STRUCTURAL ANALYSIS OF W7-X: FROM DESIGN TO ASSEMBLY AND OPERATION

V. Bykov¹, F. Schauer¹, K. Egorov¹, P. van Eeten¹, J. Fellinger¹, M. Sochor¹, N. Jaksic¹,

A. Tereshchenko¹, A. Dübner¹, A. Dudek¹, D. Zacharias¹, D. Hathiramani¹, P. Czarkowski¹,

Q. $Yang^1$

¹Max-Planck-Institut für Plasmaphysik, EURATOM Association, Teilinstitut Greifswald, Wendelsteinstraße 1, D-17491 Greifswald, Germany

Corresponding author: victor.bykov@ipp.mpg.de

The Wendelstein 7-X (W7-X) modular stellarator is in the assembly phase at the Max-Planck-Institut für Plasmaphysik in Greifswald, Germany. The goal of the project is to demonstrate that this type of machine is a viable option for a fusion power-plant.

Structural reliability of components as well as resulting deformations and displacements during various modes of operation have to be considered for the basically pentagonal magnet system with its sophisticated non-linear support structure, and also for the whole cryostat whose main components are the plasma vessel, outer vessel, and the ports.

The design of the basic machine, i.e. without diagnostics and periphery, is basically completed, parameters such as bolt preload, initial conditions for contact elements, etc. are defined, and most of the components are manufactured and partly assembled. Therefore, the focus of the analysis was shifted towards fast analyses of non-conformities, changes in the assembly procedure, and exploration of operational limits. This type of assembly-related work is expected to continue until commissioning of the machine, however, with decreasing intensity. In parallel the analysis requirements for diagnostic and periphery issues will increase.

Structural analysis of the main W7-X components revealed a number of challenges and problems to be resolved, many of which are relevant also for other large and complex fusion machines like ITER and others to be built in the future.

This paper focuses on the most remarkable results, on special problems which had to be solved, on strategic issues like parameterisation, complex FE model structuring and benchmarking with alternative models in different codes, on assumptions of reasonable safety margins and expected tolerances, and on confirmation of analysis results by tests. Finally it highlights some lessons learned so far and gives an outlook on future work.