PROTOTYPE OF THE DATA ACQUISITION SYSTEM FOR DNFM DETECTOR MODULE

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The “Divertor Neutron Flux Monitor” (DNFM) diagnostic is aimed to determine the thermonuclear power of the ITER reactor. The DNFM diagnostic provide measurements of neutron yield and thermonuclear power with temporal resolution of 1 ms and measurement uncertainty less 20% with deuterium-deuterium and less 10% whit deuterium-tritium operation modes.

The DNFM diagnostic conclude three detector modules, located on the Divertor cassettes thru 120°. The expected neutron flux change at the detector module location is ten orders of magnitude. To operate in this range of neutron flux detector modules with several fission chambers (FC) are used. The detector module consists of three FCs with U-235 and three FCs with U-238 as a radiator. Sensitivity of chambers with the same radiator type differs by about ten times.

The DNFM data acquisition system (DAQ) operates with signals of six FCs of detector module. It operates in pulse, Campbell and current modes simultaneously and provides the data to calculate neutron flux at the detector module location. Distributed architecture of the system allows to place components sensitive to magnetic and radiation under more favorable conditions. According to the DNFM diagnostics project preamplifiers and equipment for primary analog signal processing will be placed in the Tokamak building and equipment for calculating the neutron flux and data exchange with other systems will be located in the Diagnostics building. The connection between the components is provided by digital fiber optical lines which ensures their galvanic isolation from each other. Preamplifiers are detached structural units and can be installed both separately and in primary signal processing equipment. They do not contain programmable devices and components sensitive to strong magnetic fields which allow preamplifiers to be located as close as possible to the detector module and to increase the system's resistance to electromagnetic interference. The dimensions of preamplifiers are minimized to reduce the volume and weight of the protective shield.

At the present the DAQ prototype for one DNFM detector module has been developed, manufactured and configured. This prototype includes DAQ DNFM rack and preliminary amplification subsystem. The top-level software (visual screens of engineer and physics interfaces in EPICS under Linux, NDS driver) and low-level software (programs of the NI PXIe – 7966 FPGA modules) has been developed. The design and software documentation has been made in accordance with the guidelines of ITER IO and using the software Enterprise Architect and SEE Electrical Expert. The preliminary laboratory tests of the DAQ prototype for one detector module has been performed.