DESIGN ANALYSIS AND MANUFACTURING OF THE COOLING LINES OF THE IN

VESSEL COMPONENTS OF WENDELSTEIN 7X

<u>B. Mendelevitch¹</u>, A. Vorköper², J. Boscary¹, A. Cardella³, F. Hurd³, Ch. Li¹, A. Peacock³, H.

Pirsch¹, R. Stadler¹, H. Tittes¹

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

Corresponding Author: Boris.Mendelevitch@ipp.mpg.de

All of the In-Vessel Components (IVC) of W7-X are actively cooled with water. To supply this water about 4 km of pipes will be installed between the plasma vessel and the cooled components. To maximize the plasma volume the space between IVCs and the plasma vessel has been kept to a minimum and this has presented significant challenges in designing the cooling circuits.

For each W7-X half module there are 20 different cooling circuits. The cooling circuits begin at the cryostat and enter the plasma vessel through ad hoc flanged penetrations called "Plug-ins", which provide for the vacuum boundary between the plasma chamber and the torus hall atmosphere. The 80 Plug-ins are installed inside the W7-X ports and some of the Plug-ins are also used for diagnostic cabling. The Plug-ins are then connected to the inlet / outlet cooling lines using a welded hydraulic connector.

The lay-out of the cooling lines is rather complex due to the limited space and the routing between many component parts. Additionally, differential thermal expansion of the lines with respect to the supporting structures during the different operational scenarios has to be allowed for with flexibility of the lines and with specially designed supports.

The design of the cooling circuit has also to be compatible with the installation and accuracy requirements of the various IVCs and the many variants due to diagnostics and heating systems.

The paper also reports in detail:

- Flow calculations performed to ensure adequate cooling of the components (parallel supply)
- A special solution to ease the assembly (special flanges for the panels)
- Tests and test jigs used during manufacture
- Measurement problems and the use of jigs as control tools