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Design Of The Helium Cooled Lithium Lead Breeding Blanket in CEA: From TBM To DEMO.

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The Helium Cooled Lithium Lead (HCLL) blanket concept is based on the use of Helium as coolant and the eutectic Pb-16Li as neutron multiplier and breeder material. This concept was originally developed in CEA at the beginning of 2000: it is one of the two EU blanket concepts to be tested in ITER in the form of a Test Blanket Module (TBM) and one of the four blanket concepts currently being considered for DEMO.

The ITER HCLL-TBM was designed as representative of a DEMO blanket concept developed at the end of Power Plant Reactor Studies; its design is based on the same components and relevant geometries but intended to maximize the “DEMO relevancy” in the ITER environment, which is characterized by different plasma loads and the presence of other in-vessel components. It will allow studying the same physical phenomena that drive the design of DEMO, reproducing e.g. similar temperature fields in structure and functional materials and typical velocities of liquid breeder and coolant in order to validate the numerical tools used for DEMO design. However, the TBM design must comply with ITER operational constraints, i.e. not jeopardize the safety and availability of the machine and account for specific issues of integration in an equatorial port. In short, the TBM is a highly optimized component for the ITER environment that will provide crucial information for the development of the DEMO blanket in several key areas, but the overall performances of the DEMO blanket will not be addressed in TBM. On the other hand, given the tight schedule for the construction of the DEMO reactor, CEA approach is to share as much as possible the technological solutions used on the HCLL-TBM for the DEMO BB design in order to profit from the ITER experience and re-use technologies with the highest Technology Readiness Level (TRL). It is therefore essential to assess which technologies and design features could be transported from TBM to DEMO and which will instead need to be adapted, modified or replaced.

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