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Recent progress in developing a feasible and integrated conceptual design of the WCLL BB in EUROfusion Project

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The Water-cooled lithium-lead breeding blanket is in the pre-conceptual design phase. It is a candidate option for European DEMO nuclear fusion reactor. This breeding blanket concept relies on the liquid lithium-lead as breeder-multiplier, pressurized water as coolant and EUROFER as structural material. Current design is based on DEMO 2017 specifications. Two separate water systems are in charge of cooling the first wall and the breeding zone: thermos-dynamic cycle is 295-328°C at 15.5 MPa. The breeder enters and exits from the breeding zone at 330°C. Cornerstones of the design were the single module segment approach needed to avoid that He gas bubbles formed from the Li are accumulated in the breeding zone close to the first wall; a water manifold between the breeding blanket box and the BSS with the twofold function to cool the structures of the inboard segments and to maximize the neutron shielding. The breeding blanket segment is attached with the vacuum vessel by means of a plate with a thickness of 100mm. This is in charge to withstands the loads due to normal operation and selected postulated initiating events. Rationale and progresses of the design are presented and substantiated by engineering evaluations and analyses. Water and lithium lead manifolds are designed and integrated with the two consistent primary heat transport systems, based on a reliable pressurized water reactor operating experience, and six lithium lead systems (i.e. three connected with the inboard and three connected with the outboard segments). Open issues, areas of research and development needs are finally pointed out.

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