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Final Acceptance Tests of the Helium Refrigerator for Wendelstein 7-X

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The cryogenic systems of the stellarator fusion experiment Wendelstein 7-X (W7-X) consisting of superconducting coils, coil-casings and supports will be operated at 3.4K in peak power and 3.9K in standard mode. Radiation shield (80K) protects these components against ambient loads. The refrigerator supplied by Linde Kryotechnik AG has an equivalent refrigeration power of 7kW at 4.5K. It comprises compressor system, cold boxes including cold compressors, subcooler box with cold circulators, distribution valve box and test boxes. Cooling of divertor cryo-vacuum pumps (CVP) is also included in the refrigerator.
Following the successful installation and commissioning, the final acceptance tests were carried out on the refrigerator for the normal operating modes i.e. peak power (3.4K), standard (3.9K), short standby (<10K) and long standby (<100K) modes and purification mode. Also, the transient operating modes were included in the test procedure i.e. cool-down and warm-up and interchanging of the operating modes. In addition the handling of quench and emergency signals such as vacuum failure and forced shut-downs and the failure conditions were checked.
During standby modes besides cooling the applications, liquid helium is produced which is then supplemented for the additional cooling power required during peak power and standard modes. During these two operating modes the cooling conditions were achieved using four cold circulators and two cold compressors. The short standby mode contained various tests on different components. The test results shall be presented in the paper.

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