The Central Dose Registry: Analysis of Occupational Exposure

M.B. Martins, J.G. Alves, J.N. Abrantes

Objectives

ITN is entrusted the task to create and maintain a Central Dose Registry, according to Decree-Laws 165 and 167 of July, 2002. At present, the Central Dose Registry (CDR) contains the occupational exposure data of the workers monitored in Portugal by ITN-DPRSN since 1957 - 2004.

Two main aims were defined for 2004 in this field of activity: the achievement of full compatibility of the CDR and the databases used at ITN for monitoring purposes, and the statistical analysis of the occupational exposure data.

The CDR is presently ready for the insertion of the data evaluated by other monitoring services external to ITN, which is bound to take place in 2005.

Results

The CDR contains the records of approximately 31,350 workers from 1,950 facilities monitored by ITN-DPRSN since 1957 - 2004[1].

The CDR gathers the information relative to the monitored workers and to the facilities that requested monitoring, grouped into four different fields of activity, namely health or medicine, conventional industry, research and mining. In each field of activity the most frequently found functions and practices were defined.

Full compatibility of the CDR and the databases used for routine monitoring at ITN was achieved in 2004[1,2]. This allows a fast and safe transfer of data to the CDR, as in the cases of new workers or for the periodic update of dose data received by workers already inserted in the Registry.

The CDR presently allows the statistical analysis of the occupational exposure data stored[3,4]. The number of monitored workers and facilities can be grouped by fields of activity, their respective distribution by effective dose intervals can be calculated, as well as the corresponding average and collective doses. These parameters are important to characterize the occupational exposure in Portugal. This is one of the aims of this and current works[3,4]. The statistical analysis of data is also a task entrusted to ITN by Law, as mentioned above.

In 2004 Portugal began taking part in the ESOREX activities, that is, the European Study on Occupational Radiation Exposure[5].

Published, accepted or in press work

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2. J.G. Alves, M.B. Martins, A.R. Roda, J.N. Abrantes Database in use at the Individual Monitoring Service of ITN-DPRSN, *Radiat. Prot. Dosim.*, **111** 1 (2004) 27-33
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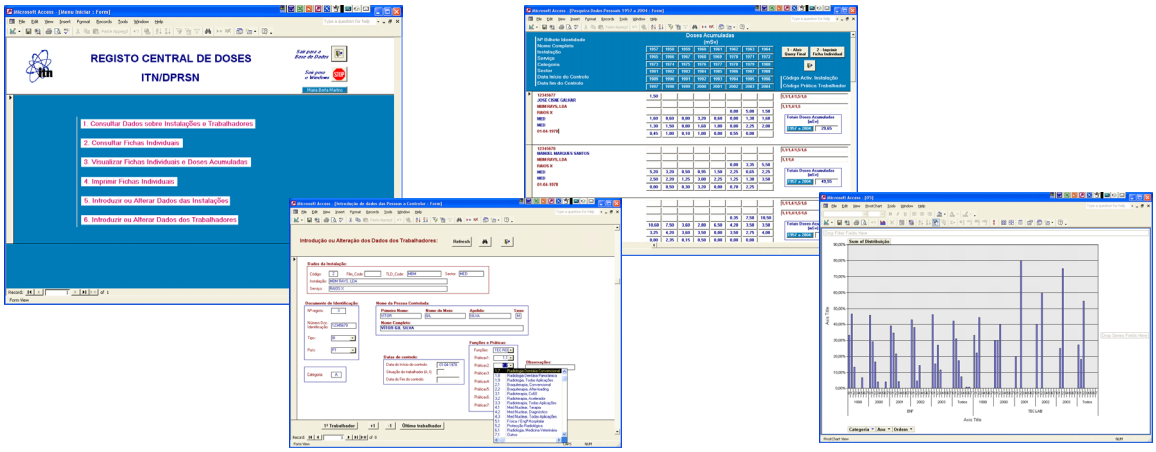
4. M.B. Martins, J.G. Alves, J.N. Abrantes, A.R. Roda Occupational Exposure in Nuclear Medicine in Portugal in the 1999 - 2003 Period *Accepted for IM2005 – European Workshop on Individual Monitoring of Ionizing Radiation,* Vienna, Austria, 11-15 April 2005.
5. J.G. Alves, M.B. Martins. The Portuguese Central Dose Registry, *Proc. ESOREX Meeting*, Prague (Czech Republic), 2-3 December 2004.



