EVALUATION OF THE FAST NEUTRON DOSE EQUIVALENT USING THE THERMAL NEUTRON RESPONSE OF LITHIUM FLUORIDE TLD

Caliopia Turcus, Cornelia Craciun, Ana Stochioiu

Institute for Physics and Nuclear Engineering,
Bucharest, Romania

INTRODUCTION

For estimation of the fast neutron dose equivalent we used the albedo method which consists in the detection of the albedo thermal neutrons. The albedo neutrons are the fast neutrons which leave the body as thermal neutrons after having been scattered in the human body. The albedo neutrons are detected at the surface of the body by means of the detectors for thermal neutrons.

For the measurement of the albedo thermal neutrons we used a Multifunctional Personal Dosimeter which contains 6 detectors of lithium fluoride with natural lithium. This has realized at Institute for Physics and Nuclear Engineering., in Bucharest.

The detectors of lithium fluoride with natural lithium are sensible at the photon radiations, at the beta radiations and at the thermal neutrons. The discrimination is realized with the help of the filters.

This dosimeter was designed so that with a suitable choice of Cd (0,8 mm), Sn (0.8 mm) and Al (1 mm) filters size and thichness he is suitable to measure the thermal neutron dose equivalent, the photon radiation dose equivalent and the beta radiation dose equivalent.

THE CONDITIONS OF IRRADIATION

The irradiation have been effectuated in the centre of a room with the next dimensions: (12 x 20 x 10) m on a support at 3 m height over of the floor.

In this way have been provided the ideal conditions of irradiation.

For to simulate the real conditions of utilization in the personal dosimetry, the dosimeters have been situated on the phantom, with the dimensions: (200 x 300 x 400) mm. The phantom has been filled with the water.

We were started with measurement at the Am-Be source with and without the phantom for to investigate the influence of scattering from the wall and the floor. We have found the thermal incident neutrons representing it a negligible contribution.

RESULTS

The experiments were performed with the neutrons from an Am-Be source and from an ^{252}Cf source.

For each fast neutrons source was determined the calibration factor, with which has been passed from the thermal neutron dose equivalent into the fast neutron dose equivalent.

The distance from the source at the phantom has been 30 cm both for the Am-Be source and for the ^{252}Cf source.

The irradiations of the Am-Be source were performed at the next values for the fast neutron dose equivalent: 0.385 Sv; 0.852 Sv and 1.331 Sv.

The irradiations of the ^{252}Cf source were performed at the next values for the fast neutron dose equivalent: 0.557 Sv and 0.751 Sv.

In the table no. 1 are presented the obtained results from the Am-Be source and in the table no. 2 are presented the obtained results from the ^{252}Cf source.

TABLE No. 1 - Am-Be Source

	$H_{nr, true}$ [Sv]	$H_{nr, ev}$ [Sv]	ε [%]	n
1.	0.385	0.385 ± 0.123	0	7
2.	0.852	0.982 ± 0.396	15.26	8
3.	1.331	1.171 ± 0.391	12,02	11

TABLE No. 2 - ^{252}Cf Source

	$H_{nr, true}$ [Sv]	$H_{nr, ev}$ [Sv}	ε [%]	n
1.	0.557	0.564 ± 0.24	1.25	12
2.	0.751	0.728 ± 0.227	3.06	10

In these tables the significance of the sizes is next:

- $H_{nr,\ true}$ is the true fast neutron dose equivalent at which has been the irradiation;
- $H_{nr,\ ev}$ is the mean value of the evaluated fast neutron dose equivalent;
- ε - the measuring error;
- n - number of the dosimeters which have been irradiated in the identical conditions and for which has been obtained the mean value.

The confidence level has been of 95 %.

The effectuated experiments have been affected in principal of the next sources of the errors:

- the little distance between source and phantom;
- the distribution of the dosimeters on the phantom;
- the long time for irradiation (the largest time has been > 1 month);
- the detectors of lithium fluoride have not been specially selected for this experiment.

From the experimental data presented results that the dose equivalent of fast neutrons can be estimated on the basis of the albedo method using our personal dosimeter with satisfactory results, only with an adequate calibration for each case.

We hope that the results can be improved.

REFERENCES

1. GRIFITH RICHARD et al.
   Recent Developments in Personnel Neutron Dosimeters-a Review
   Health Phys. 36(3) 1979, 235.
2. PIESCH, E., BURGKHARDT, B.
   LiF Albedo Dosimeters for Personnel Monitoring in a Fast-Neutron Radiation Field
   Proc. AIEA Symp. on Neutron Monitoring for Radiation Protection Purposes Vienna, Vol. II, 1973, 31.
3. HANKINS, D.E.
   Evaluation of the Fast Neutron Dose Equivalent Using the Thermal Neutron Response of LiF TL Material
   Health Phys. Vol. 31 (2), 1976, 170.
4. HOY, J.E.
   An Albedo Type Personnel Neutron Dosimeter
   Health Phys. 23 (3) (1972), 385.
5. PIESCH, E., BURGKHARDT, B.
   Advances in Albedo Neutron Dosimetry.
   Advances in Radiation Protection Monitoring
   Proc. Symp. Stocholm (1978), IAEA, Vienna (1979), 207.