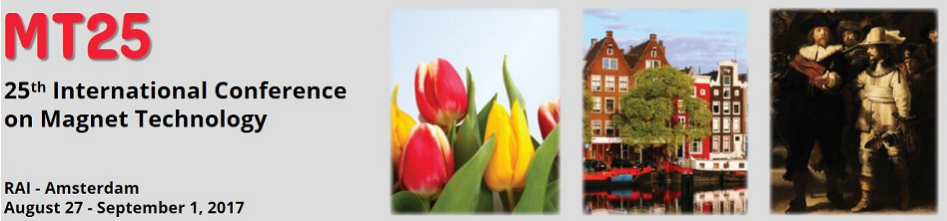

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STATUS OF CEA MAGNETS DESIGN METHODS AND TOOLS AND APPLICATION TO EU DEMO MAGNETS DESIGN

Thursday, 31 August 2017 13:45 (1h 45m)

In the framework of the design activities conducted in EU for dimensioning the future fusion demonstration reactor (DEMO), extensive analyses were led through in the EUROfusion context, aiming at ultimately defining the design of the DEMO magnets system. In this objective CEA has developed ad-hoc pre-dimensioning tools and associated methods in order to size the different magnets: Toroidal Field (TF) coils, Central Soleonoid (CS) and Poloidal Field (PF) coils. Once pre-dimensioned the magnet concepts undergo an evaluation process deriving from detailed analyses with more elaborated tools and methods. The latter being more time consuming, the whole process benefits from a most accurate as possible pre-dimensioning process. The tools address various aspects driving the operational limits of the magnets while energized in the tokamak, related to electromagnetic, thermic and mechanic phenomena.
In the present paper we mainly expose the latest developments achieved on the pre-dimensioning tools and the methods employed for obtaining a reliable macroscopic semi-analytical representation of the magnets. The assessing of the pre-dimensioning tools on reference configurations (e.g. ITER) will be also described. An outlook will be shown on the tools used for evaluation step and their possible integration. For both types of tools a discussion will be provided on the methods and criteria retained and the comparisons with reference analyses (e.g. detailed finite elements analyses on hotspot criterion).
The application of the above described tools on the DEMO configuration issued by EUROfusion will be shown, and their outcome as proposals for magnet design for: - The TF system, considered with pancake winding geometry; - The CS, considering modular geometry (6 modules) and pancake winding; - The PF system, composed of 6 coils. Discussions on the sensitivity of each system to design parameters / criteria will be provided, extended to some tentative recommendations on DEMO magnets design approach.

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