Central Dose Registry – print-screens showing some of the capabilities of the CDR

Optimization of the DPRSN TLD-Individual Monitoring System

J.G. Alves, J.N. Abrantes, S. Rangel, V.I. Batel[1]

Objectives

The Individual Monitoring System is based on thermoluminescence dosimetry (TLD) and the main objective of this work is to improve the quality of the performance.

Results

A quality control programme has been running at the TLD section of the Individual Monitoring Service since 2000. Since then regular evaluation of the quality control parameters have suggested some modifications that were introduced, when necessary(1).
More recently a few tests were carried out to evaluate the TL variation induced by changes in the HV. A thorough analysis of the daily QC parameters led to the definition of more correct alarm levels and to the set up of a modified initialization procedure(1).
The new procedure was set in practice and evaluated seven months later by analyzing the important QC parameters. The results obtained showed the system gained increased stability since the implementation of the procedure(2).
Previously implemented routine tests for the evaluation of the system's performance and for the simultaneous determination of important QA/QC parameters were continued. Sensitivity changes influencing the response of the TLD system and the dose evaluation method were also evaluated(1,2,3).
The response of the dosemeter was also studied as a function of energy and angle using radiation qualities and phantoms described in the ISO 4037 and as a function of dose(4,5).
An important item of the QA/QC is the record keeping policy. A database is being prepared for the storage of daily and monthly evaluated QA/QC data(6), e.g. reader calibration records, linear regressions, internal irradiator data, etc.
All the important procedures followed in routine work are being written down in order to prepare the necessary items for the accreditation of the service by IPQ-Instituto Português de Qualidade.

Published, accepted or in press work

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3. J.G. Alves, J.N. Abrantes, O. Margo, S. Rangel, L. Santos. Long-Term Stability of a TLD-Based Individual Monitoring System. *14th Int. Conf. on Solid State Dosimetry,* June 27-July 2, New Haven, CT, USA, 2004, *Radiat. Prot. Dosim* in press.
4. J.G. Alves, V.I. Batel, J. Cardoso, L. Santos. Studies on the response of the personal dosemeter in use at ITN-DPRSN. *11th Int. Congress of the Int. Radiation Protection Association,* May 23-28, Madrid, Spain, 2004.
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6. J.G. Alves, J.N. Abrantes, S. Rangel, L. Santos. A database for the storage of QC parameters. Accepted for *IM2005 – European Workshop on Individual Monitoring of Ionizing Radiation,* Vienna, Austria, April, 2005.

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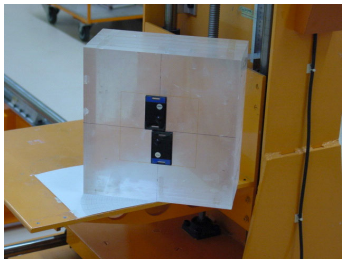
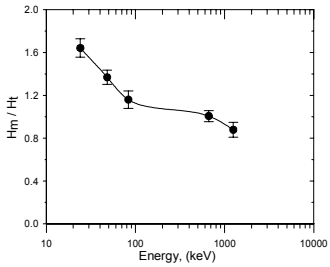




Setup for the type testing of the dosemeters and respective energy dependence curve

Harmonisation of Individual Monitoring in Europe

J.W. van Dijk[1], P. Ambrosi[2], T. Bolognese-Milsztajn[3], L. Currivan[4], R. Falk[5], E. Fantuzzi[6], M. Figel[7], J.G. Alves[8], M. Ginjaume[9], H. Janzekovic[10], V. Kamenopoulou[11], M.A. Lopez[12], M. Luszik-Bhadra[13], P.Olko[14], H. Stadtman[15], C.M. Castellani[16], F. Vanhavere[17], E. Vartiainen[18], W. Wahl[19], A. Weeks[20] and C. Wernli[21]

