POLOIDAL FIELD CIRCUITS SENSITIVITY STUDIES AND SHAPE CONTROL IN FAST

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The Fusion Advanced Studies Torus (FAST) conceptual study has been proposed [1] as possible European ITER Satellite. This facility is aimed at exploring and preparing ITER operation scenarios as well as helping DEMO design and R&D. Relevant results in ITER regimes of operation in Deuterium plasmas can be obtained from investigations of non linear dynamics that are significant for the understanding of alpha particle behaviours in burning plasmas by using fast ions accelerated by heating and current drive systems.
FAST is designed to be a compact, elongated and high performance tokamak, with a flexibility in terms of both operational space and physics that can be investigated. This paper presents the plasma position and shape control studies, focusing the attention on the reference scenarios. The study has been carried out by using the FAST linearized model of the machine computed using the 2D axisymmetric finite element code CREATE-L [2]. The analysis illustrates the Poloidal Field (PF) capabilities in terms of operational space of plasma shape configurations, as for instance the possibility to achieve plasma with minor radius down to 0.45m (keeping fixed the major radius, i.e. R/A~ 4), and the feedback control of the vertical instability. A sensitivity analysis is carried out, showing the dependence of the poloidal field system on the main parameters of the plasma.
The dynamic simulations take into account the currents on the passive structures that decrease the vertical instability growth rates to values of about 13 s^{-1} [3]. The results obtained for the control of the plasma shape are applicable for the design of the divertor zone, so as to keep the X-Point inside the vacuum chamber and the strike point inclinations compatible with the thermal loads on the tiles [4]. Another aspect treated in the paper is the set of requirements for the design of the power supply amplifiers taking into account the sensitivity of the PF coils, as for instance the different influence of the vertical field circuits on the outer plasma shape, the up-down asymmetry of the machine, and the most demanding phases of a pulse, including for instance the strike points sweeping during the steady state of the reference scenario.

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