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ITR/P1-13: CORSICA Modelling of ITER Hybrid Mode Operation Scenarios

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The hybrid mode operation observed in several tokamaks is characterized by further enhancement over the high plasma confinement (H-mode) associated with reduced MHD instabilities linked to a stationary flat safety factor (q) profile in the core region. The proposed ITER hybrid mode is currently aiming at operating for a long burn duration ($> 1000s$) with a moderate fusion power multiplication factor, Q , of at least 5. This paper presents candidate ITER hybrid mode operation scenarios developed using a free-boundary transport modelling code, CORSICA, taking relevant physics and engineering constraints into account. First, we have developed a 12.5MA ITER hybrid mode operation scenario by tailoring the 15MA ITER inductive H-mode scenario. Second, we have studied accessible operation conditions and achievable range of plasma parameters. ITER operation capability for avoiding the poloidal field (PF) coil current, field and force limits are examined by applying different current ramp rates, flat-top plasma currents and densities, and pre-magnetization of the PF coils. Various combinations of heating and current drive (H&CD) schemes have been applied to investigate several physics issues, such as the plasma current density profile tailoring, enhancement of the plasma energy confinement and fusion power generation. A parameterized edge pedestal model based on EPED1 was recently added to the CORSICA code and applied to hybrid scenarios. Finally, fully self-consistent free-boundary transport simulations have been performed to provide information on the PF coil voltage demands and to study the controllability with the ITER controllers.

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