§4. Calculation Work on Neutron Dose Evaluation in the Area Monitoring for LHD Experiments

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The error in the evaluation of neutron dose during calculation of the neutron field around the LHD in D-D operation is discussed. The expected neutron dose at each monitoring point was derived from the dose conversion factor and neutron fluence data which was calculated with the radiation transport code DOT-3.5. An example of neutron fluence data is shown in Fig. 1. In contrast, the detected dose at the neutron counter was obtained from the fluence data and the detector response given by calculation with MCNP-4b. The neutron counter used in these calculations consisted of a helium-3 proportional counter with a cylindrical polyethylene moderator. Fig. 2 shows the energy response of neutron counter with each thickness of polyethylene moderator. The coefficient which converts counts to dose was fixed so as not to underestimate the detected dose. We compared the expected dose and the detected dose for each monitoring point. The results showed that the overestimation of dose, i.e., the ratio of the detected dose to the expected dose, will have a factor 3 range of error at the site boundary.

Since the response of a single neutron counter may lead to inconsistencies in the dose conversion factor, we attempted to minimize these inconsistencies by using a pair of counters with moderators of different thickness. The counts-to-dose conversion coefficients were determined by the least squares method. Fig. 3 shows the response of paired counter with 2.5 cm & 10 cm moderators or 2.5 cm & 15 cm. The ratio of the detected dose to the expected dose ranged from 1.5 to 2.1 at the site boundary, indicating that the use of a paired counter allows a more accurate evaluation of dose than the use of a single counter.

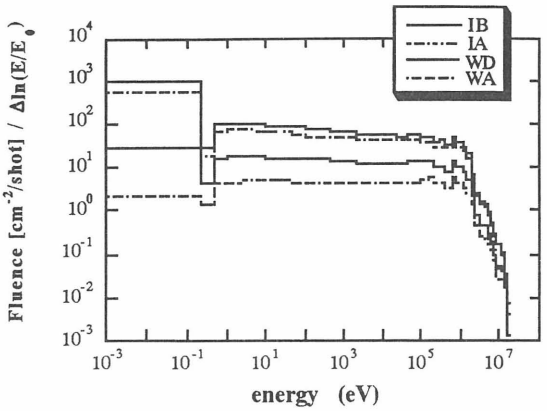

Fig. 1 Neutron energy distributions at several points in the site, indicated by IA, IB, WD and WC.

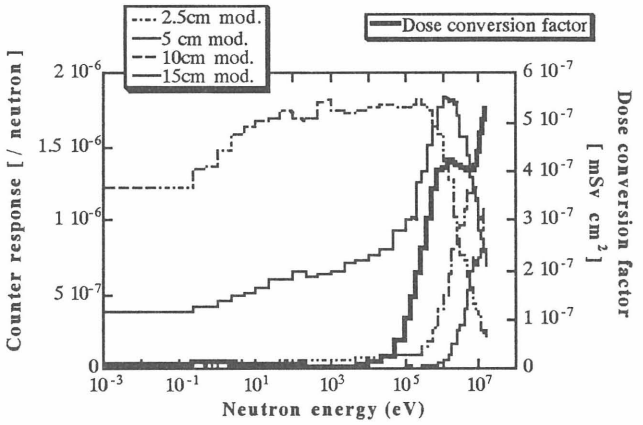

Fig. 2 Energy dependence of neutron monitors.

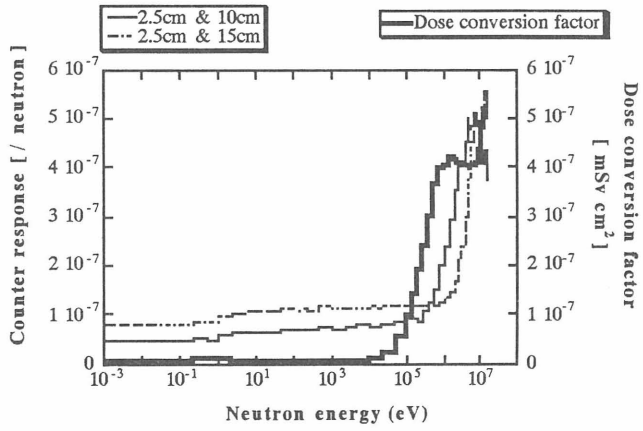

Fig. 3 Neutron monitor response of pair counter.