Contribution ID: **26**   Type: **not specified**

MAD - Modelling-Aided-Design of a tokamak magnet system

Wednesday 3 May 2023 13:15 (45 minutes)

Complex, multi-physics modelling undeniably plays a fundamental role in the design of superconducting magnet systems, as that for a tokamak reactor. Although a preliminary estimation and conceptual design can be drafted based on experience and analytical formulations, a higher-level confidence can only be gained by numerical modelling and analyses, that provide insight into design choices, allow a wider exploration of parameters space, and reduce design margins, that often result from over-simplified assumptions. The modelling-aided design of all coil components is discussed, considering as a case study that of the Divertor Tokamak Test (DTT) facility, currently under construction at ENEA. The performance evaluation of the superconducting strands and of the high-current CICCs, as well as the design of the coil winding pack and structures, all rely heavily on electro-magnetic, thermal-hydraulic, and mechanical numerical modeling, as will be shown for example for the DTT Toroidal Field (TF) and Central Solenoid (CS) coil components.

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