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Development and testing of a neutron radiation spectrometer in the fields of radionuclide sources

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The personal dosimetry of neutron exposure is one of the most difficult problems at workplaces. Behind the biological protection of nuclear physics facilities neutron radiation has continuous spectrum, spanning up to 11 orders in magnitude –from thermal up to several GeV. It is necessary the energy response function of personal dosimeter has to be as close as possible to the appropriate fluence-to-personal dose equivalent conversion function (Hp(10)) to provide adequate value of effective dose estimation. Due to there are no personal dosimeters with appropriate energy response function, readings of current personal dosimeters radically differ from the actual values of the neutron effective dose. Nevertheless, there are some approaches to solve this problem. The easiest way to achieve adequate value of effective dose estimation is using of a correction factor to a personal dosimeter reading, which is calculated using the known dosimeter response function and the energy spectrum of the operational field. To obtain information about operational neutron spectrum it is possible to use Bonner sphere spectrometer. Development and testing of one of such spectrometers are presented in this work. The detector system consists of active neutron detector based on He-3 and a set of the 12 polyethylene sphere-moderators with diameters from 3”up to 12”. Spectrometer was exposed in fields of 238Pu(α,n)Be and 252Cf radionuclide sources. Well-known mathematical technique of integral equations solving was used to spectrum unfolding (deconvolution).

Summary

New Bonner sphere spectrometer was developed and tested in the fields of radionuclide sources. The results of simulation and experimental studies of new Bonner sphere spectrometer, showing the efficiency of the conception are proposed. Energy distribution of neutrons could be obtained with using minimum 4 sphere-moderators, but for better results it is recommended to use as much spheres-moderators as possible. Neutron spectrum could be unfolded (reconstructed) without any a priori information about its form or source.

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