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PROGRESS IN DEVELOPMENT OF ITER DIVERTOR NEUTRON FLUX MONITOR *)

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The report presents progress in the development of the Divertor Neutron Flux Monitor (DNFM) diagnostics in ITER. The purpose of the DNFM system is to measure the total neutron yield and fusion power in a wide range of operation scenarios of the ITER tokamak with strict requirements in terms of both time resolution and accuracy. This diagnostic task is solved using 3 identical subsystems evenly spaced along the torus. Each one of the subsystems consists of two detector units (with high–purity uranium-238 and uranium-235, respectively). Each detector unit incudes 3 separate electrode systems – ionization fission chambers (FCs) - with a different mass of fissile material. DNFM is the only neutron flux monitor that is scheduled be installed and commissioned before the first plasma (Start of Research Operation – SRO), which means that in situ calibration of DNFM detector units becomes a key stage in the commissioning of the ITER neutron diagnostic complex.

At the current stage, the final justification of the technical solutions adopted for this diagnosis is underway. The analysis of the structural integrity of the in-vessel components of the DNFM confirmed the compliance of the design with the requirements, including the loads on the bosses welded to the inner surface of the vacuum vessel. The analysis of the radiation hardness of the electronics located in the ITER port cells was carried out, taking into account the design of shielded cabinets for electronics located in the port chambers of the lower ports #2, 8 and 14. From the point of view of measurement procedures, the developed algorithm for calibration of the Campbell signal chain of diagnostic I&C using segmented recording of FC signals [1] provides calibration procedure of DNFM detector units on site with the use of low-yield a neutron source and at count-rates much lower than the values expected during plasma operation. Detailed modeling of the FC geometry using GEANT4 software [2] provides a more detailed understanding of the procedure for characterizing diagnostic detector units from the point of view of fast neutron and fission fragment transport inside the detector volume. The DNFM diagnostic project is nearing completion of the final project stage, and the current work summarizes the key steps in this direction of research and development.

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*) abstracts of this report in Russian