HIGH HEAT FLUX TESTING OF MOCK-UPS FOR FULL TUNGSTEN DIVERTOR

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The ITER baseline foresees the use of carbon in the divertor strike-point region for the initial phases of operation with hydrogen and helium plasmas. Afterwards, a full tungsten divertor has to be procured and installed for deuterium-deuterium and deuterium-tritium plasma operations.

In January 2009, Fusion for Energy has established a task force to evaluate the option to start the ITER operation with a full tungsten divertor. Based on the related final recommendation, the EU-DA has launched a R&D program to assess the performances of W armoured Plasma Facing Components (monoblock option) under the conditions expected in the divertor strike point region.

In its initial phase, this program consisted in the High Heat Flux testing of W mock-ups up to 20 MW/m^2. Additional tests have been performed in order to validate the W monoblock option under reduced heat load, typically 15 MW/m^2.

During the first part of the campaign, eight W mock-ups, manufactured by Plansee SE (A) by Hot Isostatic Pressing and Ansaldo Ricerche (I) by Hot Radial Pressing, have been tested in the AREVA FE 200 Facility (F). The testing procedure started with 1000 cycles at 10 MW/m^2. Then, at 20 MW/m^2, 500 or 1000 cycles were performed, depending on the testing protocol.

Coolant conditions were representative of the Inner Vertical Target ones, i.e. inlet water temperature and pressure 120^{o}C and 3.5 MPa respectively. A swirl tape (twist ratio = 2) turbulence promoter was also provided. Thermal cycle was 10s power on, 10 s dwell time.

All the mock-ups survived to the testing plan with no leakage. However, although all the mock-ups sustained the cycling at 10 MW/m^2 without any visible damage, some significant surface melting and crack formation started to occur after a few tens of cycles at 20 MW/m^2, as a consequence of a high surface temperature. Moreover, for three monoblock tiles, an armour-to-heat-sink bonding degradation resulted in their complete melting.

As a preliminary result, one can say that the full W PFC mock-ups tested are not fully compliant with respect to ITER requirements. Design modifications could help to improve the performances.

The program will continue by manufacturing and testing additional W mock-ups and medium scale prototypes in order to achieve the pre-qualification of EU-DA for the manufacturing of the full W full scale Inner Vertical Target Prototype.

The main results will be presented and discussed in the paper.