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FTP/3-3: On the Physics Guidelines for a Tokamak DEMO

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With ITER construction under way, the question of possible designs for a machine after ITER is receiving renewed attention. In many fusion energy roadmaps, such a step, often called DEMO, is a machine that should bridge the gap between ITER and the first commercial Fusion Power Plant (FPP). Hence, crucial elements for many DEMO designs are e.g. net electricity production or T-selfsufficiency and reasonable reliability and availability. For such a DEMO design, a consistent set of physics and technology assumptions has to be made, usually used in 0-d system codes to optimise with respect to a given set of criteria. Since DEMO is projected to run in a different regime than ITER, extrapolation using the ITER rules (so-called 'ITER physics design guidelines') is not always straightforward and the validity of model based physics assumptions has to be checked. In the frame of the EFDA PPP&T work programme, we have conducted an assessment of the physics assumptions made in present day systems codes and have critically examined the underlying physics base.
Work has mainly concentrated on so-called 'DEMO Physics Issues', defined as issues that do not have to be resolved for ITER to achieve its mission, but are critical for DEMO, in particular the areas of
i) steady state operation, ii) high density operation at n/nGW > 1 and iii) exhaust at high P/R.
The work presented will be a first step towards establishing 'DEMO physics guide lines'similar to what has been done for ITER. We also present a study of an operating scenario for DEMO based on 'improved H-mode' (also termed 'advanced inductive') operation which has a firm experimental basis and may lead to acceptable steady state operation conditions, provided the total current drive efficiency, i.e. the product of efficiency in the plasma and wall plug efficiency can be made high enough.

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