Integrated Modelling preparing for high-beta Scenarios on JT-60SA

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Along with the construction and operation of ITER, the design of a demonstration thermonuclear fusion reactor (DEMO) is the main goal of current international fusion research. New generation of tokamaks as JT-60SA [1] are meant to provide important information to allow discriminating between different DEMO designs. In particular JT-60SA will explore the possibility of running steady state plasma scenarios characterised by high fraction of bootstrap current, low flux consumption and sustainable divertor heat-loads. The feasibility of the above scenarios will depend on the simultaneous control of core/divertor/SOL conditions to maintain a peaked pressure profile, clean plasma while ensuring an acceptable heat load on the divertor targets. The reference high-beta non-inductive scenario of JT-60SA aims at achieving steady-state normalised beta values above 4 and bootstrap-current fractions of 80% at densities well below the Greenwald density-limit for controlled operations. Preliminary investigations of the SOL/divertor conditions at full power show that sustainment of the steady state scenario can be achieved using impurity seeding to mitigate the divertor heat-loads which will occur when 37 MW of auxiliary heating power are employed [2,3]. The above scenario has been simulated with the integrated suite of core/SOL/divertor codes JINTRAC [4]. A scan in NBI power and fuelling rate/location has been performed and found that inter-ELM levels of power-load on the outer divertor plate not exceeding 10 MWm^{-2} can be achieved without the need of impurity seeding when the NBI power is lowered to 17 MW (total heating power 24MW). The 0-D plasma parameters of this lower power / high fraction of bootstrap current scenario are discussed in this paper, along with the role on performance of the internal transport barrier, and the comparison against the reference values of the JT-60SA research plan. Internal MHD stability analysis and pedestal analysis of the scenario will be also presented.

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