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FTP/P7-20: Manufacturing and Development of JT-60SA Vacuum Vessel and Divertor

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The JT-60SA vacuum vessel (VV) and divertor are key components for the performance requirements. Therefore the manufacturing and development of VV and divertor are in progress by the first priority, inclusive of the superconducting magnets. The vacuum vessel has a double wall structure in high rigidity to withstand electromagnetic force at disruption and to keep high toroidal one-turn resistance. In addition, the double wall structure fulfills originally two functions. 1) The remarkable reduction of the nuclear heating in the superconducting magnets is made by boric-acid water circulated in the double wall. 2) The effective baking is enabled by nitrogen gas flow of 200℃ in the double wall after draining of water. Three welding types were chosen for the manufacturing of the double wall structure VV to minimize deformation by welding. Trial manufacturing of the 20-degree upper half segment was carried out with three welding types in order to investigate welding deformation, to verify a manufacturing procedure and to design constraint jigs for the welding. The manufacturing of the first VV 40-degree sector was completed after the inboard and outboard connection on Naka site in May 2011.
Divertor cassettes with fully water cooled plasma facing components are designed to realize the JT-60SA lower single null closed divertor. The divertor cassettes in the radio-active VV are especially developed to ensure compatibility with remote handling (RH) maintenance in order to allow long pulse high performance discharges with high neutron yield. Trial manufacturing of divertor cassette with typical precision of +-1 mm has been successfully completed and the real manufacturing has started. Brazed CFC (carbon fiber composite) monoblock targets for a divertor target have been successfully manufactured by precise control of tolerances inside CFC blocks. The first CFC monoblock target delivered in March 2011. The heat removal performance of the CFC monoblock target was successfully demonstrated on the JAEA Electron Beam Irradiation Stand. The surface temperature of the CFC monoblock target was able to keep around 1700℃ against heat load of 15 MW/mˆ2. Infrared thermography test of real monoblock targets by using hot and cold water was also carried out to construct database for acceptance inspection of 1000 monoblock targets.

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