

Detailed Design and Fabrication Method of the ITER Vacuum Vessel Ports (P2-G-138)

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The engineering design of the ITER vacuum vessel (VV) has been progressed by the ITER International Team (IT) with the cooperation of several participant teams (PT). The VV and ports are the components allocated to Korea for the construction of the ITER. Hyundai Heavy Industries has been involved in the structural analysis, detailed design and development of the fabrication method of the upper and lower ports within the framework of the ITER transitional arrangements (ITA).

The design of the port structures has been investigated to validate and to improve the conceptual designs of the ITER IT and other PT. The special emphasis was laid on the flange joint between the port extension and the in-port plug to develop the design of the upper port. The modified design with a pure friction type flange with forty-eight pieces of bolts instead of the tangential key is recommended. Furthermore, the alternative flange designs developed by the ITER IT have been analyzed in detail to simplify the lip seal maintenance into the port flange. The structural analyses of the lower RH port have been also performed to verify the capacity for supporting the VV. The maximum stress exceeds the allowable value at the reinforcing block and basement. More elaborate local models have been developed to mitigate the stress concentration and to modify the component design.

The fabrication method and the sequence of the detailed fabrication for the ports are developed focusing on the cost reduction as well as the simplification. A typical port structure includes a port stub, a stub extension and a port extension with a connecting duct. The fabrication sequence consists of surface treatment, cutting, forming, cleaning, welding, machining, and non-destructive inspection and test. Tolerance study has been performed to avoid the mismatch of each fabricated component and to obtain the suitable tolerances in the assembly at the shop and site. This study is based on the experience in the fabrication of the KSTAR Project.

From the several structural analyses and the development of the fabrication method, the upper and lower port designs have been improved and comply with the design specification.