Power requirements for accessing the H-mode in ITER

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L-mode to H-mode (LH) transition data from 14 tokamaks are collected in a dedicated database (DB). Data taken just before the LH transition during smooth power ramps were selected from the DB. The threshold power dependence on numerous plasma parameters was investigated but its major dependences remain on magnetic field, plasma density and plasma size as indicated in previous studies. Small tokamaks with ohmic or ECH heating usually show a threshold power unexpectedly higher than the scaling. Then, a more restrictive data selection was applied to reduce the uncertainty in the deduced power law scaling. As a result, data from 6 tokamaks with ITER like shape remained selected and the threshold power expressed as $P_{thresh} = 1.67\ n_{e20}^{0.75}\ B_T^{0.73}\ a^{0.96}\ R^{1.07}$. Hence 55MW of additional power should afford a low density ($0.5\ 10^{20} m^{-3}$) Deuterium plasmas to reach the H-mode in ITER.

However, combining specific analysis of the plasma density and magnetic field dependences of threshold power in individual devices suggests that the density exponent increases with tokamak size. Therefore, the ITER threshold power might be larger than predicted by the scaling. In addition, all devices observed a minimum density below which the threshold power significantly increases in comparison to the scaling. One may speculate that the value of the minimum density increases with the magnetic field: in Alcator C-Mod (BT>5T) the minimum density seems to be ~$0.8\ 10^{20} m^{-3}$.

Finally, the threshold power prediction for ITER only indicates the power required to enter the H-mode. The operational conditions, in particular the heating power with respect to the threshold power, to obtain good confinement (H-factor>1) will be presented and the implications for ITER discussed.