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Impact of impurity seedings for divertor protection against intolerable heat loads and tungsten sputtering on general on plasma performances using the SYCOMORE system code

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The next step after ITER is the demonstration of stable electricity production with a fusion reactor. Key design performances will have to be met by the corresponding power plant demonstrator (DEMO), fulfilling a large number of constraints. System codes such as SYCOMORE, by simulating all the fusion power plant sub-systems, address those questions. SYCOMORE uses an advanced two points model to simulate the scrape-off layer (SOL) physics, that takes momentum losses and impurity radiation into account. As impurity radiation affects both the core and the SOL power balance, a loop between the SOL and the Core models is designed to find the minimal impurity fractions necessary to protect the divertor targets from both intolerable heat flux per unit of surface (qpeak) and tungsten sputtering (maximum target plasma temperature). This coupling allows to address the effect of divertor protection on gobal power plant design. Sensitivity analysis can be then used to compare the effect of the divertor design and physics uncertainties on global power plant design with uncertainty sources from other part of the tokamak. Such analysis will be performed starting from the ITER design, comparing the effect of the uncertainty on the upstream SOL width parameter (lambaq), to the following other uncertainty sources: toroidal magnetic field on axis (BT), energy confinement enhancement factor (fH), electronic density at the separatrix (nsep) and auxiliary plasma heating power (Padd). The effect of the divertor target plasma temperature constraint (Ttarg, max) will be compared to the divertor target heat flux per unit of surface (qpeak, max) one by performing the same sensitivity analysis using alternatively the qpeak, max constraint and the Ttarg, max one. The results of these two analyses will be compared to a more realistic one that take the two divertor target constraints altogether.

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