On the role of integrated computer modelling in fusion technology

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Computer modelling plays an increasingly important role in all science and technology domains. Once suitable computer simulation tools are in place, different reactor and component concepts can be subjected to various operational and accidental conditions *in silico*, providing an obvious advantage to the design of nuclear energy devices. The potential is immense: from fewer and more targeted experimental validations for complex multi-physics models, right up to integrated reactor designs codes, modelling can significantly improve productivity in a broad range of fusion R&D activities. Simulation can both handle very complex systems and help to distinguish among the individual effects of variables that in experiments would not be easily separated or studied. Accordingly, computer modelling is expected to play an increasingly important role in fusion design and technology, where the complexity of the physical processes involved (plasma, materials, engineering), and the highly interconnected nature of systems and components ("system of systems" design), call for support from sophisticated and integrated computer simulation tools. In this presentation, we review the contribution of coupled computer modelling to the design of the breeding blanket in terms of neutronics, materials behaviour, plasma-materials interaction and radiation effects, as well as compatibility with fluids, mechanical performance and diagnostics, supplemented by simulations of plasma transport out of the confinement region to determine heat and particle loads on plasma facing components. The current possibilities and levels of maturity of existing simulation tools are critically analysed, having in mind the possibility of integrating several tools in the future and highlighting the difficulties of such an endeavour.

Keywords: fusion reactor, computer modelling, neutronics, materials, plasma, model integration

Topic Category	Models and Experiments for FNT
Presentation Preference	☒ Oral Presentation ☐ Poster Presentation