Objectives

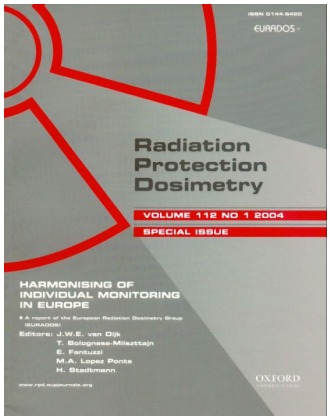
Harmonisation of individual monitoring in Europe is the title of working group 2 of EURADOS the European Radiation Dosimetry organisation.
WG 2 of EURADOS was formed within the 5th Framework Programme (EURATOM) for the period 2001-2004 and its main objective is to deal with the harmonisation of individual monitoring in Europe and on information on new techniques in this field.

Results

Four subgroups developed its activity under this EURADOS project. Each was dedicated to the following subjects: Implementation of standards, harmonization policies for the integration of results from internal and external occupational exposure, electronic dosemeters for individual monitoring and other new developments, and quality assurance, quality control and reliability of dosimetric systems.

The report of the working group was published as a Special Issue of Radiation Protection Dosimetry, as vol. **112**, 1, 1-189 (2004):

Subgroup one produced the paper *Implementation of Standards for individual monitoring in Europe* by Fantuzzi *et al*.(1)



Subgroup two divided their task into three different documents: *A catalogue of dosemeters and dosimetric services within Europe – an update*, *Individual Monitoring for internal exposure in Europe and integration of dosimetric data*, and *Workplace monitoring for exposures to radon and to other natural sources in Europe: integration of monitoring for internal and external exposures*, by M.A. Lopez Ponte *et al*.(1,2)

Subgroup three issued *Active personal dosemeters for individual monitoring and other new developments* by T. Bolognese-Milstajn *et al*.(1)

And finally, subgroup four wrote *Quality control and reliability of reported doses* by H. Stadtman *et al*.(1)

The objectives defined for the period 2001 to 2004 were attained with the publication of the report. The activities of the Harmonization group will continue in the next period.

Published, accepted or in press work

1. Radiation Protection Dosimetry Special Issue *Harmonization of Individual Monitoring in Europe,* Ed. J. van Dijk, E. Fantuzzi, M.A. Lopez Ponte, T. Bolognese-Milstajn, H. Stadtman, Radiat. Prot. Dosim. **112**, 1 (2004). 1-189
2. M.A. Lopez *et al*. Harmonization of Individual Monitoring in Europe. *11th Int. Congress of the International Radiation Protection Association,* May 23-28, Madrid, Spain, 2004.

[1]NRG-RE, Utrechtseweg 310, PO Box 9034, 6800 ES Arnhem, The Netherlands. [2]PTB, Bundesallee 100, D-38116 Braunschweig, Germany. [3]IPSN, Rue Auguste Lemaire BP 6, F-92265 Fontenay-aux-Roses, France. [4]RPII, 3 Clonskeagh Square, Dublin 14, Ireland. [5]SSI, S-17116 Stockholm, Sweden. [6]ENEA-IRP, Via dei Colli 16, 40136 Bologna, Italy. [7]GSF, Ingolstadter Landstrasse 1, 85764 Neuherberg, Germany. [8]ITN-DPRSN, Estrada Nacional 10, 2686-953 Sacavém, Portugal. [9]INTE-UPC, Diagonal 647, Barcelona, Spain. [10]HIRS, Parmova 33, 1000 Ljubljana, Slovenia. [11]GAEC, 153 10 Ag. Paraskevi-Attiki, PO Box 60092, Athens, Greece. [12]CIEMAT, Avda Complutense 22, 28040 Madrid, Spain. [13]PTB, Bundesallee 100, D-38116 Braunschweig, Germany. [14]INP, Radzikowskiego 152, PL 31442 Krakow, Poland. [15]ARCS, A-2444 Seibersdorf, Austria. [16]ENEA-IRP, Via dei Colli 16, 40136 Bologna, Italy [17]SCK-CEN, Boeretang 200, 2400 Mol, Belgium. [18]STUK-Personal Dosimetry, PL 4, FIN 00881 Helsinki, Finland. [19]GSF, Ingolstadter Landstrasse 1, 85764 Neuherberg, Germany. [20]BNFL RVT, Berkley Centre, 4L13 4PB Berkley Gloucestershire, United Kingdom. [21]PSI, CH-5232 Villingen PSI, Switzerland.

