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Studies of Impurity Seeding and Divertor Power Handling in Fusion Reactor

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The power handling in the divertor is one of the most crucial issues for a fusion reactor design. In the previous study of development of the power handling scenario for a compact DEMO reactor, SlimCS, further reduction of the target heat load was required even in the case where more than 90% of the exhausted power from the core plasma was radiated by the argon impurity gas seeding. In this paper, the impact of the impurity seeding and the machine specifications on the power handling in the fusion reactor divertor has been investigated by using an integrated divertor code SONIC. With decreasing the fusion power, the divertor plasma detachment is extended and the target heat load decreases. The SONIC simulation found the operational regime, i.e., the target heat load less than 6 MW/m2 for a tungsten mono-block divertor with a ferritic steel water-cooling pipe, at the fusion power less than 2 GW. It is also found that the impurity radiation fraction on the exhausted power can be reduced to 80% at the fusion power of 2 GW in the case of a copper-alloy water-cooling tube.

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