

## Experience with High Voltage Tests of the W7-X Magnets in Paschen-Minimum Conditions

**Boy-Michael Petersen-Zarling(1)**, Konrad Risse(1), Holger Viebke(1), Dirk Gustke(1), Hartmut Ehmler(1), Juergen Baldzuhn(1), Carlo Sborchia(1), Holger Scheller(2)

1. Max Planck Institut für Plasmaphysik IPP Wendelsteinstrasse 1 17491 Greifswald Germany
2. Babcock Noell Nuclear GmbH Alfred-Nobel-Str. 20 D-97080 Würzburg Germany

The W7-X machine is a low-shear stellarator of the Wendelstein line, which is being assembled at the IPP Branch Institute of Greifswald, Germany. The machine features a superconducting magnet system with 50 non-planar and 20 planar magnets operated at about 6 T and discharged with peak voltage levels up to 6 kV. Following the factory tests, the magnets are delivered to CEA Saclay, France, for the final acceptance tests at cryogenic condition. A series of high voltage tests in air and vacuum are part of the final acceptance test. During these tests the quality of the insulation, especially the hand-wrapped ground insulation in the termination area, has proven not to be adequate. In order to improve the reliability of the insulation system and detect defects for early repair, high voltage tests in reduced pressure of air (Paschen-minimum conditions) have been added as part of the factory acceptance procedure. This has been implemented in the vacuum chambers of BNN/Ansaldo for the test of the 50 non-planar coils, while other tests have been carried out at CEA/Saclay after cold testing. IPP has also installed a vacuum tank to perform Paschen tests during the preparation of all the coils for assembly, including also the 20 planar coils which cannot be tested at the manufacturer Tesla. These tests have proven to be a powerful tool to detect hidden insulation defects and void/cavities in the primary impregnation system, which could not be detected otherwise with the standard high voltage tests. This paper will summarize the background and experience accumulated in about 2 years of Paschen tests on the W7-X coils, including a description of the equipment, main results and statistics, weak points detected and repaired on the coils, and possibilities of improvements in the development and production of the W7-X magnets. The importance and the need of Paschen tests as part of the acceptance procedure for superconducting magnets to be used in future projects will also be highlighted.