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NIPNE-HH WHOLE BODY COUNTING LABORATORY - EIGHT YEARS OF NOTIFIED ACTIVITY. STATISTICS ON MONITORING DATA*

M.A. SAIZU[1, 2]

[1] *"Horia Hulubei", National Institute of R&D for Physics and Nuclear Engineering (NIPNE-HH), P.O. Box. MG-6, Magurele, Atomistilor Street 407, Romania, saizu_ang@yahoo.com*
[2] *Faculty of Physics, "Politehnica" University of Bucharest, Bucharest, Splaiul Independentei Street 313, Romania*

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Abstract. In the period 2000-2007, the Whole-Body Monitoring Laboratory (USCIR-CCU) from NIPNE-HH, Bucharest-Magurele, Romania, has performed, as notified dosimetric laboratory, 4169 radioactive internal contamination measurements for people involved in nuclear activities from industry, medicine, research and security. The effective doses were estimated, resulting for the period of eight years, a value of 816.34 Man*mSv for the collective dose, with an average of 102.04+- 5.38 Man*mSv.

Key words: whole-body, monitoring, accidental release, dosimetry, internal.

1. INTRODUCTION

The Romanian legislation into force for monitoring the occupational exposure (internal and external) of workers is represented by the document NSR-01: "Fundamental norms of radiation safety" [2] , where there are expressed the general demands to assure the radioprotection for the exposed workers, public and environment, and by the more specific document, NSR-06:" Norms of occupational personal dosimetry" [3]. Both documents respect the general law No. 111/1996 [1], republished and updated, regarding the safety of nuclear activities. They were issued by the Romanian competent authority in nuclear activities, namely the National Commission for the Control of Nuclear Activities (NCCNA), in accordance with the latest International Commission of Radiation Protection (ICRP) and International Atomic Energy Agency (IAEA) guidelines in the field.

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To perform the radioactive internal contamination monitoring, in notified conditions, the Whole Body Counting Laboratory (WBCL), from the Institute for Physics and Nuclear Engineering, Bucharest-Magurele, Romania, has implemented its own Quality Assurance system, based on NCCNA legislation, developing an annual monitoring program for workers involved in nuclear activities from industry, medicine, research and security.

The aim of this paper is to present, in a comparative manner, the contribution of each nuclear activity to the total collective dose, taking into account the distribution of workers on every nuclear activity, on every year.

2. MATERIALS AND METHODS

The Whole Body Counter from WBCL is a gamma spectrometric system based on a tilted chair geometry, on 2 lead shielded NaI(Tl) scintillation crystals, one for whole body–12.5 cm (*D*) and 10 cm (*H*) and the other for the thyroid- 4cm (*D*) and 5cm (*H*), and on the associated modular electronics: HV power supply, spectrometric amplifier, analog to digital converter, the interface and Multichannel Analyser.

The energy calibration of the measurement system was made using sealed point standard sources, in the energy range of 0.1 MeV to 2 MeV, while the efficiency calibration was performed using BOMAB (BottleManikinABsorbtion) phantom consisting of bottles from a material equivalent tissue, simulating the dimensions of the Reference Man and filled with known amounts of different radioactive solutions, with known activities. The MDA of the system was determined for whole body and thyroid, namely, 180 Bq and 300 Bq for Cs-137, respectively Co-60, and 26 Bq for I-131.

The effective doses were estimated using LUDEP 2.0 software, an internal dosimetry dedicated software from HPA (former NRPB).

3. RESULTS AND CONCLUSIONS

The annual distribution of Collective Dose (Man*mSv) and that of the measured persons, in 2000–2007 interval, are presented in Table 1.

Table 1

The annual distribution of Collective Dose (Man*mSv) and of the measured persons

Year	Collective Dose (Man*mSv)	Measured persons
2000	98.17	448
2001	126.83	500
2002	95.42	568
2003	96.63	462

Table 1 (continued)

2004	122.19	509
2005	93.62	506
2006	102.45	586
2007	81.03	590
Total	**816.34**	**4169**

The radionuclides identified during the measurements of the subjects were Na-22, Co-60, Tc99m, Zn-65, Ga-68, I-125, I-131 and Ir-192, specific for every type of nuclear activity, as follows:

