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P5.1012 Reassessment of steady state operation in ITER with NBI and EC heating and current drive

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The parametric Operational Space (OS) for Steady-State (SS) operation [1] in ITER has been reassessed by global analysis taking into account the baseline design of the Neutral Beam Injection (NBI) and EC H&CD systems and their foreseen upgrades (up to P_NBI = 49.5 MW and with P_EC = 30 MW, where up to 40 MW upgrade is possible). The analysis has been carried out for so-called Type-II SS scenarios, which exclusively use NBI and EC for heating and current drive H&CD and for which no internal transport barriers are assumed [2, 3]. The obtained OSs determine the choice of plasma current, density, H&CD specifications (power levels, injection geometries, etc.) and required energy confinement to achieve a given fusion gain, Q=P_fus/(P_EC+P_NB). From these OSs a set of Operational Points (OP) with fusion gain Q=5 with various H&CD specifications have been selected for more detailed MHD stability and 1.5-D transport and current drive analysis including sensitivity studies. Self-consistent 1.5-D transport simulations have been carried out for these selected OPs during the steady-state current flat-top phase. The 1.5-D simulations take into account the contribution of the fast particles pressure as well as bootstrap and externally driven currents. Sensitivity studies to current and pressure profiles have been performed by variation of NBI & EC specifications and the consequences for ideal MHD stability evaluated including diamagnetic effects. These studies allow the determination of the optimum operational conditions for the achievement of MHD stable plasmas to demonstrate the Q = 5 steady-state goal in ITER in terms of plasma current, density, NBI and EC specifications, as well as the capability of the H&CD systems to ensure MHD stability and the assessment of other integration issues, such as divertor power load control. The capability of the ITER CS/PF magnets' system to support these scenarios is found to be adequate [4] and will be described in the paper.

[1] A.R. Polevoi, et al, "Assessment of Operational Space for Long-pulse Scenarios in ITER", P2.187, EPS2010
[2] A.R. Polevoi, et al, Nucl. Fusion 45 (2005) 1451-1456
[3] C. Gormezano, et al, Nucl. Fusion 47 (2007) S285-S336
[4] S.H. Kim, et al, (2019), submitted to NF

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