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Overview of JA DEMO Breeding Blanket Development

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The water-cooled solid breeder concept has been adopted as the concept of tritium breeding blanket for Japanese DEMOnstration fusion reactor (JA DEMO). The coolant water conditions are similar to those of pressurized water reactor, with the temperature of 290 –325℃ and an operation pressure of 15.5 MPa. The design has evolved to simultaneously meet the requirements of structural integrity (including pressure tightness against in-box loss-of-coolant), achievement of the target tritium breeding ratio (TBR), and manufacturability. A cylindrical blanket design using beryllide (Be12Ti) in block form as a functional structural element with neutron multiplication and heat transfer has been proposed as a design concept that satisfies the above diverse requirement [1,2].
In this concept, nuclear heat from the tritium breeding area is removed through contact heat transfer between the beryllide blocks and the inner wall of the casing. A tritium breeder (Li2TiO3) pebbles are filled between the inner surface of the cylindrical structure and the outer surface of the beryllide block to ensure maximum tritium production. Thermal analysis considering contact heat transfer confirmed that the casing structure is designed to meet the operational temperature range of the tritium breeding material and structural materials. Thermomechanical analysis showed that the primary and secondary stress values of the enclosure structure are below the allowable stresses for all evaluation lines. Nuclear analysis of the local TBR indicated that the TBR is estimated to exceed 1.20.
A technical readiness assessment (TRA) was conducted to identify critical technology elements (CTEs) and technical readiness level (TRL) of JA DEMO BB [3]. CETs were identified in the area of structural material development, functional material development and system integration. The current status and strategies for the design methodology of irradiated structures, as well as the efforts to develop the material property handbook (MPH) of the structural materials (reduced activation ferritic/martensitic steel, F82H) and functional materials, (beryllide blocks, etc.) will be discussed.

REFERENCES
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