

Study of the Spatial Variation of the Air Kerma Backscatter Factor on the Standard ISO Phantom: Experimental and Numerical Evaluations

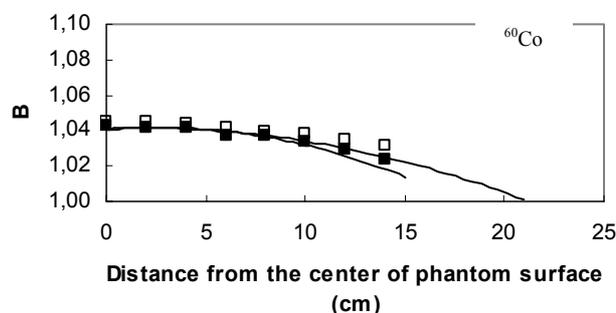
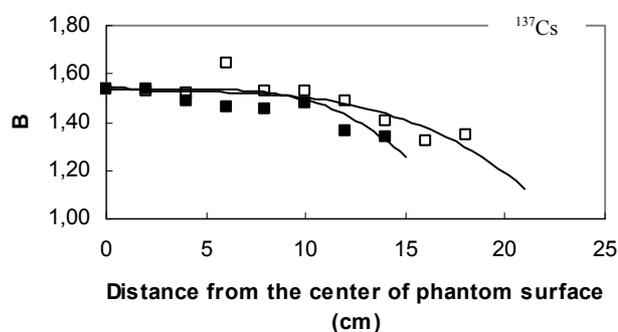
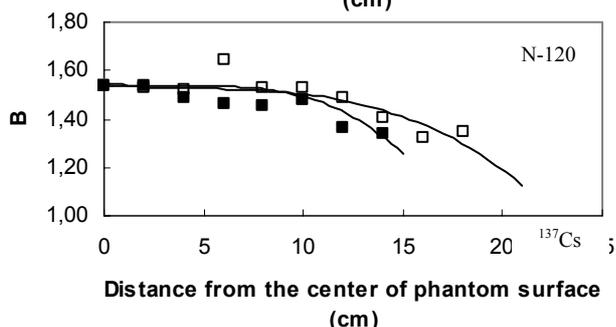
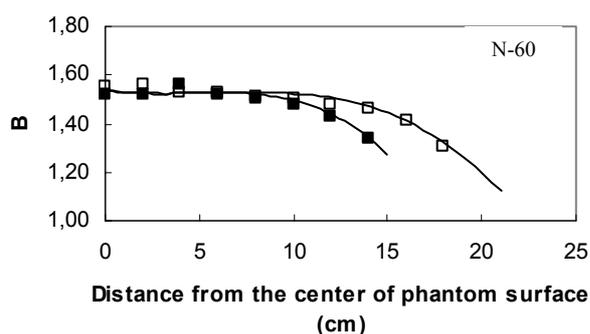
C. Oliveira, A. F. Carvalho, João Cardoso

Objectives

Personal dosimeters should be calibrated on the surface of the ISO water phantom. For this purpose dose values should present a uniform distribution over the calibration area. To determine the boundary of the uniform dose area, two complementary approaches are purposed: the experimental and the numerical simulation. This article presents the results of Monte Carlo calculations and of experimental determinations of the spatial variation of the air kerma backscatter factor on the ISO water phantom surface. The Monte Carlo code used has been the MCNPX code. Laboratory measurements were carried out with a 1cc ionisation chamber. The simulated and the experimental work have been performed for the ^{60}Co and ^{137}Cs gamma radiation qualities and for the X-ray Narrow spectrum ISO series for 60 kV and 120 kV. This work is part of a feasibility study carried out by the Laboratory of Metrology of Ionising Radiations aimed at adopting routine procedures for in-group irradiation of personal dosimeters and consequent calibrations.

Results

The experimental results, as well as, the normalized simulation results for the several distances taken from the centre of the phantom are shown on the next four figures, where the experimental results (■ for apothem axis and □ for diagonal axis) and normalised simulation results (—) for the indicated radiation qualities are presented.



The experimental B values on the center of the phantom surface and d_F values taken of the normalised simulation curves are represented on table 1.

	B	d_F (95%) (cm)	d_F (98%) (cm)
N-60	1.54	22.5	18.5
N-120	1.54	21.4	16.5
^{137}Cs	1.09	30.0	22.5
^{60}Co	1.04	>30	27.0

Published, accepted or in press work

1. J. Cardoso, C. Oliveira, A. Ferro de Carvalho. Study of the Spatial Variation of the Air Kerma Backscatter Factor on the Standard ISO Phantom, with a ^{60}Co Irradiator. *Radioprotecção*, Dezembro de 2003 e Maio de 2004, Vol. 2, N.º. 4 e 5.
2. C. Oliveira, A. F. Carvalho, João Cardoso. Study of the Spatial Variation of the Air Kerma Backscatter Factor on the Standard ISO Phantom: Experimental and Numerical Evaluations. *IRPA11*, May 2004, Madrid, Spain.