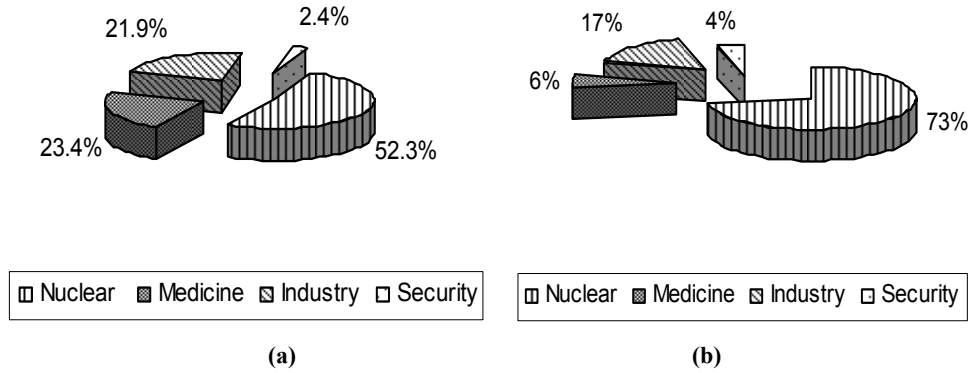
– production of radiopharmaceuticals labeled with I-131, I-125 and Tc99m;
– production of sealed sources : Co-60 and Ir-192;
– nuclear medicine : I-131;
– cyclotron maintenance : Zn-65;
– research activities : Na-22, Ga-58.

The distribution of Collective dose (Man*mSv) and that of the number of measured persons, considered for each field of nuclear activity – nuclear, medicine, industry, security, divided in its activities – research centers, waste management, nuclear medicine, radiopharmaceuticals production, industrial irradiation, accelerators operation, other industrial activities- are presented in the Table 2, Figs. 1 and 2.

Table 2

The distribution of Collective Dose (Man*mSv) and of the measured persons *versus* the field of nuclear activity for the period 2000–2007

Field of nuclear activity		**Collective Dose(Man*mSv)**		**Measured persons**	
Nuclear N0	Research centers N30	426.62	381.3	3023	2692
	Waste management N40		45.32		331
Medicine M0–NuclearMedicine M30		191.08		270	
Industry I0	Radiopharmaceuticals production I30	178.68	139.22	706	417
	Industrial irradiation I40		9.9		71
	Accelerators operation I50		16.47		119
	Other industrial activities I90		13.09		99
Security E0		19.96		170	
Total		**816.34**		**4169**	



(a) **(b)**

Fig. 1 – The percentage distribution of: a) the Collective Dose (Man*mSv) by main fields of nuclear activities; b), the measured persons by main fields of nuclear activities (b) in 2000–2007.

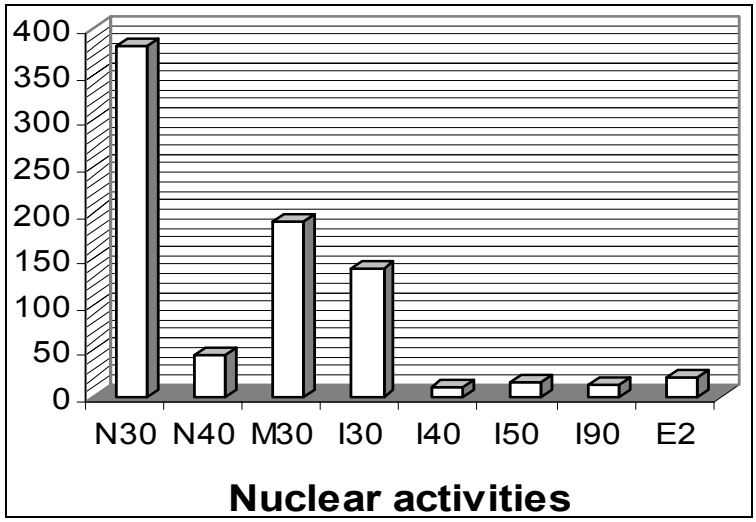


Fig. 2 – The distribution of Collective Dose (Man*mSv) by the nuclear activities.

In accordance with the document NSR-06, the collective dose distribution and that of measured persons were made and reported, also, by dose ranges in mSv, considered to be 9 doses rangls (MDL-0.1 mSv, 0.1-0.2 mSv, 0.2-0.5 mSv, 0.5-1 mSv, 1-2 mSv, 2-5mSv, 5-10 mSv, 10-15 mSv, 15-20 mSv) for the interval MDL-20mSv and one for values greater than 20 mSv.

