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Modeling and analysis of quench in the 15-kA HTS conductor

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Abstract
High Temperature Superconductors (HTS) are very promising materials to be applied in future fusion magnets. HTS conductors are already considered as a possible option for some components of the superconducting magnet system of the EU DEMO tokamak, which are being designed by the EUROfusion consortium, e.g. for the innermost subcoil of the Central Solenoid coils developed by the EPFL-SPC team. Geometric and thermophysical characteristics of HTS and LTS conductors differ significantly, e.g. only a few thick macrostrands in HTS conductors vs. ~103 thin strands in LTS conductors, anisotropic thermal conductivity and Jc of HTS tapes vs. isotropic LTS strands, quench propagation velocity in HTS much smaller than in LTS, etc. Thus, it can be expected that numerical simulations of the behavior of HTS conductors may require specific approaches, different from those which are successfully used for LTS conductors, particularly in cases when fast transient processes (such as e.g. quench) are considered. In order to provide data for better understanding of the quench evolution in HTS conductors as well as for testing different numerical approaches and proper tuning of the numerical codes, a series of dedicated HTS 15-kA subsize samples with different geometries were produced and tested at the SULTAN test facility in the Quench Experiment performed within the international collaboration between EUROfusion and China. Our analysis is a part of the work on analysis and interpretation of the results of the Quench Experiment. We simulated selected experimental runs using a few THEA models with different levels of complication. Some uncertain model parameters, such as thermal resistances and copper RRR, were treated parametrically. The goal of the study was selection of the possibly simple model which would properly reproduce the results of the Quench Experiment.

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