

Realization of the requirements for a safe operation of Wendelstein 7-X

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The Wendelstein 7-X superconducting stellarator is a fusion experiment designed for processing of short plasma discharges in the range of some seconds up to long discharges up to 30min in a quasi-steady state operation mode. The first plasma experiment was conducted in December 2015. Since this first plasma experiment within three operational phases were successfully performed more than 100 experimental days with about 3500 plasma experiments.

The operation of W7-X requires the handling of many different sources of danger and with different hazard potentials for persons and for the plant. To identify hazards, risk analyses and risk assessments are performed out at an early stage in the development process for all W7-X technical components and diagnostics, so that measures for risk reduction in design can be taken into account. The main objective of this process is to ensure safe operation for the personnel and to protect the investment in the W7-X plant.

In this work, we present the safety model for operation of W7-X. After a brief introduction to the architecture of the W7-X control system, the process of capturing safety requirements will be discussed. In addition, the multi-shell safety model for the technical implementation of risk mitigation functions at the various levels of the W7-X control system is described. The experiences with the implemented safety concept made at W7-X during the previous operating phases will be described.

Finally, a preview of the enhancements and modifications of the safety systems for the next operational phase OP2, which will start in mid-2021, will be given.

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