DEVELOPMENT OF ARCHITECTURE FOR CONTROL AND DATA ACQUISITION SYSTEM OF ITER VERTICAL NEUTRON CAMERA DIAGNOSTIC SYSTEM [[1]](#footnote-1)\*)

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The ITER vertical neutron camera (VNC) is a multichannel neutron collimator intended to characterize fusion plasma neutron source and thermonuclear power in real time mode. In total, 12 detecting units will be installed in the VNC. Each detector unit contains two diamond detectors and two fission chambers that record fast neutrons. This report presents the architecture of the VNC data acquisition and control system.

Pulse signals from the VNC detectors go to preamplifiers modules inputs (in the proposed architecture, each preamplifier module processes 4 channels – one module for one detector unit). All preamplifier modules have a function to receive an external test signal for calibration and test purposes. Since the preamplifier modules are located in high radiation conditions, they do not contain complex digital devices and control electronics. The functions for preamplifiers control, including power supply and bias voltage control, are combined in preamplifier control modules based on slow controllers. The preamplifier control modules are located in the diagnostic gallery – a zone of less intense neutron fluxes – and receive commands from fast controllers (a combination of an industrial PC and an NI PXI chassis with the necessary peripheral equipment). Also, fast controllers are used to test signal of the desired frequency and shape and provide control flexibility.

Measured signal transmission from preamplifiers to fast controllers, as well as the transmission of test signals from fast controllers to preamplifier modules, is carried out via optical lines through optical transceiver devices to reduce the level of electromagnetic interference.

Signals from the detector units are received by fast controllers using ADC modules. When choosing ADC modules, the minimum requirements for signal digitization, the availability of equipment in the ITER catalog, the complexity of integration and software development for these modules are taken into account. Pulses signals at the ADC input have a duration of about 15 ns. To digitize pulses with the required accuracy, a 12-bit ADC with a speed of at least 500 MS/s is required. With this configuration, a data flow of 8 GB / s will be generated between one PXI chassis and one industrial PC, and 48 GB/s for the entire VNC. The data collected and preprocessed using FPGA from all measuring channels is transmitted to the master fast controller using the Synchronous Databus Network ITER to calculate the neutron source profile. Time synchronization of the system is achieved using the Time Communication Network ITER at the level of data collection equipment.

The VNC architecture presented in this report meets the requirements for diagnostics.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/E/ru/HZ-Nagornyi.docx) [↑](#footnote-ref-1)