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Fri-Mo-Or27-06: Field and Voltage transient behavior in REBCO HTS coils up to the limiting critical current: Comparison between Experiment and Modelling

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The development of ambitious REBCO HTS coils (Rare-EarthBiCaCuO High Temperature Superconductor) is faced by two commonly acknowledged issues: Protection against thermal runaway induced by local dissipative zones, and dynamic field homogeneity. These two problems stem from two specificities of REBCO Coated Conductors: significant spatial inhomogeneity of critical current density and large conductors with high aspect ratios. We developed modelling tools to represent both the electro-thermal phenomena leading to thermal runaway [1] and the electro-magnetic phenomena that governs the current density distribution [2] and therefore the transient voltage and field behavior in simple HTS coils. We showed that to avoid dangerous thermal runaway, dissipating voltage must be detected early, at a level comparable to the transient voltage due to magneto-electric effects, which therefore must be taken into consideration in the detection scheme.
Here we present the test of several coils of different sizes using such adapted detection scheme based on modelling, up to the appearance of dissipative voltage. Experiments were conducted both in standalone and under external field, with conductors formed from single tapes and in some cases bundled tapes. The validity of the approach is evaluated on these simple coils in terms of protection efficiency and predicted transient behavior. In a second time, the errors generated by simplifying hypothesis (homogenized conductor, simplified geometries) are quantified, as such kind of approximations may be required to handle bigger systems or obtain faster results at the preliminary design step.

[1] A. Badel et al., IEEE TAS (2019) in press.
[2] B. Rozier et al., SuST (2019) in press.

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