Cosmic Radiation Dose Estimates for Military Crew in Transport Missions

J.G. Alves, J.N. Abrantes, J. Mairos[1], Chaveiro[1]

Objectives

In this work an estimate of the cosmic radiation dose received by military aircraft crew on realistic typical transport missions is made.

Results

Aircraft fighter pilots may experience risks other than the cosmic radiation exposure due to the characteristics of a typical fighter flight. The combined risks for fighter pilots due to the G-forces, hypobaric hypoxia, cosmic radiation exposure, etc. have determined that pregnant female pilots should remain on ground. However, several military transport missions can be considered an ordinary civil aircraft flight and the question arises whether the pregnant female pilot could be part of the aircrew.

In this work the cosmic radiation dose received in several transport missions was estimated[1,2]. Typical transport missions carried out in one month by a single air squad were considered. The flights departured from Lisbon to areas such as the Azores, to several countries in central and southern Africa, to the eastern coast of the USA and to the Balkans and an estimate of the cosmic radiation dose received on each flight was performed.

The cosmic ray dose estimates were performed using the EPCARD v3.2 and the CARI-6 computing codes. EPCARD v3.2 was kindly made available by GSF-National Research Centre for Environment and Health, Institute of Radiation Protection (Neuherberg, Germany).

CARI-6 (version July 7th, 2004) was downloaded from the web site of the Civil Aerospace Medical Institute, Federal Aviation Administration (USA).

Published, accepted or in press work

1. J. Mairos, J.G. Alves, E, Chaveiro, R. Ribeiro. Exposição à Radiação Cósmica e Gravidez na Avaliação Civil e Militar. *XVII Congresso Nacional de Obstetrícia e Ginecologia,* Lisboa, Portugal, November 2004.
2. J.G. Alves, J. Mairos, J.N. Abrantes, E. Chaveiro, R. Ribeiro. In-Flight Estimates for Military Aircraft Crew on Transport Missions Accepted for *IM2005 – European Workshop on Individual Monitoring of Ionizing Radiation,* Vienna, Austria, April 2005.

[1] Hospital da Força Aérea, Serviço de Ginecologia e Obstetrícia, Az. dos Ulmeiros, 1649-050 Lisboa

The calculations were carried out for the flight altitudes typical of this aircraft

Services

Individual Monitoring of External Radiation

In the beginning of 2004, the Individual Monitoring Service of ITN-DPRSN provided monitoring for external exposure to approximately 9,500 workers from 970 facilities in Portugal. This figure represents nearly 90% of the monitored population in the country. Two dosimetric systems were running simultaneously one based on film and the other one on thermoluminescence dosimetry (TLD).

In January, a strong staff reduction followed by no replacements led to the discontinuation of film monitoring and to a decrease in the number of workers monitored with TLD. The changes became effective from March 31st onwards.

In total, approximately 44,546 occupational doses were assessed in 2004.

Considering the monitored population in Portugal, four fields of work are available, namely, health or medicine, industry, research laboratories and mining, which are respectively, identified by the acronyms MED, IND, RES and MIN.

Film dosimetry

M.B. Martins, G.C. Rangel, M.A. Gameiro, J.N. Abrantes.

Film monitoring is based on the Kodak type II film inserted in a homemade holder for the evaluation of $H_p(10)$. Two monitoring periods were in use, on a monthly basis and on a quarterly basis. This methodology was discontinued on March 31st.

