DOI: 10.34854/ICPAF.52.2025.1.1.108

# THREE-DIMENSIONAL MODEL OF THE FIRST WALL AND VACUUM CHAMBER OF THE FNS-1 FUSION NEUTRON SOURCE FOR NEUTRON PHYSICS CALCULATIONS *)

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The development of nuclear energy requires the use of fusion neutron sources for the production of artificial nuclear fuel and the transmutation of long-lived radioactive waste. In Russia, the prototype of the FNS-1 fusion neutron source being developed is the tokamak T-15MD [1]. For the development of the FNS-1 project, a wide range of computational neutron physics studies in the full-scale three-dimensional geometry of the device is required.

The first problem on the way to developing a full-scale computational model of the real geometry of FNS-1 is to create a three-dimensional model of the first wall and vacuum chamber for neutron physics calculations using the Monte Carlo method. The model was created using the MCNP-5 program [2], based on the T-15MD tokamak drawing, by simulating and analyzing the first model and the vacuum chamber in match 1:1. The materials of the first wall and the vacuum chamber are determined in accordance with the composition of the materials of the tokamak T-15MD.

In the constructed model according to the MCNP-5 code with the library of nuclear data of the ENDF/B-VII [3], a computational analysis of the energy distributions of the neutron flux density in the detectors-cells of the first wall and vacuum chamber, fluences, doses of radiation displacements and the accumulation of gas impurities from nuclear reactions in the materials used was performed. The calculations used a plasma model as a volumetric toroidal source of thermonuclear neutrons with the energy of 14 MeV from the fusion reaction of deuterium and tritium nuclei. The obtained results are planned to be used for conducting experiments on FNS-1 to study changes in the properties of materials of thermonuclear installations under the influence of high-energy neutron radiation, including from a source of D-T neutron fusion radiation.

## References

[1]. P.P. Khvostenko, I.O. Anashkin, E.N. Bondarchuk, N.V. Inyutin, V.A. Krylov, I.V. Levin, A.B. Mineev, M.M. Sokolov, Tokamak T-15MD experimental thermonuclear installation, Problems of Atomic Science and Engineering. Ser. Thermonuclear fusion, 2019, vol. 42, issue 1, pp. 15-38.

[2]. J.F. Briesmeister, “MCNP — general Monte Carlo N-particle transfer code, version 4C", LA-13709-M, Los Angeles (2000); introductory text (lbl.gov ).

[3]. “ACE formatted files for ENDF/B-VII.1", May (2008).

*) abstracts of this report in Russian