Contribution ID: **287** Type: **not specified**

Progress on thermo-hydraulic and thermo-mechanical performances of Helium-Cooled-Molten-Lead-Ceramic-Breeder as near-term alternative blanket for EU-DEMO

Monday, 17 September 2018 11:00 (2 hours)

Within the framework of EUROfusion activities, an alternative Helium-Cooled Molten Lead Ceramic Breeder (HC-MLCB) solid breeding blanket is being also developed at KIT for European DEMO. This concept is proposed as an alternative near-term breeding blanket and it is based on a fission-like “fuel-breeder pin” assembly configuration. Molten lead is used here as the neutron multiplier, Li4SiO4 in form of pebbles inside the fuel-breeder pins as tritium breeder and pressurized helium as coolant. In comparison to typical former cooling-plate configurations, the fuel-breeder pin assemblies greatly reduce the pressure drop, solving the key technology readiness issue of the currently available helium-circulator. Also, the combination of lead and lithium ceramics shows a good tritium breeding performance in a compact configuration (outboard blanket average radial thickness of 1000 mm instead of former 1300 mm).
After initial design works with this concept for the previous EU DEMO tokamak baseline design 2015 (reported elsewhere), the current status of the design activities on the HC-MLCB integrated for the latest EU DEMO baseline 2017 (EU DEMO 2017) are presented and discussed in this paper.
Firstly, the structural integrity of the preliminary blanket design under an in-box LOCA event (a key design driver) has been assessed and the design iterated to fulfill the design criteria. Then, and after corresponding neutronics analysis to validate the soundness of the design in terms of nuclear performance, thermo-hydraulic analyses have been conducted to evaluate the blanket temperatures and the coolant pressure drop. After some design iterations to satisfy the temperature design limits and pressure drop requirements, a structural assessment under normal conditions has been conducted with respect to the structural design standard RCC-MRx. The results presented here show that the current design of the HC-MLCB meets the basic nuclear and thermo-hydraulic-mechanical performances, setting the path for a consolidated design of this concept.

Co-author: ZHOU, Guangming (Institute for Neutron Physics and Reactor Technology Karlsruhe Institute of Technology)

Presenter: ZHOU, Guangming (Institute for Neutron Physics and Reactor Technology Karlsruhe Institute of Technology)

Session Classification: P1