ANALYSIS OF EXTERNAL OCCUPATIONAL EXPOSURE TO NUCLEAR RADIATION - CLOR /POLAND/ 1979 - 1981

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METHODS

Dose measurements were made with individual photometric dosemeters [1]. Each dosemeter has a two-sided system of plastic filters /surface density of 50 mg/cm^2 and 300 mg/cm^2/, copper filters /thickness of 0.05 mm, 0.5 mm and 1.5 mm/ and zink-lead filters /thickness of 0.6 mm Sb and 0.3 mm Pb/. The Kodak Radiation Monitoring Film used has emulsion layers of different sensitivity, which permits dose equivalent measurements ranging from $5 \cdot 10^{-4}$ Sv to 10 Sv. Dose film badges are worn for a period of one month or 3 months depending on the exposure level to the persons working with ionizing radiation.

DATA PROCESSING

To make an analysis of the occupational exposure risk the results of annual dose equivalents were grouped in five ranges: below 0.005; 0.005 - 0.015; 0.015 - 0.05; 0.05 - 0.12 and above 0.12 Sv [2].

Cases of the annual dose equivalent values exceeding 0.05 Sv and those of exceeding the quarterly maximum permissible levels /i.e. 0.013 Sv for women in the reproductive age and 0.03 Sv for other workers/ were analyzed on an individual basis taking into consideration the age and sex of the person, type of radiation, kind of work with ionizing radiation.

All the establishments were classified into research, industrial, medical and others and the persons were divided into the following age groups: 18 - 30, 31 - 40, 41 - 50 and above 50 years.

RESULTS OF MONITORING

The number of persons occupationally exposed to the ionizing radiation and covered by individual dose monitoring by the Central

Laboratory for Radiological Protection was 7414, 7275 and 7455 in 1979, 1980 and 1981, respectively.

Persons employed in research establishments constituted over 40% of all persons monitored /47.8%, 43.9% and 43.3% in 1979, 1980 and 1981, resp./. The second largest group was that of persons employed in industry: 24.7%, 25.3% and 24.6% in 1979, 1980 and 1981, resp./. Medical institutions employed 18.5%, 22.2% and 22.8% in 1979, 1980 and 1981 of all the working force monitored. The remaining persons were those working in other branches of economy.

The results of annual individual dose measurements between 1979 and 1981 are shown in Table 1.

Table 1. Distribution of annual dose equivalents for persons working in establishments using ionizing radiation /1979 - 1981/. Values are given in per cent.

Type of establishment	Year	Dose equivalents range				
		<0.005 Sv	0.005 - -0.015 Sv	0.015 - -0.05 Sv	0.05- -0.12 Sv [x]	>0.12 Sv [x]
Research	1979	98.06	1.46	0.42	0.06 /2/	-
	1980	97.94	1.59	0.47	-	-
	1981	98.27	1.24	0.46	0.03 /1/	-
Industrial	1979	84.78	8.78	5.56	0.65 /12/	0.22 /4/
	1980	84.23	9.24	5.38	1.09 /20/	0.05 /1/
	1981	84.93	8.65	5.60	0.65 /12/	0.16 /3/
Medical	1979	89.27	9.49	1.24	-	-
	1980	90.89	8.49	0.62	-	-
	1981	92.24	6.88	0.82	0.06 /1/	-
Others	1979	98.49	1.21	0.30	-	-
	1980	97.92	1.28	0.64	0.16 /1/	-
	1981	98.40	1.31	0.29	-	-
All groups of establishments	1979	93.19	4.73	1.83	0.19 /14/	0.05 /4/
	1980	92.91	5.03	1.76	0.29 /21/	0.01 /1/
	1981	93.62	4.36	1.80	0.19 /14/	0.04 /3/

[x] In brackets are indicated numbers of persons whose dose equivalents exceeded 0.05 Sv.

About 16% of all the persons monitored in industry received annual dose equivalent higher than 0.005 Sv, while the percentage of those employed at research and other establishments was about 2% and the percentages for those working in medical institutions were 11% in 1979 and 8% in 1981 for the same dose equivalent value.

Annual dose equivalents above 0.12 Sv were found only in persons working in industrial defectoscopy. In 1979, 1980 and 1981 four, one and three cases were registered of values above 0.12 Sv /i.e. 0.22%, 0.05% and 0.16% of the total number of persons in this group/ respectively.

The numbers of cases where the quarterly maximum permissible dose was exceeded in persons working with gammagraphic units were 20, 27 and 17 for 1979, 1980 and 1981, respectively.

It is, therefore, clear that the highest exposure levels were obtained in persons employed in defectoscopy. The mean annual dose equivalents calculated for this group were twice as large as the mean values for the whole group monitored /Table 2/.

Table 2. Mean values for annual dose equivalents received by persons employed at various establishments /1980 - 1981/.

Type of establishment	Mean values of annual dose equivalents /in Sv/	
	1980	1981
Research	$0.139 \cdot 10^{-2}$	$0.133 \cdot 10^{-2}$
Industrial	$0.441 \cdot 10^{-2}$	$0.452 \cdot 10^{-2}$
Medical	$0.203 \cdot 10^{-2}$	$0.192 \cdot 10^{-2}$
Others	$0.134 \cdot 10^{-2}$	$0.103 \cdot 10^{-2}$
All groups of establishments	$0.229 \cdot 10^{-2}$	$0.223 \cdot 10^{-2}$

The mean values of annual dose equivalents were calculated from

$$\bar{D} = \frac{D_c}{N}$$

where $\underline{D_c}$ is the annual collective dose equivalent calculated by summing the values for annual dose equivalents received by individual persons in the group, and $\underline{N}$ is the number of persons in the group.

The annual collective dose equivalent for the whole group monitored was 16.6 man Sv /1980 and 1981/, when the persons employed in industry it was 8.1 man Sv in 1980 and 8.3 man Sv for 1981.

LITERATURE

1. Jasiak J., Musiałowicz T., Wysopolski J.: Personnel film monitoring in Poland in the years 1963-1965 /in Polish/, Report CLOR-58/D, Warsaw 1966.

2. Mazgajska E., Jasiak J., Wysopolski J., Musiałowicz T.: Analysis and evaluation of the professional exposure to ionizing radiation in Poland in the years 1976-1978 /in Polish/, Probl.Techn.Med., 1980, XI, 1, 37-45.