

Design Studies, Magnetic and Structural calculations for a DEMO hybrid CS proposal

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The Roadmap to Fusion Electricity draws on innovative experiments pivotal for the accomplishment of the European DEMO, i.e. the demonstration fusion power plant by the EUROfusion Consortium.

At the end of the pre-conceptual design phase, the machine comprises three main magnetic systems: 6 poloidal field (PF) coils, 16 or 18 toroidal field (TF) coils and the central solenoid (CS), primary member of the ideal transformer in which the induced plasma is the secondary. A few design solutions are being studied, in order to enhance the performance of the CS in terms of magnetic flux density, structural integrity and feasibility.

The ENEA design proposal is based on a layer wound graded design, comprising for each CS module a High Field, a Medium Field and a Low Field sub-module made of Nb3Sn Cable-in-Conduit Conductors.

The option of an additional inner High Temperature Superconducting (HTS) grade, is also analyzed. Among the different CICC design options being considered, a new possibility is proposed identified with the acronym RRIS (Round-in-Round-In-Square): a circular insulated jacket is inserted in an external rectangular 316LN structure.

The proposed solution aims to obtain a cable capable of withstanding the intense electromagnetic loads generated during the DEMO plasma scenarios, preserving the CICC turn insulation integrity. This work presents the updated solution generated via the ENEA Design Explorer algorithm, and the magneto-structural analyses for this design.

Keywords

fusion, tokamak, superconductivity, magnets, DEMO, CICC, EUROfusion, ITER

Category

Electromagnetics modelling of LTS and HTS magnets

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