TITLE

On the implementation of new technology models for fusion reactors systems codes

AUTHORS

Fabrizio Franza[1], Lorenzo Virgilio Boccaccini[1], Christian Day[1], Ulrich Fischer[1], Reinhard Heller[1]

AFFILIATIONS

[1]Karlsruhe Institute of Technology, Karlsruhe, Germany

PAPER

For the pre-conceptual design of the next generation fusion power plant (DEMO), systems codes are being used from nearly twenty years. In such computational tools, all the reactors components (namely plasma, blanket, magnets, etc.) are integrated in a unique computational system and simulated by means of rather simplified mathematical models. The system code tries to identify the main design parameters (e.g. major radius, net electrical power, toroidal field) and to make the requirements and constraints to be simultaneously accomplished.

In fusion applications, requirements and constraints can be either of physics or technology kind. Regarding the latest category, in this study a novel modelling approach is proposed in order to accurately consider the key technology aspects in systems analyses, such as neutronics in the breeding blanket and electromagnetic and mechanical analyses in magnets systems. In particular, Breeding Blanket, Magnets and Fuel Cycle/Vacuum systems are analysed in details, aiming to highlight the connections among these components and the impact on the overall power distribution. As a matter of fact, more accurate technology modules imply better estimations of the key power terms to be considered in systems codes, such as the nuclear power in the breeding blanket and the coolant pumping power. Particular attention is also paid to the geometry models which are necessary for the poloidal representation of the reactor.

This study is first characterized by a modelling part, where the proposed new models for Blanket, Magnets and Fuel Cycle/Vacuum systems are briefly described; this part is then followed by a dedicated investigation on methodologies for the integration in systems codes, focusing on the linking parameters between the different technology modules and the plasma physics core. In the final part, the new models are tested on the most up-to-date DEMO version and the preliminary results are presented and discussed.