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## Thermometric chains for ITER superconductive magnets

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High environmental constraints are applied on the ITER magnets and therefore on their cryogenics thermometric chains. Accurate and reliable temperature measurements of ITER magnets and their cooling circuits is of fundamental importance to make sure they operate under well controlled and reliable conditions. Therefore, thermometric chains shall reach a high operation reliability. In this paper, we present the full thermometric chain installed on the ITER magnets and their helium piping as well as the associated components production. The thermometric chain is described from the sensor and its on-pipe assembly, to the signals conditioning electronics. The thermometric block design is based on the CERN's developed one for the LHC, which has been further optimized thanks to thermal simulations carried out by CEA to reach high quality level of industrial production. The ITER specifications are challenging in terms of accuracy and call for severe environmental constraints, in particular regarding irradiation level, electromagnetic immunity and distance between the sensors and the electronic measuring system. A focus will be made on this system, which has been recently developed by CEA: based on a lock-in measurement and amplification of small signals, and providing web interface and software to monitor and record temperatures. This measuring device provides a reliable and fast system (up to 100 Hz bandwidth) for resistive temperature sensors between a few ohms to 100 kohms.

During last two years, around 2500 thermo-blocks and nearly 50 crates of 5 boards, with eight channels each, have been produced and tested at CEA low temperature laboratory. All these developments and tests have been carried out thanks to three test benches built up at CEA Grenoble and in one industrial electronics laboratory. Test benches results on the entire production will be presented.

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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