MT 26
International Conference
on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **1096** Type: **Poster Presentation**

Wed-Mo-Po3.01-06 [6]: CEA Broad Design Studies on EU Demo TF, CS and PF Magnets Systems

Wednesday 25 September 2019 09:30 (1h 45m)

In the framework of EU design activities for dimensioning the future fusion DEMOnstration reactor (DEMO), extensive analyses were conducted in EUROfusion context, aiming at ultimately defining the design of the DEMO magnets system. In this objective CEA proposes design for all cryomagnetic systems: Toroidal Field (TF) coils, Central Solenoid (CS) and Poloidal Field (PF) coils.
In the last DEMO reactor baseline, designs for all three systems were investigated with pre-dimensioning macroscopic CEA tools, resulting in many possible design options.
Broad parametric investigations, conducted on the three systems, will be presented, highlighting the merits of the selected afore-mentioned open choices. For example, regarding TF system, several pancake-winding patterns can be envisaged while complying with machine-level constrains. Central design parameters are varied (e.g. mechanical stress, maximum conductor current, temperature margin⋯) for which each design option shows a specific sensitivity. Parametric studies will not only address variables but also TF pancake-wound design concepts variants: presence or absence of radial plates. Taking into account the DEMO baseline, the influence of important inputs (maximum field, operating temperature⋯) accuracy (macroscopic models, detailed numerical codes⋯) on the TF design features will also be quantified, with considerations on design strategy.
On CS system influence of e.g. dimensions (height, external radius), conductor material (LTS versus HTS), design criteria (e.g. temperature margin, stress⋯) or mechanical model (static, fatigue⋯) are investigated to identify a domain of compliance around the reference design for DEMO configurations. And finally PF system will also be parametrically explored especially regarding the aspect ratio of PF coils winding.
The outcomes of this exhaustive broad exploration will be exposed and discussion will be led on pros and cons of each option.
Finally recommendations will be issued both for choosing reference design for the three magnetic systems and for the definition of methodologies to be followed for design purposes.

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Session Classification: Wed-Mo-Po3.01 - Fusion V: DDT and DEMO