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P1.1084 Tritium-concentration requirements in the fueling lines for high-Q operation in ITER

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One of the most fundamental control problems arising in ITER and future burning-plasma tokamaks is the regulation of the plasma temperature and density to produce a determined amount of fusion power while avoiding undesired transients. ITER is designed to achieve a ratio of fusion power to auxiliary power, Q, of 10. The reactor's high plasma density (> 1x10^20m^-3) and low burn fraction (1%) will require high deuterium (D) and tritium (T) fueling rates. Gas puffing will have a low fueling efficiency (< 1%) due to poor neutral penetration [1]. Therefore, the initial phase of ITER will rely on two pellet injectors located on its magnetic high-field-side (HFS) for deep core fueling. The D pellet injector (with pellets of 100% D nominal concentration) and the D-T pellet injector (with pellets of 10%D-90%T nominal concentration) are planned to have maximum throughputs of 120 Pa m3/s and 111 Pa m3/s, respectively [2]. However, limitations in the tritium plant subsystems could result in a lower T concentration. Even if the nominal concentration could be initially achieved, it might not be possible to sustain it for the total duration of long pulses. This not only imposes burn-control challenges [3] but also raises serious concerns over having sufficient concentration of T in the fueling lines to sustain long-pulse high-Q operation. In this work, a volume-averaged model of ITER's burning plasma is used to assess the feasibility of accessing Q = 10 operation for different levels of T concentration. Operation points characterized by Q = 10 are sought within ITER's limits for fueling rates and auxiliary heating powers. The results are presented in the form of Plasma Operation CONtour (POPCON) plots that span the density-temperature space. The minimum tritium concentration that can maintain the plasma at Q = 10 is determined for different particle-recycling assumptions. Although this work is concerned with the design parameters of ITER, the analysis can be extended to other future burning-plasma reactors such as DEMO.

References
[1] S. K. Combs, L. R. Baylor and others, "Overview of recent developments in pellet injection for ITER," Fusion Engineering and Design, vol. 87, pp. 634-640, 2012.
[2] J.A. Snipes, D. Beltran and others, "Actuator and diagnostic requirements of the ITER Plasma Control System," Fusion Engineering and Design, vol. 87, no. 12, pp. 1900-1906, 2012.
[3] A. Pajares and E. Schuster, "Robust Burn Control in ITER Under Deuterium-Tritium Concentration Variations in the Fueling Lines," 27th IAEA Fusion Energy Conference, Gandhinagar, India, October 22-27, 2018.

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