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Benchmark experiment of neutron penetration through iron and concrete shields using 243 and 387 MeV quasi-monoenergetic neutrons part-I: Measurement and calculation of neutron depth-dose distribution and attenuation length.

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A shielding experiment using 243 and 387 MeV quasi-monoenergetic neutrons have been performed at the Research Center for Nuclear Physics (RCNP), Osaka University, Japan. Neutron energy spectra and doses behind concrete with 25, 50, 100, 200 and 300 cm thicknesses and iron with 10, 20, 40, 70, and 100 cm thicknesses have been measured. Two different sizes of NE213 liquid scintillators of 5" and 10" and two types of Bonner ball neutron spectometers were used for the neutron energy spectrum measurement. Details and the results of the neutron spectrometry will be presented in the next presentation (part II).

The measured neutron energy spectra are folded with the dose conversion factor to estimate the neutron doses. Neutron doses were also directly measured by several dosimeters of Fuji wide-range REM counter, Thermo wide-range REM counter WENDI-II, Fuji REM counter, ALNOR REM counter, Chiyoda photo-luminescence personal dosimeter, Nagase Landauer Luxel personal dosimeter, and the DARWIN multi particle dosimeter. Theoretical estimation of neutron energy spectrum and dose distributions behind the concrete and iron shields were also performed by the general-purpose particle transport Monte-Carlo code PHITS. A global comparison is carried out on neutron doses obtained by several methods both experimentally and theoretically as a function of the thickness of the shielding materials. Neutron dose attenuation lengths of 243 and 387 MeV neutrons for concrete and iron are finally estimated.

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