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EXPOSURE TO IONIZING RADIATION OF WORKERS IN POLAND

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Abstract: Results of individual monitoring of occupied workers based on the doses estimations carried out by Central Laboratory for Radiological Protection (CLOR) in Warsaw has been presented. In 2011, about 5000 persons from 330 institutions were monitored. Monitoring service in CLOR is based on two doses assessment methods, Kodak films and MCP-N thermo luminescent detectors. Presented results show that 97% of registered doses were less than 1 mSv and only about 0.1% of assigned doses were higher than 20 mSv. The monitored workers were divided in four groups: medical, scientific, industrial and others. Six cases of excess of the 20 mSv annual dose limit were registered in medical, three in scientific and three in industrial group. The average annual dose in each particular group was calculated: 0.51 mSv in medical, 0.62 mSv in scientific, 0.48 mSv in industrial and 0.44 mSv in others.

Keywords: radiological protection, thermo luminescent detector

Doses monitoring service in CLOR has been established in 1956 and working with success up today as the Laboratory of Individual and Environmental Doses. On December 2003, the Laboratory was approved by Polish Centre For Accreditation and granted Accreditation Certificate (Nr AB 450). Until 1999, the monitoring service was only based on the film method using Kodak personal monitoring films. In 1999, RADOS TLD system was put into operation. Since then, a part of the monitored workers has been covered by this new monitoring system. At the beginning, MTS-N (LiF: Mg, Ti) material was used, then from 2008, more sensitive material, i.e., MCP-N (LiF: Mg, Cu, P), both for individual and environmental monitoring was introduced.

POLISH LAW REQUIREMENTS

The safety of workers exposed to ionizing radiation is regulated by the act of parliament, known as Polish Atomic Law (1). According to this document, two categories of workers, depending on magnitude of exposure, should be established:

1. Category A, for workers who may be exposed to an effective dose exceeding 6 mSv in one year or to an equivalent dose exceeding three-tenth of the dose limits for eye lens, skin and extremities.
2. Category B, for workers who may be exposed to an effective dose exceeding 1 mSv in one year or to an equivalent dose exceeding one-tenth of the dose limits for eye lens, skin and extremities. The limiting dose quantities were the effective dose for the whole body exposure, and the equivalent dose for exposure of certain tissues or organs, as defined in ICRP Publication 60 (2).

MATERIALS AND METHODS

The operational dose quantity used for estimation of effective dose equivalent from external radiation is the personal dose equivalent Hp(10). The operational dose quantity for exposure of skin and extremities is Hp(0.07). The detection limit of CLOR monitoring systems was 0.2 mSv and the standard monitoring period is three months.

Currently, two methods for doses estimation are used in CLOR, one based on film and second

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Table 1. Numbers of readouts of whole-body and extremities dosimeters at four doses ranges.

Method	Group	Individual dose equivalent Hp(10) range (mSv)				Number of readouts
		< 1	< 1–6	< 6–20	> 20	
TLD + Film	Scientific	2641	13	2	3	2659
	Industrial	2968	89	12	3	3072
	Medical	12649	80	3	6	12738
	Total	18258	182	17	12	18464
TLD + Film	Group	Individual dose equivalent HP(0.07) range [mSv]				Number of readouts
		< 50	< 50–150	< 150–500	> 500	
	Medical	2521	21	0	0	2542

