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Modelling of Pulsed and Steady-State DEMO Scenarios

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An intensive programme has been started in the EU, aiming at a more and more refined selection of the DEMO design. The general strategy adopted consists in developing two DEMO concepts in parallel: a pulsed tokamak, characterised by rather conventional physics and technology assumptions (DEMO1) and a steady-state tokamak, with moderately advanced physics and technology assumptions (DEMO2). The physics assessment part of this programme involves three main steps: i) the analysis of the general physics guidelines of a tokamak DEMO; ii) the search for optimum working points, performed by means of systems codes, i.e., 0-D codes combining both physics and technology constraints; iii) space and time dependent simulations of plasma scenarios, performed by means of integrated modelling codes with various levels of assumptions. In this last area of work, a coordinated effort has been undertaken at the EU level, as an EFDA Task Agreement during 2012 and 2013. The general goal of this Task was the analysis of working points produced by the systems code PROCESS for both DEMO1 and DEMO2 by means of various integrated modelling codes. Iterations between systems codes and scenario modelling should eventually converge to the definition of optimum working points that are consistent with the physics guidelines. The main results of this work on scenario modelling are reported here. The computational tools used for these studies are:

- The 0.5-D integrated modelling code METIS
- The coupled core-edge code COREDIV
- The 1.5-D integrated modelling codes ASTRA, JINTRAC and CRONOS

Starting from the 0-D outputs of the PROCESS code for both DEMO1 and DEMO2 working points, the following steps have been performed:

- test of the consistency of the PROCESS working points by exploratory runs of METIS. Iterations with PROCESS in order to improve the working points
- assessment of density and temperature profiles consistent with the reference working points and with first-principle particle transport models (TGLF, GLF23), by ASTRA
- assessment of impurity and radiation profiles consistent with the reference working points and with suitable impurity transport assumptions by COREDIV
- global scenario assessment by 1.5-D simulations with JINTRAC and CRONOS
- sensitivity analysis for variations of selected plasma and machine parameters and of transport models (by METIS, ASTRA, COREDIV)

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