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# Wed-Af-Po.09-08: Toward design finalization for the Central Solenoid coil system of the DTT tokamak

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The design of the Central Solenoid (CS) for the "Divertor Tokamak Test"(DTT) facility has evolved through different options, investigated with the aim to satisfy the demanding magnetic flux performance required by the DTT scientific program, while providing a robust solution from the manufacturing and operational point of view.
In the present paper we illustrate the current design choice, based on a stack of six identical Nb3Sn modules, and the required pre-compression structure, and the engineering activities carried out so far.
A crucial aspect supporting the design choice, has been the test outcomes under relevant electro-mechanical conditions at 77 K, of a 5 x 5 turns winding pack mock-up, in particular to probe the inter-turn electrical insulation limits under the effect of the foreseen 2x25000 electromagnetic loading cycles.
Particular care has been devoted to the definition of the quench detection technique, as in the specific current design of the DTT CS, a quench detection tape co-wound around the conductor is considered risky for the integrity of the highly loaded winding pack insulation. In this work, different layouts of quench detection sensors have been studied, also considering the expected noise levels that have been computed by numerical codes, so to evaluate different possibilities, such as: using just the voltages measured across the different coil layers; using a steel wire co-wound at the corner of each CICC turn for inductive noise cancellation; or adopting an internal quench wire placed inside the superconducting cable. Since the coil is made of Nb3Sn strands, any of these sensors must be resistant to the superconductor reaction heat treatment temperatures.
The minimum temperature margin has been computed during all relevant operation scenarios of the magnet, including the effects of the very rapidly varying current and field at plasma breakdown, where the computation of AC losses has to be carried out under the assumption of cable saturation, with specific models. The main results of the thermo-hydraulic analyses performed with the "4C"code will be reported, along with the main outcomes of the 3D FEM structural analyses.

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