Development of HCLL DEMO First Wall design for SYCOMORE System Code

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The conceptual design of the DEMOnstration reactors is already started and, in order to achieve a final configuration, several reactor configurations have to be tested by exploring some design parameters. To justify the final design, it is necessary to simulate the physical behavior of the components with accuracy that could be very time consuming, in particular, using specific design codes. The system codes, powerful means for understanding the suitable design solution, can identify quickly the overall impact of the design choices and their interactions, testing easily a lot of configurations. One of the system codes, used within the European Integrated Tokamak Modelling framework, is SYCOMORE (SYstem COde for MOdelling tokamak REactor) developed by the *Commissariat à l'énergie atomique et aux énergies alternatives* (CEA). SYCOMORE includes several specific modules linked together, one of which is aimed to define the suitable design of the Helium Cooled Lithium Lead (HCLL) Breeding Blanket (BB). The research activity has been devoted to improve the method to define automatically the First Wall (FW) design starting from thermal-hydraulic and thermo-mechanical considerations, using analytical design formulae and, also, taking into account the design criteria coming from Codes&Standards (C&S). Considering the issues related to the efficiency of DEMO reactor, it has been decided to use the pumping power as significant design parameter, expressed as a fraction of the thermal power recovered in the coolant. Thanks to these considerations, it has been possible to derive the first dimensions of the FW channels from which all the other characteristics are deducted. Afterwards, it has been assessed the thermal and mechanical field using a theoretical approach coded in a dedicated Python script. Therefore, in order to compare and validate the results of the Python script, a 3D geometric model has been created and FEM analyses have been carried out. The present work, performed in the framework of EUROfusion activities, aims to summarize the research activity carried out and the results obtained.

Keywords: DEMO, system code, SYCOMORE, breeding blanket, FW HCLL

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