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Numerical analyses of baseline JT-60SA design concepts with the COREDIV code

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JT-60SA is a superconducting tokamak supporting fusion research on the way towards realization of energy production in a DEMO reactor. The baseline JT-60SA design foresees full carbon wall, however feasibility studies have been initiated recently to assess the possibility of the transition to full W. In this paper, JT-60SA reference design scenarios at high (#3) and low (#2) density have been analysed with the help of the self-consistent core-edge COREDIV code. Simulations results for standard carbon wall and the full W have been compared in terms of the influence of impurities, both intrinsic (C, W) and seeded (N, Ar, Ne, Kr) on the radiation losses and plasma parameters. In particular, the reduction of the divertor target power load due to radiation of sputtered and externally seeded impurities has been investigated. Simulations of plasmas with C wall have been performed for scenarios (#3) and (#2) assuming N as the reference seeding gas. However, for scenario (#2) seeding by other gasses (Ne, Ar, Kr) has been investigated as well. It has been found that the main plasma parameters of analysed scenarios can be reasonably reproduced by COREDIV. For the considered scenarios N and C radiates predominantly in the SOL region, Ne radiates also in the core, whereas Ar and Kr radiate mostly in the bulk plasma. For scenario #3 the regime of detachment on divertor plates can be achieved with N seeding whereas for high auxiliary power and scenario (#2), the carbon and seeding impurity radiation does not effectively reduce power to the targets. In this case only increase of neither average density or edge density together with Kr seeding might help to develop conditions with strong radiation losses and semi-detached conditions in the divertor. First calculations done for scenario #3 with W divertor and Ne seeding show that for large enough Ne influx the divertor heat load is below the technological limit requirements. The energy losses are dominated by Ne and deuterium radiation and plasma contamination is tolerable with the energy losses approaching 70% . Simultaneously the target temperature is low indicating semi-detached conditions. This result is further analysed in terms of different transport assumptions and plasma edge parameters. Similar strategy is applied for analysis of scenario #2. In this case however, in addition to the Ne also Kr seeding is considered.

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