Contribution ID: **1100** Type: **not specified**

P3.053 Design of inductive sensors and data acquisition system for magnetic diagnostic of the T-15MD tokamak

Wednesday, 19 September 2018 11:00 (2 hours)

Magnetic diagnostics plays an important role in tokamak operation. Magnetic data are used for real-time control of plasma current, shape and position and for post-discharge analysis of magnetohydrodynamic plasma instabilities and equilibrium reconstruction. The magnetic diagnostic of the T-15MD will consist of more than 500 inductive sensors of various types: poloidal flux loops, saddle loops, Rogowski loops, diamagnetic loops, magnetic probes. Location and number of sensors is determined by the measured physical value. Most sensors, including 6 poloidal sets of 48 high-frequency (up to 300 kHz) magnetic probes for investigation of three-dimensional structure of Alfvén eigenmodes with high toroidal and poloidal mode numbers (m,n≤16), will be located inside the vacuum vessel.

The data acquisition system must simultaneously provide both some sensors data real-time transfer to the control loop and all sensors data storage for subsequent analysis. The requirements for the data acquisition depend on the data destination. Since the duration of the plasma magnetic control cycle (determined by the characteristics of the tokamak and the power supply system) for the T-15MD is about 1 ms, it is sufficient to have a sampling rate up to 10 kHz for the data transferred to the control loop, but these data must be transferred and processed in real-time mode. At the same time, for the study of fast processes (disruptions, tearing modes, Alfvén eigenmodes), sensor signals should be acquired with a sampling rate from 100 kHz to 1 MHz (depending on the type of sensor) and transferred to the database at an acceptable time (about 3 minutes) after discharge.

The article describes the construction and location of inductive sensors, as well as the architecture of the data acquisition system.

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Session Classification: P3