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P2.186 DEMO Breeding Blanket Helium Cooled First Wall design investigation to cope high heat loads

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In the framework of the European “HORIZON 2020” innovation and research program, the EUROfusion Consortium develops a design of a fusion power demonstrator (DEMO). One of the key components in the fusion reactor is the Breeding Blanket (BB) surrounding the plasma, ensuring tritium self-sufficiency, heat removal for conversion into electricity, and neutron shielding. CEA-Saclay, with the support of Wigner-RCP and Centrum výzkumu Řež, is in charge of the development of one of the four BB concepts investigated in Europe for DEMO: the Helium Cooled Lithium Lead BB.

The first component of the BB facing the plasma, the First Wall (FW), has until now been designed in order to respect the design criteria and temperature limit of the Eurofer structure for a maximum heat load extrapolated from ITER TBM, equal to 0.5 MW/m^2 . New heat loads on the First Wall of DEMO BB have been assessed recently showing higher values on some poloidal location of the BB.

This paper presents the investigation on the Helium FW design integrated to the BB (inlet helium temperature at $300 \text{ }^\circ\text{C}$). Different designs have been studied from rectangular to circular channels and with different options for the tungsten armour surrounding the channels. The performance of the different concepts has been assessed with thermal and mechanical Finite Element Method numerical simulation based on simplified FW models and comparing results with the RCC-MRx code design rules to prevent failure during normal steady state condition and off normal condition in case of Loss Of Coolant Accident (LOCA) event. The results show that selected options with circular channel surrounded by tungsten could meet some of the requirements of plasma heat loads from design point of view. However, the concept is still in an early stage of development and open issues are discussed.

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