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Progress in the Design and Manufacture of High Vacuum Components for ITER & Manufacturing Design and Progress of the First Sector for ITER Vacuum Vessel

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A
ITER is a large experimental tokamak device being built to demonstrate the feasibility of fusion power. The main scope of this paper is to report the status of the design and manufacturing activities of two major ITER components, the ITER Vacuum Vessel (VV) and the Cryostat. Both components will provide the necessary high-vacuum required in the case of the VV for plasma operation and confinement and to allow for cooldown of the superconducting magnets to cryogenic temperature (Cryostat).
The design of the two systems has been developed by the ITER Organization (IO) with the support of many R&D activities carried out by the Parties and is almost complete. Procurement Arrangements (PAs) with four Domestic Agencies (DAs) have been signed to develop the manufacturing design and manufacture the components of these systems. Some detailed design on specific components still needs to be completed.
Manufacturing contracts have been placed in 2010-2012 with many preparation and qualification activities. The production of the full-scale VV sectors and cryostat sections has started in the four DAs with the procurement of base materials and manufacture of mock-ups or full-scale components. Realistic manufacturing schedules are being consolidated and the presently expected completion dates will also be reported in this paper.

B
The ITER Vacuum Vessel (VV) is a torus shaped double wall structure and consists of nine sectors and several ports. Main functions of the VV are to provide high vacuum for plasma operation and to protect radioactive contamination as the first safety barrier. Korea Domestic Agency (KODA) has responsibility for procuring of two sectors including the first sector which will be delivered before others. KODA contracted with Hyundai Heavy Industries Co., LTD (HHI) to product the VV sectors and major ports.
The design and fabrication of the VV as nuclear equipment shall be complied with the RCC-MR code and regulations of nuclear pressure equipment in France (ESPN). The manufacturing design has been developed to fabricate the main vessel and port structures in accordance with the design requirements. All manufacturing sequences including welding methods are also established to meet the demanding tolerance and inspection requirement. The manufacturing design of Korean sectors has special design concepts to minimize welding distortion such as self-sustaining support ribs and cup-and-cone type segment joints. Several mock-ups have been constructed to verify and develop the manufacturing design and procedures. Qualifications for welding, forming and NDE have been conducted to verify related procedures according to the requirement.
For fabrication of the VV sectors and ports, 3,000 tons of plates and forgings had been produced by European steel companies and delivered to HHI. Four poloidal segments (PS) for the first sector are being fabricated simultaneously in HHI factory. All inner shells were cut, bended and machined for welding. Welding and NDE of inner shells for PS2 and PS4 are finished. To reduce schedule delay machining of forging blocks are on-going in parallel. Some of machined blocks are welded on the inner shell by TIG and electron beam welding.

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Primary authors: Mr SBORCHIA, Carlo (ITER Organization); Mr AHN, Hee-Jae (NFRI)

Presenter: Mr SBORCHIA, Carlo (ITER Organization)

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