THE QUENCH DETECTION SYSTEM OF W7-X

D. Birus[1], M. Schneider[1], Th. Rummel[1], M. Fricke[1]

[1] *Max-Planck-Institut für Plasmaphysik Greifswald*

Corresponding author: Dietrich.Birus@ipp.mpg.de

The Quench Detection System of Wendelstein W7-X have been developed, pretested and manufactured during the last four years. This safety subsystem of the super conducting magnet power supply will guarantee the safe operating of the whole magnet system.

The main targets of the Quench Detection System are the complete data acquisition of all the voltages along the super conducting components, i.e. non planar and planar coils, and bus bars, the evaluation of this data and the control of the magnet system safety discharges.

The Quench Detection System is generating control commands for the magnet power supply control system and the electrical status of the super conducting components of W7-X. The Quench Detection System consists of nearly 580 Quench Detection Units (QDU) located in 9 QD-subsystems, 8 racks in each, one host system and two special interfaces for evaluation of the quench control commands and the failure signals.

Each QDU have a special analogue input circuit consisting of a programmable half bridge front end with different polarity-sensing and limiting functions for suppressing high dynamic voltages. The design of the Quench Detection Unit has been made as a fully remote reconfigurable system using a fast RS485 interfaces, one for data transfer and one for control operations with a multiple onboard parameter memory.

Each QDU checks the differential voltages of all the superconductors permanently. In case of a quench it triggers the fast discharge of the magnet system and the storage of the voltage signals on the onboard memory unit. The QDU transfers the stored signal data via a high-speed RS-485 serial interface with 20kV optical isolation barrier to an industrial type embedded PC at the QD-subsystem.

All QDU have been designed with an internal failsafe, programmable self test and redundancy feature, broken wire check of the quench detection cables and connectors inside and outside of the cryostat of W7-X. The design of the Quench Detection System allows an operation under high voltage levels of up to 8kV and under magnetic stray field levels up to 30mT. All QDU will be fed via an UPS supported 24V DC bus using a high voltage isolated DC-DC converter on each unit to minimize the noise and interferences from the main power supply.

Two Special Interfaces including a 100% redundancy are evaluating the failure signals in relation to the two quench control signals in the right way by an intelligent controller unit inside. The outputs of the two interfaces control the status inputs of the magnet power supply control system either for a fast or a slow discharge depending on the actual failure level.

The Host of the QD System has been coupled to the nine QD-subsystems using a fiber optic local Ethernet network. The operating software of the Quench Detections System allows controlling of the configuration, the operation and the maintenance of the whole system.

The Quench Detection System was successfully tested for all specific EMC standards, also the mechanical and thermal loading in accordance with the EU standards for industrial electronic equipment by a certificated special company.

The paper gives an overview about the whole QD system and reports the status of manufacturing, commissioning and assembly of the whole system.