ITER DIVERTOR DOME FULL-SCALE PROTOTYPE [[1]](#footnote-1)\*)

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The main functions of the ITER Divertor Dome located below the separatrix are to baffle neutrals and to protect the cassette body (CB) and diagnostics systems from direct interaction with plasma. The Dome consists of a steel supporting structure (SSS), onto which the Plasma-Facing Units (PFUs) are mounted. There are three different PFUs: the Inner Particle Reflector Plate (IPRP) PFUs, the Umbrella (UM) PFUs and the Outer Particle Reflector Plate (OPRP) PFUs. The Dome is an actively cooled component with inlet water pressure of 3.3 MPa and an inlet water temperature of 110°C. All Dome PFUs are coated with flat tungsten-copper (W-Cu) tiles. All PFUs shall be high-heat-flux (HHF) tested and demonstrate the capability to withstand N=5000 cycles at q=5 MW/m2 and N=300 cycles at q=10 MW/m2. The ITER Divertor Dome is a high-vacuum equipment and has a specified allowable leak rate of 1·10-10Pa·m3/s.

During the qualification phase of the Procurement Arrangement (PA) for supply of the Dome full-scale prototype (FSP), all Dome PFUs were manufactured and successfully tested in the JSC “NIIEFA”. The following manufacturing techniques were developed and qualified: explosion welding for CuCrZr/SS joint, laser and orbital welding for SS/SS joints, brazing of tungsten armor to CuCrZr substrate. Non-destructive test reports were developed and applied to the control of manufactured components. All Dome PFUs have successfully passed the HHF tests. The Dome FSP has successfully passed the hydraulic water flow and pressure tests and the hot helium leak test.

One of the main problems identified during production of the Dome prototype was the discrepancy between the geometry of the plasma-facing surfaces located on the reflecting targets of the Dome to the required one. The UM PFUs of the Dome FSP had the most significant armor surface deviation - far beyond the allowed tolerances on the surface profile and on the surface step between neighboring PFUs. The subsequent R&D work was aimed at measuring the surface deformations at all stages of PFU manufacturing, finding the ways to minimize them and estimation of the possibility to use the reverse engineering as the way to observe the PFU surface tolerances.

Another problem of Dome prototype manufacturing was armor brazing defects of the UM PFUs. An excess of the filler leads to its penetration into the gaps between the armoring tiles of the UM PFUs and to the gravity-driven flux of the melt filler from the UM PFU top to its ends and also to the brazing defects. Measuring the filler by its specific (by area) weight helps to minimize the brazing defects.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/E/ru/IB-Makhankov.docx) [↑](#footnote-ref-1)