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Final integration, commissioning and start of the Wendelstein 7-X stellarator operation

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The main objective of the Wendelstein 7-X (W7-X) stellarator is to demonstrate the integrated reactor potential of the optimized stellarator line. An important element of this mission is the achievement of high heating-power, high confinement in fully controlled steady-state operation. In March 2014, after the installation of the last current lead in the outer vessel, the cryostat was finished, and the commissioning of the W7-X device could start. The installation of the in-vessel components, diagnostic systems and of peripheral components was continued.

First, the cryostat vacuum system was commissioned and the cryostat was pumped for the first time. Movements and deformations of the outer vessel and the port bellows during this pumping agreed rather well with the corresponding FE modelling.

In the fall of 2014 also the cryo-piping was finished, and leak-search and cleaning of the 2000 m piping started. In spring 2015 the magnetic coil set together with the support system, was cooled down to 4 K without any problem. In the next step, the superconducting magnet system consisting of 7 circuits with 10 coils each in serial connection was loaded with current for the first time. After integral commissioning of the magnet system, the magnetic flux surfaces were confirmed with an electron. Subsequently, the plasma vessel was baked to 150° C, and the central safety system was commissioned and validated. In December 2015, the first plasma was ignited in helium with ECRH, in February 2016 the working gas was switched to hydrogen.

The technical experiences of this commission process and the first operation phase will be discussed in this paper. The strong backing through numerical modelling and mechanical instrumentation monitoring has supported this process to guarantee structural integrity of W7-X main systems.

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