In 2004 about 2,726 workers from 274 facilities were monitored. The number of monitored workers and facilities, distributed by fields of activity are presented in Figures 1 and 2, respectively.

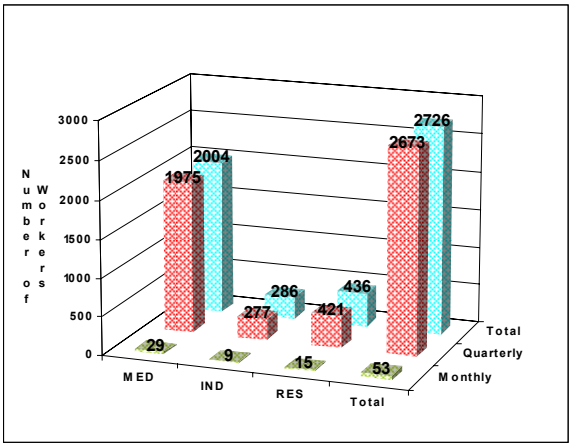


Fig. 1. Number of monitored workers grouped by field of activity and monitoring period.

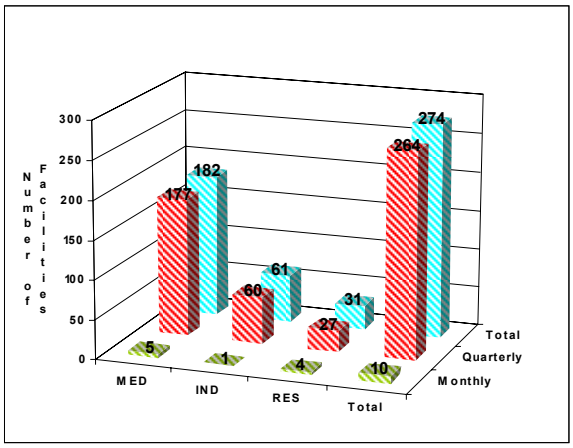


Fig. 2. Number of facilities grouped by field of activity and monitoring period.

The distribution of the annual effective doses by dose intervals for the different fields of activity is presented in Figure 3. It can be seen that the annual doses are distributed in two intervals D=0 mSv (~95%) and 0<D<6 mSv (~5%).

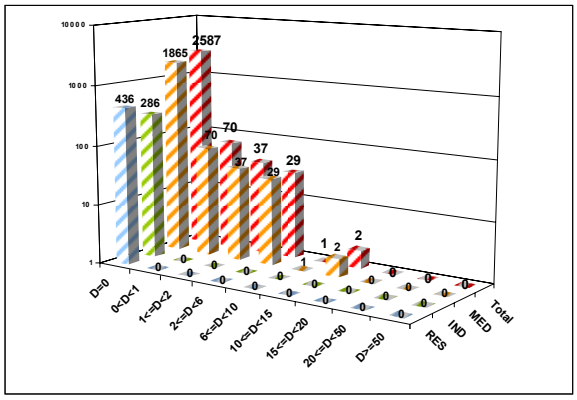


Fig. 3.Distribution of the annual effective doses by dose intervals.

Thermoluminescence dosimetry

J.G. Alves, E.M. Amaral, J.V. Monteiro, O.C. Margo, C.M. Favinha, S.S. Rangel.

The TLD system is comprised of two 6600 Harshaw readers and on the Harshaw 8814 TL card and holder containing two LiF:Mg,Ti (TLD-100) detectors for the evaluation of $H_p(10)$ and $H_p(0.07)$. The system allows the measurement of the operational quantities $H_p(10)$ and $H_p(0.07)$, the personal dose equivalents at the depth of 10 and 0.07 mm, respectively. Whole body doses were measured on a monthly basis and on a quarterly basis. The quarterly period of control ended in March 31st.

In 2004, 6,724 workers from 696 facilities (approx.) were monitored. The numbers of monitored workers and of facilities distributed by fields of activity are presented in Figures 4 and 5, respectively.

