Dynamic Modelling of the Helium-cooled DEMO Fusion Power Plant with an Auxiliary Boiler

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The Demonstration Fusion Power Plant (DEMO) project aims to construct and successfully operate an industrial size tokamak fusion power plant generating electricity to the grid. In order to succeed in this task, several challenges in the current fusion technologies have to be overcome. One key challenge relates to the pulsed operation of the machine and adopting conventional power conversion systems, which are commonly designed for continuous operation. The DEMO balance-of-plant systems have to be designed to manage a periodical drop in fusion heat production during the dwell period.

A configuration utilizing an Auxiliary Boiler (AUXB) between the helium-cooled Primary Heat Transfer System (PHTS) and the Power Conversion System (PCS) have been studied over the course of several years within the EUROfusion Balance of Plant (BoP) workpackage. In such arrangement the AUXB provides necessary power to maintain ~50% power generation conditions in the PCS during dwell time. KIT developed a realistic PCS scheme and performed steady-state balance analysis for pulse and dwell operation of DEMO with the simulation tool Ebsilon. To complement the static analyses VTT has made a model of the same configuration with the Apros system code. Dynamic analyses have been performed to assess plant performance during power cycles consisting of transitions from pulse to dwell and back to pulse operation. The goals of present study are to verify that the developed balance-of-plant concept is feasible, to establish and optimize a plausible control strategy minimizing various stresses on the components, i.e. enhancing reliability of DEMO operation andthus providing input for further improvements.

Keywords: DEMO fusion power plant, Apros, dynamic modelling, tokamak, auxiliary boiler

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