experimental results with those obtained via a lumped-parameter equivalent electrical circuit, solved numerically in a time-varying regime, and a 1-D thermal model.

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