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Numerical analysis of the DTT Toroidal Field conductor samples tested in SULTAN

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In the EU DEMO reactor, currently in its pre-conceptual design phase, power exhaust represents a major challenge, asking for a new, robust design of the divertor. To address this issue, the Divertor Tokamak Test (DTT) facility is being built in Italy. It will be a compact and flexible tokamak, allowing the implementation of several plasma configurations as test bed of DEMO-relevant divertor solutions.
The DTT fully superconducting magnet system will include 18 Nb3Sn Toroidal Field (TF) magnets, cooled by forced-flow supercritical helium at 4.5 K and 0.5 MPa and operated at 42.5 kA in a 11.9 T peak magnetic field. The TF Cable-In-Conduit Conductors are currently being manufactured and to verify their performance some qualification tests in relevant conditions close to the operating ones were carried out in 2022 in SULTAN (Swiss Plasma Centre, Villigen, Switzerland).
The sample was composed of two conductor sections with a different cabling twist pitch sequence. They underwent 3000 electro-magnetic cycles and two warmup/cooldown cycles, and the DC performance and AC losses were measured before and after the cycles. Minimum Quench Energy (MQE) tests were also carried out.
The 4C code, the state-of-the-art tool for the thermal-hydraulic simulation of transients in superconducting magnets for fusion applications, is being used to support the design verification of the DTT magnet system. In this work, the 4C code is used to model the DC tests carried out on the SULTAN sample. This allows to qualify the Ic scaling parameters obtained from dedicated measurements on the Kiswire Advanced Technology (KAT) strands at E-WASP facility in the ENEA Superconductivity Laboratory of Frascati and used for the numerical analysis of the DTT TF coil performance.
The simulation of the MQE tests is also presented, to support the data interpretation and investigate the stability of the TF conductor.

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Primary author: SCARANTINO, Giuseppe (Politecnico di Torino)

Co-authors: DI ZENOBIO, Aldo (ENEA); ZAPPATORE, Andrea (Politecnico di Torino); FIAMMOZZI ZIGNANI, Chiarasole (ENEA); DE MARZI, Gianluca (ENEA); SEDLAK, Kamil (EPFL Lausanne); BONIFETTO, Roberto (Politecnico di Torino); ZANINO, Roberto (Politecnico di Torino)

Presenter: SCARANTINO, Giuseppe (Politecnico di Torino)

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