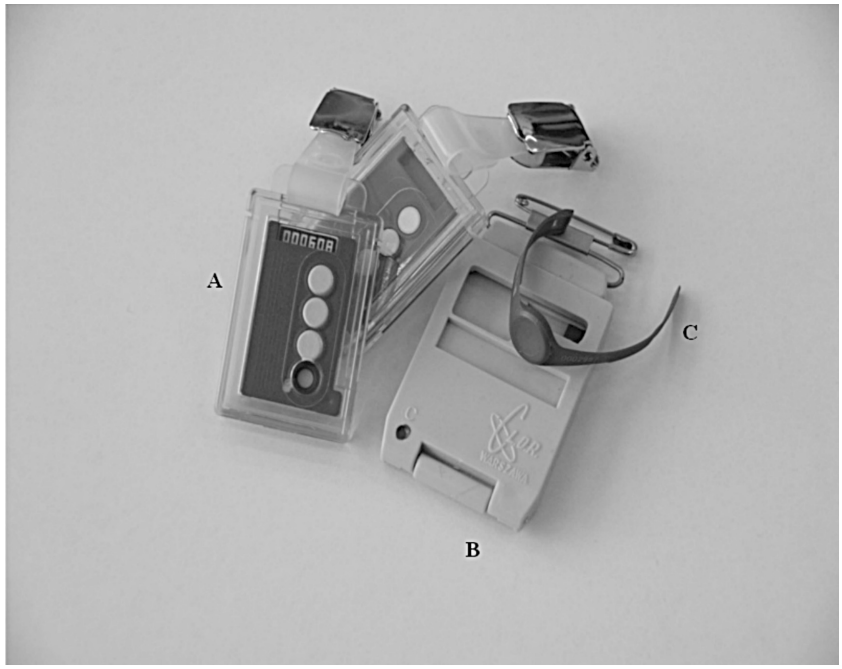

Figure 1. Three types of personal dosimeters used in CLOR individual monitoring service. A – TL whole-body dosimeter, B – film whole-body dosimeter and C – TL extremities ring.

based on TL materials. For film method (3) Kodak Films Type 2 is applied. System includes two densitometers manufactured by Victoreen and two PC with home made software for doses estimation. Doses calculation are performed based on optical density special algorithm (4). Standard film dosimeter (Fig. 1B) consists of one "window" and six filtered positions: 300 PL – plastic; 0.5 mm Cu; 50 PL – plastic; 1.5 mm Cu; 0.6 mm Sn; 0.3 mm Pb.

TL dosimeters are measuring by RADOS RE-1 reader connected with PC with Magic software. Doses calculation is performed by algorithm formulas written in Excel spreadsheet. It also consists of its own data base of all monitored persons, calculated doses and calibration factors. For TLD system, ALNOR type dosimeters, with two thermo luminescent pellets for hole-body dose estimation are used (Fig. 1A). TL materials are placed in two positions, one bared and one under Al filter. In a few cases, the dosimeters are worn on wrist using special plastic bags. For extremities, finger rings, with one pellet were used (Fig. 1C). In both types of TL dosimeters high sensitivity material MCP-N (LiF: Mg, Cu, P) is used.

Value of a background is taking into consideration basing on three months measurement makes by environmental TLD dosimeters in the first cycle.

RESULTS AND DISCUSSION

In 2011, 18469 readouts of whole-body and 2542 extremities dosimeters were performed that means that about 5000 of the occupationally exposed workers were monitored during the three months monitoring period (see Table 1). The majority of monitored group was medical, which covered 73% of all monitored by CLOR population, the next most numerous group was scientific (13%) and then the industrial and others, both cover 14%. The distribution of registered doses shows that 98% of monitored workers quarterly received doses of Hp(10) under 1 mSv. The 182 registered doses were in the range from 1 to 6 mSv that made up about 2% of all estimated Hp(10) doses. In 2011, twelve cases of dose equivalents over the limits of 20 mSv (0.1% of all readouts) have been registered. Six of them occured in medical institutions, three in the industrial and three in scientific group.

In 2011, 2542 readouts of extremities dosimeters were carried out only in 21 cases the Hp(0.07) exceeded 50 mSv.

The quarterly doses analysis ensure that the persons who received in given quarter a dose of Hp(10) higher than 6 mSv was taken away from work in exposure condition to prevent from exceeding the annual dose limit of 20 mSv.

The average annual dose for Hp(10) for all monitored persons in each particular group was: 0.51 mSv in medicine, 0.62 in scientific, 0.48 in industrial and 0.44 mSv in the other group. The average annual dose for the entire monitored population was 0.51 mSv.

Comparing these results with items obtained in 1999 (5), the average annual doses decreased by 40% in industrial group and increased by about 50% in scientific and other and increased by about 40% in medicine group.

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