

Scenario development of ITER ELMy H-mode hydrogen plasma

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An important part of the ITER research plan is the Pre-Fusion Power Operation (PFPO) phase, which includes demonstration of H-mode plasma operation and the commissioning of the ELM control systems. However, since hydrogen or helium are the main ion species in PFPO plasmas, the L–H power threshold P_{L-H} is expected to be considerably higher than equivalent D and D–T plasmas [1, 2], which restricts operation in terms of toroidal field and plasma density.

Here, we study the possibility for H-mode operation in hydrogen or hydrogen dominant plasma at 7.5MA/2.65T. Auxiliary heating is done by up to 33MW of hydrogen NBI and 20 – 30MW ECH. Two strategies are considered to lower P_{L-H} and provide stationary H-mode scenarios: a) operation at low density, and b) introducing helium to $\sim 10\%$ level (since this is observed to decrease P_{L-H} in JET [3]). The desired density regimes require introduction of neon to adjust NBI shine-through power to acceptable levels [4].

The scenarios are modelled self-consistently using JINTRAC [5], developed by EUROfusion, for integrated core (JETTO/SANCO/EDWM), edge and SOL/divertor modelling (EDGE2D/EIRENE). Results have indicated that a stable ELMy H-mode is indeed accessible for 7.5MA/2.65T H-mode hydrogen plasma with and without 10% He, provided that the ECH power is 30MW. In the He minority scenario, 20MW ECH might also be sufficient, although the operational space is narrow.

References

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