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Assessment of Critical Heat Flux margin on the Tungsten monoblock design of ITER Divertor

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ITER will operate with a full-tungsten (W) divertor made of 54 water-cooled cassettes equipped with W armoured plasma-facing units. The units that protect the vertical targets are made of W monoblocks bonded to poloidal copper-chromium-zirconium (CuCrZr) cooling tubes.
The maximum design heat flux on W monoblocks located in the vertical target part is specified as 20 MW/m2 for 10 seconds during, so-called, slow transient events.
It is prescribed by the ITER internal components structural design criteria to validate experimentally the thermal-hydraulic design of these units with respect to the occurrence of the CHF event, corresponding to a fast and drastic reduction of the heat transfer capability due to vapour layer formation, and the subsequent failure of the component.
The first part of this paper deals with recent Critical Heat Flux (CHF) experimental results obtained at the ITER Divertor Test Facility (IDTF, St Petersburg, Russian Federation) on Tungsten (W) monoblocks mock-ups, which confirmed the margin to the CHF regards to the design heat flux to be higher than the prescribed value 1.4. Comparison with predictions based on thermal-hydraulics correlations was found satisfactory.
In the second part, the reduction of the CHF margin is assessed, taking account the effect of tilting the vertical targets with respect to the cassette body and the introduction of the 0.5 mm depth toroidal bevel on the monoblocks. In the worst case situation, taking account manufacturing tolerances the reduction of the CHF margin could be in the range of 20%. Taking into account the presence of acceptable bonding defects, the reduction could be as high as 40%.
Meanwhile, the latest experimental results balance the consequences of this reduction so that the CHF margin during ITER operations is confirmed to be 1.4

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