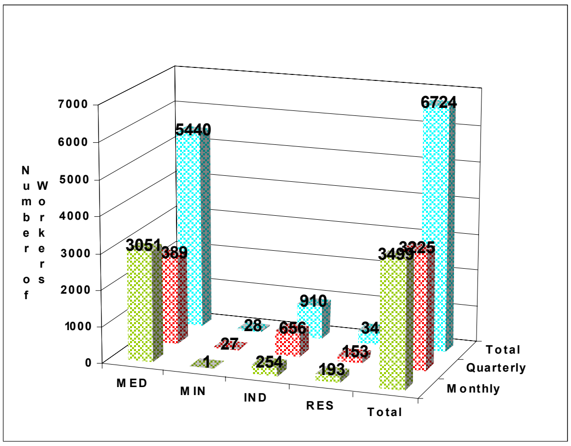


Fig. 4. Number of monitored workers grouped by field of activity and monitoring period.

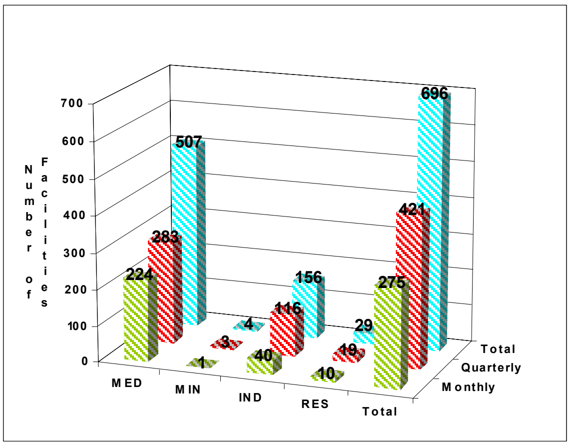


Fig. 5. Number of facilities grouped by field of activity and monitoring period.

The distribution of the annual effective doses by dose intervals for the different fields of activity is presented in Figure 6.

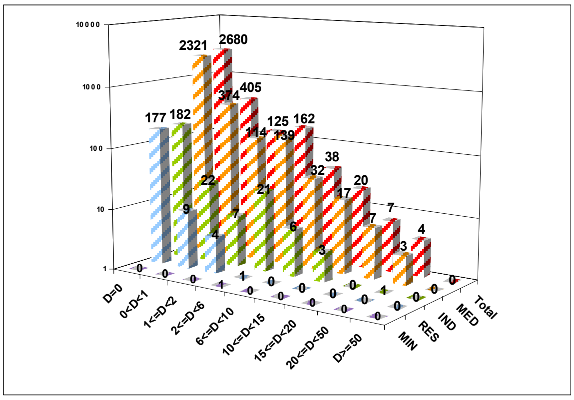


Fig. 6. Distribution of the monthly annual effective doses by dose intervals.

From the data in Figure 6, nearly 75% of the workers monitored on a monthly basis received an effective dose bellow the recording level. 85% of the same group of workers received a dose value below 1 mSv.

Only three workers received a dose value higher than 20 mSv. These cases were observed in the medical sector of activity.

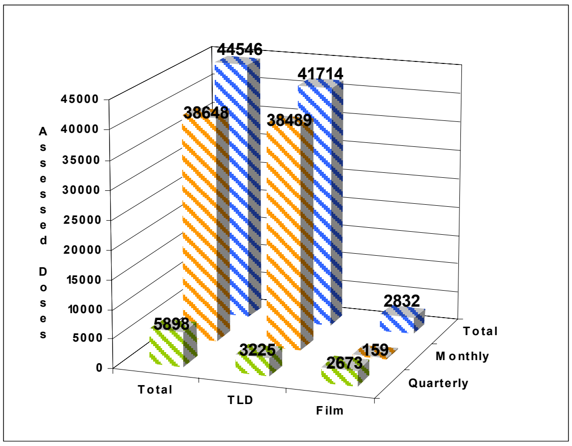


Fig. 7. Total number of assessed doses in 2004.

Considering both monitoring methods, Film and TLD, approximately 44,546 occupational doses were measured. The total number of assessed doses is displayed in Figure 7, organized by monitoring method and period of control.