

Current Design and R&D Progress of CN HCCB TBS

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As the testing mockup of tritium breeding blanket for DEMO, Chinese Helium Coolant Ceramic Breeder (HCCB) Test Blanket System (TBS) are under developing by China and will be tested in ITER to verify the key tritium breeding blanket technologies. After the approval of conceptual design by ITER Organization in 2015, the design optimization and more R&D activities for HCCB TBS have been under implementation for preliminary design phase.

As the structural material of TBM module, eight tons RAFM steel (CLF-1) plates and forgings have been fabricated and a certification of 3.2 requested by EU Pressure Equipment Directive 97/23/EC (PED) has been obtained for CLF-1 steel. The fabrication techniques for the functional materials, beryllium pebble and Li₄SiO₄ pebble, have also been developed and the properties have tested. The new manufacture facility for Li₄SiO₄ pebble is under construction and the manufacture facility for beryllium pebble was upgraded to achieve production rate 10kg/batch.

Recently the TBM-set design was significantly optimized and the whole integration method of TBM and the fabrication procedure plan has been updated. The results show that the total heat deposition in TBM was similar with conceptual design, while the tritium production ratio was slightly higher. The fabrication technology of TBM is under development. Following the fabrication procedure plan of TBM, semi-prototype of TBM is under fabrication to verify the final integration plan.

Ancillary systems have been optimized considering the review comments, safety and interface requirements. Accordingly the Process Flow Diagram (PFD) and Pipe & Instrumentation Diagram (PID) have been updated, but still some interface issues with ITER facility have been identified and have to be solved. The system performance has been assessed to optimize the operation control plan and equipment requirements. Several test platforms for breeding blanket technology development have been constructed and started experiments to test components, processes and get the operation data.

At same time, the safety assessment of HCCB-TBS has been updated and it shows that HCCB TBS has not over-temperature issues for all accident cases. Considering the limited inventories and multiple confinement barriers, no major safety consequences had been identified through accident assessments.

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