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Investigation of Sustainable Reduced-Power non-inductive 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 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. Preliminary investigations of the SOL/divertor conditions show that sustainment of the steady state scenario without impurity seeding will be challenging due to the large heat loads which are likely to appear when 30 MW of NBI power are employed. Before developing seeding schemes for the full power scenario it will be therefore necessary to prepare a reduced-power optimised scenario where both the fraction of non-inductive current and beta are maximised while the heat flux to the divertor is kept at a sustainable level. The above reduced-power scenario has been investigated with the integrated suite of core/SOL/divertor codes JINTRAC. A scan in NBI power and fuelling rate/location has been performed and found that acceptable levels of power-load on the outer divertor plate can be achieved in the absence of impurity seeding when the NBI power is lowered to 17 MW. 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.

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