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Overview of Indian LLCB TBM program and status of R&D activities

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The Lead-Lithium Ceramic Breeder Test Blanket Module (LLCB-TBM) is the Indian TBM representing the DEMO breeding blanket, to be installed in ITER radial port no-2. The prime testing objective of LLCB TBM in ITER is to generate experimental data on the performance of tritium breeding blankets (such as tritium breeding and its extraction, nuclear heat extraction, neutron shielding) in an integrated fusion nuclear environment and validation of design tools. The LLCB TBM consists of lithium titanate (Li_2TiO_3), as ceramic breeder (CB) material, in the form of packed pebble beds and molten lead-lithium (Pb-Li) flows around the ceramic breeder cassette for extracting heat from pebble bed zone. Apart from performing the role of a coolant, Pb-Li also acts as a tritium breeder and neutron multiplier. The blanket module is in the shape of a box structure which is made of India specific Reduced Activation Ferritic Martensitic Steel (IN-RAFMS) and is cooled by high pressure gaseous helium. The box structure encloses the breeder cassettes and flowing lead-lithium. The tritium produced in the ceramic breeder zones is extracted in-situ by flowing low-pressure purge helium gas and the tritium produced in the Pb-Li circuit is extracted separately by an external detritiation column. The TBM shield is located behind the TBM to shield high-energy neutrons and radiation from plasma.

LLCB TBM has several ancillary systems, such as Helium Cooling Systems (HCS), Lead-Lithium Cooling System (LLCS), Tritium Extraction System (TES), Coolant Purification System (CPS), etc. Their successful operation is highly desirable to achieve the desired testing objective of LLCB TBM. The Conceptual Design Review (CDR) of LLCB TBS has recently been completed and design up-gradation is currently under progress considering process optimization, fabrication feasibility and safety consideration.

TBM R&D activities are also under progress with a specific attention to blanket material qualification and database generation (IN-RAFMS, Pb-Li and Li_2TiO_3), technology development for LLCB TBS ancillary systems (in specific to Pb-Li and tritium) and fabrication technology development through fabrication and qualification of mock-ups

This paper will provide a brief overview of the present status of LLCB TBS design and various R&D activities.

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