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NEUTRON TRANSPORT MODELING FOR NEUTRON DIAGNOSTIC SYSTEMS OF EAST TOKAMAK DURING *in-situ* CALIBRATION *)

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Neutron diagnostics has a great role in determining discharge parameters at tokamak-type fusion power facilities. With the help of neutron diagnostics, it is possible to determine a number of important parameters such as ion plasma temperature, fusion reaction power, ion plasma temperature, fuel ratio, etc. The accuracy of the measurements will depend on the quality of the calibration performed. For some systems, performing calibration in the laboratory is not sufficient. These include, for example, fission chambers (FCs) for determining the neutron fluence at the point of emplacement and scintillation spectrometers. Interaction with the surrounding structural materials of the facility will affect the readings of the diagnostics. So, it is important to consider this effect when finding calibration functions. Performing in-situ calibration by placing compact neutron generators inside the tokamak vacuum vessel before the main plasma discharge campaign will allow the neutron diagnostic equipment to be tuned to consider all geometrical features of the facility.

In this paper, the possibility of using a neutron generator NG-14 manufactured by FSUE VNIIA [1] as an in-situ calibration source of the EAST tokamak [2] in China is considered. The total outputs is ~2×1010 and ~2×108 n/sec for the D-T (neutron energy En~14,1 MeV) and D-D (En~2,5 MeV) neutron tube, respectively. A source model reproducing the geometry and angular distribution of energy and output of NG-14 was placed at several points along the main magnetic axis in the vacuum vessel of the digital twin of the EAST tokamak. For each geometrical configuration the modeling of D-T and D-D neutron transport by Monte Carlo method was carried out. The neutron field characteristics were determined in the areas of placement of sensitive elements of neutron diagnostics of the facility, such as Radial Neutron Camera (6 liquid scintillators of BC-501A type [3]) and FCs with uranium radiators placed in the moderator in the hall of the EAST tokamak. Considering the features of the diagnostic systems, the expected detector counts at different positions and types (D-D or D-T) of calibration sources are estimated. Based on this, conclusions are drawn about the possibility of such calibration of the EAST tokamak systems using the compact neutron generator NG-14.

The results of neutron transport modeling using a source corresponding to the output of a sealed-tube neutron generator form the basis of the calibration technique being developed for the ITER reactor tokamak and planned for testing on the operating EAST tokamak.

References

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