

Conceptual Design Development for a Demonstration Fusion Power Reactor

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Demonstrating the capabilities of reliably generating a few hundred of MW of net electricity and operating with a closed fuel-cycle in a DEMOnstration Fusion Reactor is the remaining hurdle towards the exploitation of fusion power after ITER. ITER is a crucial step and its construction and operation will provide major advances in technology and physics knowledge. Nevertheless, outstanding challenges will remain in some areas with potentially large gaps.

As an important part of the Roadmap to Fusion Electricity, Europe is now conducting a conceptual design study on a DEMO plant which considers, for the initial design integration studies, a pulsed “low extrapolation” system based as far as possible on mature technologies and reliable regimes of operation (to be extrapolated from the ITER experience), and on the use of materials suitable for the expected level of neutron fluence. It is clear that, to realistically convert this outline concept into a reliable high performance facility, there is a need for significant technical and scientific innovation. In addition, DEMO must be capable of testing advanced technical solutions that will be developed in parallel for application in a fusion power plant, thus playing (at least in part) the role of a component test facility.

This tutorial talk will provide an overview about status and plans of this concept design development. Design point studies applying system codes will be introduced as one of the activities on the system level. For each key component of the device a project has been established to develop a concept design, which is consistent to the overall design and to interfacing systems. Objectives and status of some of these projects will be reported. Another focus will be dedicated to DEMO Physics Integration Aspects. Here a number of DEMO Physics Challenges that significantly exceed the ones, which ITER will face, are introduced. In particular the first wall thermal load problem and the related development of the first wall load specification and considerations on the first wall design will be introduced.