§2. Design Study of High Quality Neutron Dosimeter

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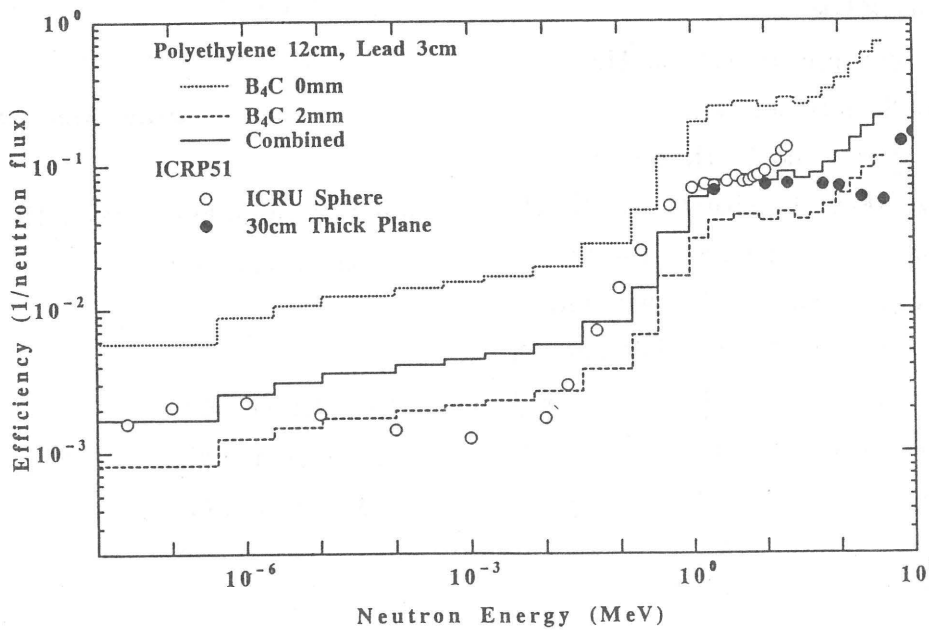
The objective of the study is to make design study of a high accuracy neutron dose monitor which can be utilized in the experimental room during the D-plasma discharge as a head of the monitoring system.

To develop a high efficiency detector, we adopted Andersson-Braun type detector, which was composed of a ^{3}He detector and a polyethylene moderator. The design was carried out based on the adjoint transport calculation by ANISN code, assuming the reaction cross section of ^{3}He as an adjoint source in the ^{3}He detector region. The response of the monitor for the beam neutrons was estimated. The group constants utilized in the calculations were taken from the DLC-119/HILO, which were collapsed to 23 groups.

Calculations were made varing the polyethylene thickness, with assuming a thin B_4C neutron absorber layer in the moderator. The results for each thickness moderator obtained with and without the absorber were summed up with an adjusted weighting factor so that the summed curve may best agreed with the 1-cm dose equivalence curve given by ICRP-51. As a result of the above survey calculations, the most adequate polyethelene thickness which gave the best fit of the response to the ICRP 1-cm dose in the whole energy range was 12~15 cm. The location of the absorber layer affected the response only slightly. Therefore we selected the 12-cm thickness for the polyethylene moderator and the absorber was located at the center in the moderator. The remaining problem in the response was in the higher energy range above several MeV, where the response curve decreased with increasing the neutron energy and underestimated largely the 1-cm dose curve. To improve the response at these energies, a neutron multiplier zone of lead was added outside the moderator. The survey calculation clarified that a 2~3 cm thick lead layer was enough to improve the response of the higher energy part.

The response curve of the monitor which was composed of the best materials configuration thus determined is compared with the 1-cm-dose curve of ICRP-51. It is seen that the designed monitor has an enough accuracy for the neutron dose monitoring up to 100 MeV.

Fig.1 Comparison of the estimated detector response with ICRP 1-cm dose curve.



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