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Wed-Mo-Po3.01-10 [10]: Progress in the Design of a Hybrid HTS-Nb3Sn-NbTi Central Solenoid for the EU DEMO

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State-of-the-art high field solenoids make use of hybrid designs exploiting the superior high field performance of High Temperature Superconductors (HTS) in the innermost region. The benefits of a hybrid Central Solenoid in a pulsed tokamak like DEMO can be two-fold: either to reduce its outer radius (which would result in a reduced overall size and cost of the tokamak), or to increase the generated magnetic flux (which could extend the plasma burn time and possibly increase the power plant efficiency). In the framework of the pre-conceptual design studies for DEMO coordinated by EUROfusion, a hybrid Central Solenoid is proposed based on ten layer-wound sub-coils using HTS, Nb3Sn, and Nb-Ti conductors respectively for the high, medium, and low field sections. The design exploits the flexibility of layer winding by grading both the superconductor and the stainless steel cross sections in each sub-coil, which has the potential for significant space and cost savings. Mechanical analyses have identified fatigue as the main design driver for the EU DEMO Central Solenoid. Possible alternatives to reduce the sensitivity of the proposed design to fatigue are currently under investigation.

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