THERMO-MECHANICAL ANALYSIS OF THE W7-X DIVERTOR

M.Y. Ye [1], V. Bykov[1], F. Schauer[1], A. Peacock[2]

[1] *Max-Planck-Institut Für Plasmaphysik Teilinstitut Greifswald*

Wendelsteinstraße 1, D-17491, Greifswald, Germany

[2] *Max-Planck-Institut Für Plasmaphysik*

Boltzmannstraße 2, D-85748, Garching bei München, Germany

Corresponding author: minyou.ye@ipp.mpg.de

The superconducting stellarator Wendelstein 7-X (W7-X) is now under construction at the Max-Planck-Institut für Plasmaphysik in Greifswald. The machine (major radius R=5.5 m, minor radius a=0.55 m, five periods) is designed for stationary operation (30 minutes) at $B_o \approx 3\ T$, plasma parameters $T_e \leq 10\ keV$, $T_i = 2\text{-}5\ keV$, $n_e = 0.1\text{-}3{*}10^{20}\ m^{-3}$, and with continuous ECR wave heating up to 10 MW power. Additional heating will be applied by NBI and ICRH with powers up to 14 MW for 10 s. Main goal of the W7-X experiment is to demonstrate the suitability of the advanced stellarator concept as a desirable alternative to the tokamak fusion reactor. The W7-X machine has a divertor consisting of 10 units installed inside the vacuum vessel. The long pulse high-heat flux (HHF) divertor targets are made of carbon - carbon fibre (CFC) as plasma facing material which is bonded via a copper interlayer to a water cooled CuCrZr structure. The HHF divertor has been designed to withstand thermal loads up to 10 MW/m^2 for steady state operation [1]. It was decided not to install the HHF divertor already for the beginning of W7-X operation but to start instead with an inertially cooled test divertor unit (TDU) for shorter plasma pulse operation. This allows to accumulate operation experience with the much simpler component, and to accurately adjust from the beginning the actively cooled HHF divertor which will replace the TDU for stationary operation. The geometry of TDU is similar to the HHF divertor but uses fine graphite instead of CFC. The TDU has been designed to withstand thermal loads up to 8 MW/m^2 for pulse operation [2]. Thermo-mechanical analyses have been performed with a full 3D finite element (FE) model to guide the designs of the TDU and HHF divertors. Detailed results of temperature response, deformation and thermal stress of the divertor components will be reported.

[1] J. Boscary et al., *Fusion Eng. Des.* **84,** 2009,497.

[2] A. Peacock, et al., *Fusion Eng. Des.* ***84,*** 2009,1475