The data were represented considering the cumulative values for all the nuclear activities, for the period 2000–2007 (Fig. 3, Fig. 4) and for every year, for Nuclear Medicine-M30 that have had the most important contribution at the collective dose per measured subject (Fig. 5, Fig. 6).

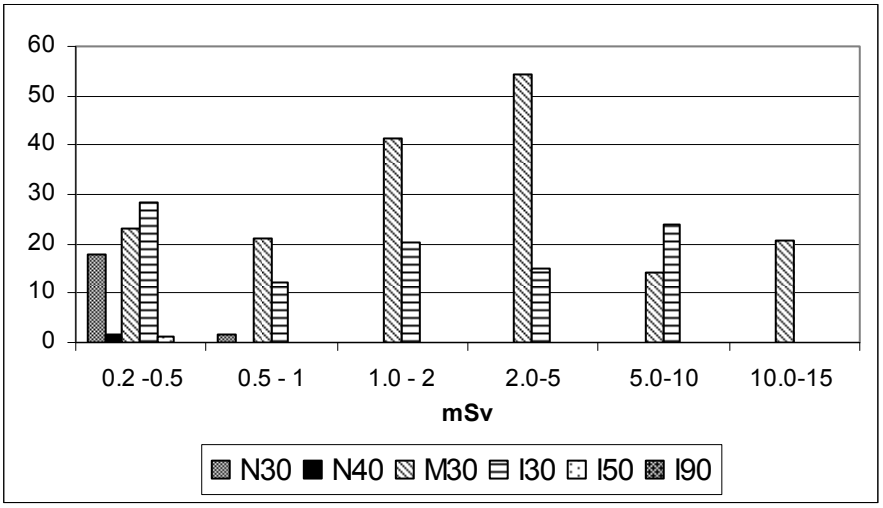


Fig. 3 – The distribution of Collective Dose (Man*mSv) by dose ranges for 2000–2007.

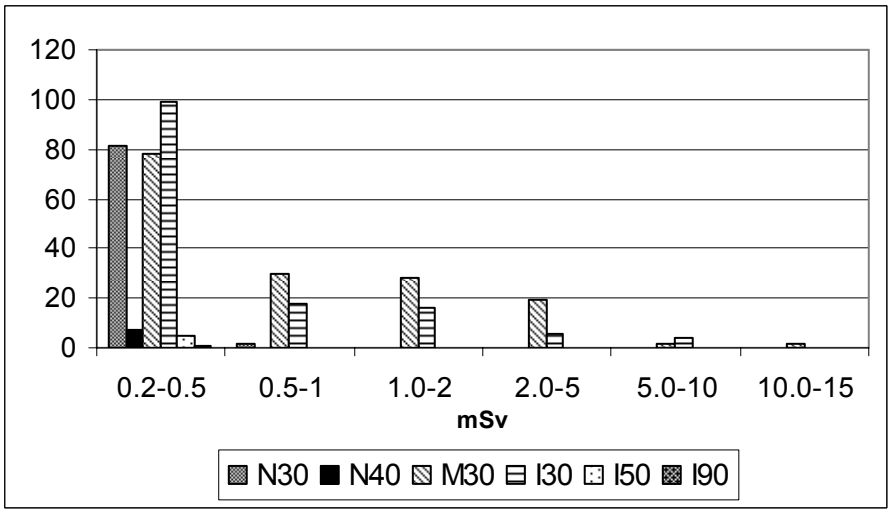


Fig. 4 – The distribution of measured persons by dose ranges for 2000–2007.

