EVALUATION OF RADIATION SKYSHINE AND GROUNDSHINE OF A D-D TOKAMAK USING MONTE CARLO METHOD

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The tokamak EAST, which is under construction in Institute of Plasma Physics of Chinese Academy of Sciences, will perform D-D plasma experiments and the production rate of 2.45 MeV neutrons will achieve the level of 10^{15} n/sec. The D-D plasma discharge time will be as long as 10^5 seconds per year. Therefore, it is very important to assess the dose rate level outside the tokamak building and ensure that the radiation exposure of the nearby population is below the limit. It is anticipated that radiation field outside the tokamak building is significantly influenced by the skyshine and groundshine of neutrons and neutron-induced secondary gammas.

The analyses were performed with the Monte Carlo transport code MCNP, the nuclear data library FENDL-2 and a simplified air-over-ground geometrical model. This model includes the most important shielding components of the machine, namely the vacuum vessel (VV) and the toroidal field coils (TFCs), and the shielding hall with 1.5m concrete side walls and 1m (changed in different design cases) concrete ceiling. Calculations for five different design cases were performed to investigate the influence of different filling materials of VV and different dimensions of the concrete ceiling on the environmental dose rate. The contributions to the dose rate via the means of skyshine, groundshine and direct contribution from the source were evaluated using Cell-Flagging technique of the MCNP code.

It was found that the environmental radiation field is quite different from each design case. For the standard design (the filling material is borated water and the ceiling of the building is 1m concrete), within the short distance (< 55m) the environmental dose rate is dominated by the secondary gamma ray mainly coming from the neutron capture reaction happened in the side concrete wall. The highest dose rate for this case is ~11_Sv/hr and the maximum exposure at this point is ~0.3mSv per year which is below the dose limit (1mSv per year). All the results of each design case will be reported and discussed in this paper.