European Preparations for the ITER Vacuum Vessel Sectors Manufacture

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Abstract

For the benefit of the bidders for the Call-for-Tender for the 7 Sectors of the ITER Vacuum Vessel, launched in early 2010, a large amount of relevant technical information was included to ensure a rapid start to successful manufacture programme, without the need for a full-scale prototype, which would cause an unacceptable delay to the ITER schedule.

The methodology of the logical structures of the specification and the additional planned mockups are described and the results from nearly a decade of R&D and manufacturing studies carried out inside the EU under the auspices of EFDA and F4E are also summarised. The work covers the evolution of novel manufacturing schemes and technologies, including a modular special local machining centre for making holes in the shell of the vessel with weld preparation included. New results from the combined studies by three parties, and using a round-robin trial system on the UT inspection of single-sided welds, including the successful control of the root side are described. A full-scale, partial prototype has demonstrated the successful construction segments using jigs to control the distortion from conventional welding, from the inner shell to the outer shell, and then the joining of the segments to form a part Sector. The paper also summarises the results from the prototype segment, manufactured without jigs and using only EB welds. In order to be able to achieve the required as-welded tight tolerances, two specialised computational techniques have been developed, using SYSWELD and ANSYS codes and calibrated with the mock-ups in order to efficiently predict welding distortions. Based on this successful practical and theoretical work, computer models of the complete poloidal segments or sectors, including jigs, were can now generated and used to investigate many welding sequences in order to optimise the construction and achieve all the tolerances.

Note: The information presented herein is derived from EFDA and F4E tasks and contracts and so is the property of the EU