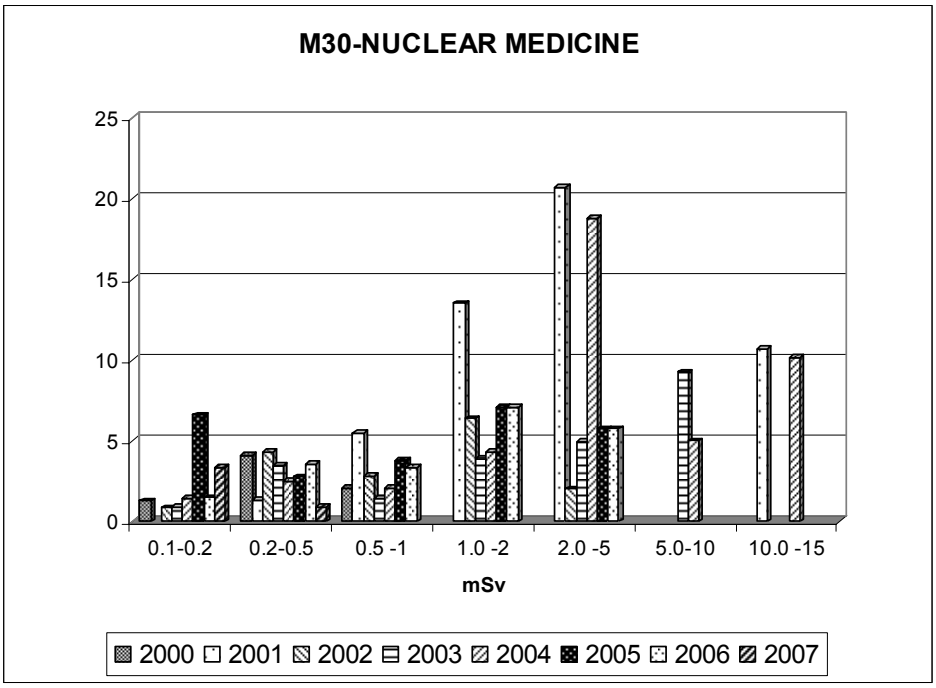


Fig. 5 – The distribution of Collective Dose (Man*mSv) by year for nuclear medicine.

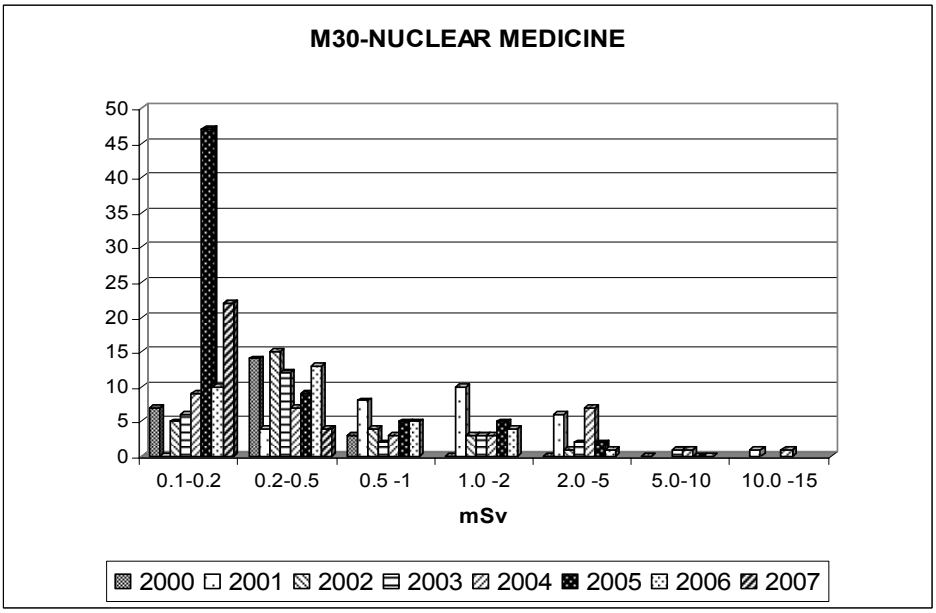


Fig. 6 – The distribution of measured persons by dose ranges and by year for nuclear medicine.

Among all activities with radioactive internal contamination potential, the nuclear medicine (M-30) has the most cases of radioactive intake, followed by radiopharmaceutical production (I30), nuclear research centers (N30), the management of radioactive waste (N40) and accelerators operation (I50).

The most frequent incorporated radionuclides were: Co-60, Tc99m, Zn-65, I-125, I-131 and Ir-192. In some isolated cases were identified: Na-22 and Ga-68, used in peculiar research activities.

The value of 20 mSv for the maximum annual effective dose for occupational exposure had never been exceeded.

The monitoring of workers from nuclear entities was made periodically, at the intervals declared in NSR-06, for each radionuclide.

The results were reported in accordance with the CNCAN regulations, expressed in the document NSR-01: “Fundamental norms of radiation safety” and in the document, NSR-06: “Norms of occupational personal dosimetry”.

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