
Contribution ID: **915** Type: **Regular 15 minutes Oral Presentation**

# Prediction and analysis of quench propagation test results in the ITER TF Insert Coil using the 4C code

*Tuesday 29 August 2017 09:45 (15 minutes)*

The ITER TF Insert (TFI) coil is a 43 m long single-layer solenoid wound in the grooves of a stainless steel mandrel, using one of the Nb3Sn circular cable-in-conduit conductors adopted in the winding of the ITER TF coils and cooled with supercritical He in forced circulation at ˜4.5 K. The TFI is the last in a series of ITER Insert Coils, all tested in the bore of the ITER Central Solenoid Model Coil at Naka, Japan, under conditions relevant for the actual ITER operation. Several tests were devoted to the study of quench propagation, aimed at the assessment of the hot spot in the conductor. The quench was initiated pulsing an inductive heater, located at mid length of the TFI, at increasing energies. Different delay times (3 s, 5 s, 7.5 s) after quench detection were imposed, before the 68 kA TFI current was dumped on an external resistor. In the first part of the paper, the main results of the TFI quench tests are presented and discussed. In the second part, we focus on the numerical analysis of the quench using the state-of-the-art 4C code: for the first time since the ITER Insert Coils program started, more than fifteen years ago, an attempt was made to predict the quench propagation in the strict sense, i.e., performing the simulations before the tests. Here we present the results of the comparison between predictions and measurements, showing that global as well as local voltages, i.e. the hot spot temperature and the propagation of the quench, were very well predicted by the 4C code. The success of this predictive exercise confirms that the 4C code can be reliably used to address quench-related issues in the design of future Nb3Sn magnets and/or in the planning of their operation.

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**Session Classification:** Tue-Mo-Or12

**Track Classification:** B1 - Superconducting Magnets for Fusion