Performance predictions for the COMPASS upgrade tokamak

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We present modelling results for the COMPASS Upgrade tokamak [Panek et al. Fus. Eng. Des. 2017], a 5 Tesla, 0.84 m major radius tokamak, to be constructed at the Institute of Plasma Physics of the CAS in Prague, Czech Republic. COMPASS-U will feature 80 keV neutral beam injection (NBI) and 170 GHz electron cyclotron (EC) heating and current drive systems of up to 8 MW total power. Plasma facing components will be entirely metallic, designed for edge, scrape-off layer and plasma exhaust studies.

We assess the core plasma performance in the foreseen operation scenario parametric range. Equilibria with various plasma shapes, created using the planned ITER-like poloidal field (PF) coils, are calculated, including the PF coil currents, using the free-boundary equilibrium code FREEBIE [Artaud and Kim EPS 2012]. The PF currents stay within the operational limits, including the necessary flux swing. MHD stability of the equilibria is assessed. Confinement, heating and current drive are studied using METIS [Artaud et al. NF 2010], a rapid integrated modelling tool which combines scaling laws, 1-D current diffusion, 2-D equilibrium and simplified heat and current drive source models. We show that COMPASS-U will be able to operate at 5 T, 2 MA plasma current with elongation up to 1.8 and a high triangularity, reaching β_N above 1 % and average electron/ion temperatures above 3 keV, depending on the plasma density and the heating power. For edge and plasma exhaust physics, it is important that pedestal pressures can reach above 30 kPa and the power flux through the separatrix will be in a 4 – 8 MW range, generating reactor level power fluxes on divertor targets due to the narrow power decay length.