

Reception tests of the industrial series manufacturing of WEST ITER-like tungsten actively cooled divertor

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The WEST lower divertor is composed of 456 actively-cooled plasma-facing components called PFUs (Plasma Facing Units) using ITER tungsten monoblock technology. They are assembled onto 12 independent toroidal sectors through mechanical fixation and welding to a cooling system.

In order to be used in the WEST tokamak these PFUs must meet strict technical specifications (geometry, dimensions, material ...). To that end, non-destructive tests, such as visual and dimensional inspections, ultrasonic testing and leak testing, were performed on all PFUs during the series production to ensure their good conformity.

After their reception at CEA, some acceptance tests are also performed. Practically, the tests performed at CEA lead: to provide information on the feasibility to attach mechanically PFUs on sectors, to ensure geometrical tolerances for the welding of PFUs to water manifolds, to check the PFU vacuum tightness and to ensure PFU alignment in WEST vacuum chamber, this later avoiding leading edge during tokamak operation. This study shows that all the PFUs are tightened and that PFUs dimensions fit to the requirements. CEA tests aim also to evaluate the PFUs heat exhaust capability. The heat exhaust capability is attributed to the combination of several PFU characteristics such as: quality of the PFU hydraulic cooling system, quality of the PFU interfaces (W to Cu and Cu to CuCrZr), relevancy of materials (W, Cu, CuCrZr) thermal properties. Heat exhaust is assessed using high heat flux test facilities (~10% of the PFU production tested) such as HADES at CEA and GLADIS at IPP-Garching. Infrared thermography tests were also performed (~25% of the PFU production tested). These tests lead to the first conclusion that detected defects are in general consistent with the ones detected using ultrasonic testing. It also provide information on the criteria and test sampling which can be used to assess the heat exhaust capability.

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