DESIGN AND TECHNOLOGICAL SOLUTIONS FOR THE PLASMA FACING COMPONENTS OF WENDELSTEIN 7-X

J. Boscary[1], R. Stadler[1], A. Peacock[3], F. Hurd[3], A. Vorköper[2], B. Mendelevitch[1], A. Cardella[3], H. Pirsch[1], H. Tittes[1], J. Tretter[1], C. Li[1], M. Smirnow[1]

[1]*Max-Planck-Institut für Plasmaphysik, EURATOM Association, 85748 Garching, Germany*
[2]*Max-Planck-Institut für Plasmaphysik, EURATOM Association, 17491 Greifswald, Germany*
[3]*European Commission c/o Max-Planck-Institut für Plasmaphysik, EURATOM Association, 85748 Garching, Germany*

The operation of W7-X stellarator for pulse length up to 30 minutes with 10 MW input power requires a full set of actively-cooled plasma facing components mostly covered with carbon-based materials which represent a surface of about 265m². From the lower thermally loaded area of the wall protection system designed for 100 kW/m² to the higher loaded area of the divertor up to 10 MW/m², various design and technological solutions have been developed meeting the high load requirements and coping with the restricted available space and the particular 3D-shaped geometry of the plasma vessel. In addition interface difficulties have arisen due to diagnostics integration and heating systems requirements. 80 ports are dedicated alone to the water-cooling of plasma facing components and a complex networking of kilometers of pipework will be installed in the plasma vessel to connect all components to the cooling system.
An advanced technology was developed in collaboration with industry for the target elements of the high heat flux (HHF) divertor. A large effort has been invested in the development of the bi-layer technology for the bonding of flat tiles made from CFC NB31 onto the CuCrZr cooling structure. The HHF divertor has a plasma facing surface of 19m² covered with about 18000 tiles, the production of which has been launched.
For all plasma facing components and especially the divertor elements, the selected technological solutions as well as inspection methods for the acceptance tests have been qualified by a series of tests on full-scale elements.
The design, R&D and the adopted technological solutions of plasma facing components will be presented, including the problems encountered during manufacturing. A particular section will be devoted to the development of the target elements of the high heat flux divertor.