ENGINEERING EVOLUTION OF THE FAST MACHINE

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FAST (**F**usion **A**dvanced **S**tudies **T**orus) (Fig. 1) is a proposal for a Satellite Facility which can contribute the rapid exploitation of ITER and prepare ITER and DEMO regimes of operation, as well as exploiting innovative DEMO technology. FAST operates with high performance H-Mode (B_T up to 8.5 T; I_P up to 8 MA) as well as Advance Tokamak operation (I_P=3 MA), and full non inductive current scenario (I_P=2 MA) [1].

FAST Load Assembly, consists of 18 Toroidal Field Coils, 6 Central Solenoid coils, 6 External Poloidal coils, Vacuum Vessel and its internal components and the mechanical structure. The load assembly is kept under vacuum inside a stainless steel cryostat [2]. Helium gas at 30 K is Recent design activities within the FAST program have led to improve several of the main machine components. Cooling of the toroidal magnet system is guaranteed by helium gas through suitable channels carved in the coil turns. An extensive thermal analysis will be performed using ABAQUS code, to define the inter-pulse cooling time for the most demanding scenario (pulse length up to 170 s).

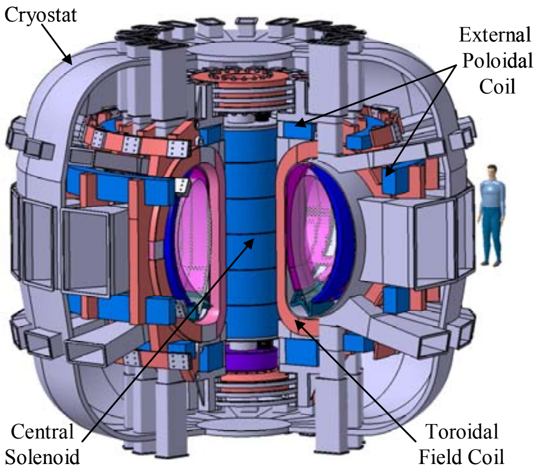

Figure 1: FAST Load Assembly view

The Finite Element Method (FEM) has been employed to analyse the stresses of the load assembly structure using the ANSYS code. Due to the full structural cooperation, the Toroidal Field Coils, Central Solenoid and mechanical structure, have been modelled as a whole, using mechanical and thermal smeared properties. Structural analysis are performed at the most significant times of the operating scenario, including the preload at 30K.

The FW consists of a bundle of tubes armoured with 4 mm plasma-sprayed tungsten. The conceptual design of the FW, emphasising the more relevant aspects of the mechanical solution, will be reported. Due to the magnetic configuration of the tokamak, the power carried by the charged particles, following the field lines, is concentrated on the specially designed divertor target plates. The expected high power flux (18 MW/m^2) in the divertor target plates [3] imposed the use of monoblock W tiles actively cooled. An optimization of the divertor configuration, as a result of upgraded plasma edge modelling, will be presented. The engineering aspects and the principal features of the divertor revised design, expecially concerned vertical heat flux target, will be discussed.

[1] A. Pizzuto et al., The Fusion Advanced Studies Torus (FAST): A Proposal for an ITER Satellite Facility in Support of the Development of Fusion Energy, 22nd IAEA-FEC, October 13-18, 2008, Geneva, Switzerland.

[2] A. Cucchiaro et al., Conceptual design of the FAST load assembly, Fus. Eng. Des., **85**, 2010, pp. 174–180.

[3] G. Maddaluno, et al., Edge plasma physics issues for the Fusion Advanced Studies Torus (FAST) in reactor relevant conditions, Nucl. Fusion 49, 2009, p. 095011.