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Current Status of Final Design and R&D for ITER Blanket Shield Block in Korea

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The main function of the ITER blanket shield block (SB) is to provide nuclear shielding and support the first wall (FW) panel. It is required to accommodate all the components located on the vacuum vessel (in particular the in-vessel coils, blanket manifolds and the diagnostics). The conceptual, preliminary and final design reviews (FDR) have been completed in the framework of Blanket Integrated Product Team (BIPT). Korea domestic agency (KODA) has been successfully completed not only the final design activities including thermo-hydraulic and thermo-mechanical analyses for SB02, 06, 08 and 16 but also the SB Full Scale Prototype (FSP) pre-qualification program prior to issuing of the procurement agreement.

SB #2 and #6 are located at in-board region of Tokamak. The pressure drop was less than 0.3 MPa, and fully satisfied the design criteria. The thermo-mechanical stresses were also allowable even though the peak stresses occurred at nearby radial slit end holes, and their fatigue lives were evaluated much more than 30,000 cycles. The SB #8 is one of the most difficult modules for design, since this module shall endure the severe thermal loading not only from nuclear heating but also from plasma heat flux at uncovered regions by the First Wall (FW). In order to resolve the design issue, the Neutral Beam (NB) shine-through module concept was applied for FW uncovered region, and it has been successfully verified as a possible design resolution. The SB #16 is located at out-board central region of Tokamak. This module is under much higher nuclear loading than other modules and is covered by an enhanced heat flux FW panel. In the early design stage, many cooling headers on front region were inserted to mitigate a peak stress nearby the access hole and radial slit end hole. However, the cooling headers on front region needed to be removed in order to reduce the risk from cover welding during manufacturing. Finally, a few cooling headers remained by the effort through several iterations to remove them and to optimize the cooling channels. The SB #8 FSP has been manufactured and tested in accordance with pre-qualification program based on the preliminary design, and related R&D activities were implemented to resolve the fabrication issues.

This paper provides the current status of final design and relevant R&D activities of the blanket shield block.

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