A PRACTICAL METHOD FOR EVALUATING NEUTRON DOSE EQUIVALENT RATE

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Abstract—Measurement of the dose equivalent rate for neutrons is very difficult, when the spectrum is unknown and the energies range from intermediate to fast, such as those leaking from nuclear reactors. A practical method applied to the field monitoring using survey instruments is presented for evaluating the dose equivalent rate for neutrons, the spectrum of which is unknown. The detectors employed include a BF_3 proportional counter, with paraffin moderators 6.5 and 1.0-cm thick sheathed in 0.5-mm thick cadmium, and a scintillation (ZnS + plastic) counter.

The dose equivalent rate D_B (mrem/hr) for neutrons below about 2 MeV is determined as follows. The neutron flux $\phi(E)$ (n/cm^2·sec) is measured by the BF_3 proportional counter covered with a 6.5 cm-thick moderator, uniformly sensitive to neutrons below 2 MeV, and the effective energy E_{eff}(MeV) is determined from the ratio of the counting rate by the BF_3 proportional counter covered with a 1.0 cm-thick moderator, to that covered with a 6.5 cm-thick moderator. Then D_B is determined by means of the equation $D_B = h(E_{eff})\phi(E_{eff})$, where $h(E)$ (mrem/hr/n/cm^2·sec) is the conversion factor from the flux density to the dose equivalent rate.

The dose equivalent rate D_S(mrem/hr) for neutrons above about 2 MeV is measured with the scintillation counter, the sensitivity of which is nearly proportional to the dose equivalent rate for neutrons above 2 MeV, calibrated by the proper source in mrem/hr.

Since the neutron energies range in general from epithermal to fast, the total dose equivalent rate D(mrem/hr) is obtained from the equation $D = D_B + D_S$.

The error in evaluating the total dose equivalent rate by the present method was calculated to be a maximum of 60 per cent for typical neutron spectra, in the energy range of epithermal to 10 MeV.