EFFECT OF DESIGN GEOMETRY OF THE DEMO FIRST WALL ON THE PLASMA HEAT LOAD

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In this work we consider the effect of W armour surface shaping on the heat load otimization for the W/EUROFER DEMO sandwich type first wall (FW) blanket module with the water coolant. The most severe damage of the FW is expected during the transients and the run away electron (RE) impact. The W armour melting and melt splashing are expected under DEMO conditions, were the plasma stored energies are so high that could drive shallow melting on the top surfaces of armour. This impact may lead to modifications of surface topology and requires a three dimensional thermo-hydraulic analysis. For this purpose the ENDEP and 3D MEMOS codes are developed and verified against ILW JET experiments.

To avoid excessive heating and consequent thermal erosion during the heat loads in DEMO I operation we profile the W armour surface. A parametric analysis has been carried out to assess the influence of geometrical and thermo-hydraulic parameters. The expected energy density deposition to the FW pannel armour surfaces during transients (ELMs), and the ranaway electrons in DEMO are much higher than expected in ITER [1].

The damage of tungsten castellated armour surfaces for the PFC for several scenarios of expected in DEMO I operation conditions is analysed. To minimize the RE and ELMs impact the armour wetted area is varied by changing the inclination and height of the «roof» type armour surface. Calculations show the distribution of energy and the evolution of temperature in the bulk of W armour as well as the consequent surface melting for different values of wetted area. An expected level of erosion for optimal inclination and technically acceptable shape of the considered sandwich type blanket module is estimated.

[1] Yu.Igitkhanov and B. Bazylev, Fusion Engineering and Design, 87, Issues 5–6, 2012, 520

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