Quench in HTS conductors – M. Breschi – University of Bologna

A. Zappatore: Analysis of quench in HTS conductors for fusion applications: a novel 1D thermal-hydraulic modeling approach

- *Anisotropic thermal conductivity of the HTS macrostrand (vs isotropic LTS): a few macrostrands in the HTS conductor (vs 1000 in LTS)*
- *For each macrostrand the model describes three components: copper, HTS stack. The macrostrands interact through electrical and thermal resistances*
- *H4C code improves description of current distribution between macro-strands. Different hot spot evolution with respect to 4C code in case of localized heating (voltage departure is much slower than that computed with typical LTS code)*

N. Amemiya: Study on conditions for successful quench protections of coils wound with coated conductors by short-sample experiments and quench simulations

- *Fast quench experiments using short samples of coated conductor provides data on conditions for successful quench protection*
- *Hot spot temperature increases with increasing operating current (at 700 K sample degraded)*

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N. Amemiya: Study on conditions for successful quench protections of coils wound with coated conductors by short-sample experiments and quench simulations

- *The hot spot temperature increases with increasing the current decay time constant (degradation with τ = 6 s) and the quench detection voltage.*
- *Critical current of the tape and heater power do not affect the hot spot temperature.*
- *Simulations with a 1D model show that for sample lengths from 180 mm to 300 mm the temperature distribution does not change (experimental sample length of 180 mm sufficient)*
- *From discussion: check the total deposited energy in the tape which determines degradation*

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R. Kang: Modelling of a 50 kA REBCO Conductor with Multi-strand Made by Twisted Stacked Tapes

- *Aim to determine how long it takes from a local quench initiation to detection (NZPV), and level of the hot spot temperature*
- *Various model details: single cable model, multi-monolithic strand model, quasi 3D model (under development)*
- *Electrical coupling in the order of ms in a soldered strand for any two tapes, thermal coupling in the order of ms for adjacent tapes. This makes the monolithic strand model a good assumption for the model*
- *Strand movement identified as a possible origin of quench in the conductor*

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M. Wolf: Design and analysis of HTS subsize-conductors for quench investigations towards future HTS fusion magnets

- *HTS CroCo conductor proposed at KIT. Three options analysed.*
- *Option 1: Baseline design of triplet samples to get 12-15 kA at 4.5 K, 12 T*
- Option 2: Cu tube wall thickness reduced from 2 mm to 1 mm
- Option 3: Use of Cu profiles for larger contact areas between strands and jacket and between strands
- Comparison of quench behavior with THEA. **Merged model** with three CroCos simulated as one thermal element. Smaller quench energy for Option 2 due to less copper in the cross section
- Temperature of the jacket lags behind that of the strands
- **Segregated models** give similar results as the merged model in terms of temperature evolution, but get a better insight into current redistribution phenomena

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- *Models of HTS conductors for fusion are being developed: which could be the origin of quench in these conductors in real applications is still a field of investigations (experiments needed)*
- *The anisotropy of the HTS based conductors is significant: can it be neglected in the modeling of quench propagation ?*
- *Experimental investigations to explore the no-degradation limit of REBCO tapes combined with modeling*