HCPB TBM THERMO MECHANICAL DESIGN: ASSESSMENT WITH RESPECT CODES AND STANDARDS AND DEMO RELEVANCY

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The three main functions of a blanket module in a future fusion reactor are removing heat, breeding tritium and shielding sensitive components from radiation. Different DEMO relevant breeding blanket concepts will be tested in ITER under the form of six different Test Blanket Modules (TBM). In the frame of the activities of the European TBM Consortium of Associates the Helium Cooled Pebble Bed Test Blanket Module (HCPB-TBM) is developed in Karlsruhe Institute of Technology (KIT): four different HCPB-TBMs of the EU will be installed into one dedicated ITER equatorial port and tested during different test campaigns.

Nuclear analyses of the preliminary design [1] of the HCPB-TBM in vertical arrangement have been performed. The design of the Breeder Units (BU) has been developed in parallel evaluating the power produced in the BU itself and deposed on the TBM box structures. Nuclear results together with the heat flux distribution from the BU allowed assessing the HCPB-TBM thermal design. Different design options have been proposed optimizing the HCPB-TBM behavior under typical ITER loads. A synthesis of the solution proposed has been realized building two different assemblies of the vertical HCPB-TBM: these two assemblies and the analyses performed on them are presented in this paper.

Finite Element thermo-mechanical analyses of two detailed ¼ scaled models (reflecting the two HCPB-TBM assemblies proposed) have been performed, with the aim of verifying the accordance of the mechanical behaviour with the criteria of the design codes and standards. The structural design limits specified in the codes and standard are discussed in relation with the EUROFER available data and possible damage modes. Solutions to improve the weak structural points of the present design are identified together with the missing rules and the model development needs. The present choice of the thermal and structural design parameters and their related level of DEMO relevancy are discussed.

[1] F. Cismondi et al., Fusion Engineering and Design, 84, 2009, 607–612