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CONSOLIDATED DESIGN OF THE LOW TEMPERATURE EU-DCLL

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A conceptual design of a DCLL outboard equatorial module was produced according to the specifications of the EU-DEMO based on 16 sectors, 1572 MW fusion power, with the main objective of bringing into maturity this breeder blanket concept. Specification and design guidelines for the DCLL Blanket System were developed, identifying the main requirements needed for the initial design and producing a preliminary CAD model of an equatorial module in a DEMO outboard segment based on neutronics, thermal-hydraulics and thermomechanical calculations. During the definition of this first conceptual design of the DCLL a new version of the EU-DEMO (with 18 sectors, 2037 MW fusion power) was released. Thus, the blanket design has been adapted to this new scenario by reviewing its operational conditions and producing important differences in the CAD model. Thus, some changes have been implemented with respect to the previous design, looking for simplicity. One of the most important ones is the new PbLi routing inside the modules, implemented to facilitate the draining of the individual modules. Related to this point, the previous annular geometry of the connection between the modules and the Back Supporting Structure has been simplified to reduce strong MHD problems. A comprehensive transient structural analysis revealed the occurrence of high stress concentration at the connections of the FW with the radial plates in case of a LOCA, therefore suggesting that an increase in the number of radial stiffening walls is necessary, and therefore the number of internal PbLi circuits.
Specific design elements have been consolidated, such us the thermal-hydraulic general scheme for the segments, the poloidal segmentation or the structural design. A MHD estimation of the convective heat transfer coefficient has been performed, and serves as input for the thermal-hydraulic and structural calculations.
Finally, an integration of the DCLL blanket within the PbLi loop is made, including the outcomes from tritium transport modeling in order to understand the overall behavior of the DCLL, as well as the impact on the Tritium Extraction System.

Eligible for student paper award?

No

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