Quality Control and Quality Assurance in a Gamma Spectrometry Laboratory

Lídia Silva, Jorge Gouveia, Luís Ramos, Gonçalo Carvalhal, Carlos Oliveira

Objectives

The gamma spectrometry laboratory (LEG) is improving its methods and routines, with the purpose of accreditation. As our services are used for research projects and for environmental monitoring, it is very important that our technique follows quality control procedures and is ruled by internationally accepted norms.

Results

The complete spectrometry system (pre-amplifier, amplifier, MCA, detector performance) is under regular tests, with periodical standard measurements making use of a pulse generator, an oscilloscope and radioactive sources; control charts were created for this purpose, so that any changes occurring in the system may be detected and corrections may be made.

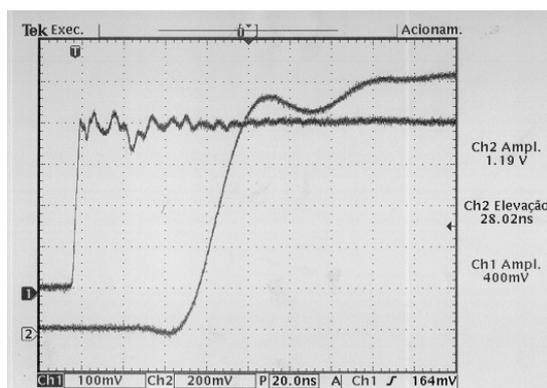


Fig 1. Example of a control test to a pre-amplifier, made with an oscilloscope and a pulse generator.

The software package we use in the laboratory for acquiring and analyzing spectra (Genie 2000, V3.0, Canberra) is also being used for quality assurance routines, by maintaining records of the energy and efficiency calibrations, of the detectors' resolution, background, etc. During 2004, the software in use was progressively unified: we began abandoning Sampo 90, and kept only Genie 2000 in use.

For calibration purposes the requirements of two standards will be fulfilled: the *American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-*

Ray Emission Rates of Radionuclides, ANSI N42.14-1999 and the *General requirements for the competence of testing and calibration laboratories*, ISO/IEC 17025.

The gamma spectrometry laboratory participated in an intercomparison exercise promoted by the CSN, Spain, for the measurement of Cs-137 in drinking water. We had a satisfactory result, with 7% difference from the recommended value.

Published, accepted or in press work

1. F. P. Carvalho, M.J. Madruga, J.M. Oliveira, J.M. Gouveia, L. Silva. Radioactivity in the Northern Seas of Europe. *Radioprotecção* 2: (2004) 118-125.
2. F. P. Carvalho, M.J. Madruga, M.C. Reis, J.M. Oliveira, J.G.Alves, A. Libânio, J.M. Gouveia, L. Silva. Minas de Urânio e Contaminação Ambiental no Centro-norte de Portugal. Uma Avaliação Preliminar. *8ª Conferência Nacional do Ambiente*, Lisboa, 27-29 Outubro 2004 (ed. in CD-ROM).
3. F. P. Carvalho, J.M.Oliveira, A.Libânio, M.J. Madruga, L. Silva J. Gouveia, P. Monteiro, M. Perdigão, M. Malta. Avaliação da Contaminação do Estuário do Tejo por Substâncias Radioactivas de Várias Origens. *8ª Conferência Nacional de Ambiente*, 27 a 29 de Outubro 2004, Lisboa (ed. in CD-ROM).
4. M.J. Madruga, F. P. Carvalho, M. Reis, M.M. Sequeira, G. Ferrador, M. A. Gameiro, L. Silva, J. Gouveia, L. Machado, J.M.Oliveira, I. Lopes, V. Silvino. Vigilância Radiológica do Ambiente em Portugal. *8ª Conferência Nacional de Ambiente*, Lisboa, 27-29 Outubro 2004 (ed. in CD-ROM).
5. F. P. Carvalho, M.J. Madruga, M. C. Reis, J.G. Alves, J.M.Oliveira, J. Gouveia, L. Silva. Radioactive survey in former uranium mining areas in Portugal. *Intern. Workshop on Environ Contamination from Uranium Production Facilities and Remediation Measures*, organized by the ITN/DPRSN and the IAEA, Sacavém, 11-13 Fev. 2004 (in press)

Services

Metrology Laboratory of Ionizing Radiation

A. F. Carvalho, João Cardoso, C. Oliveira and Luís Santos

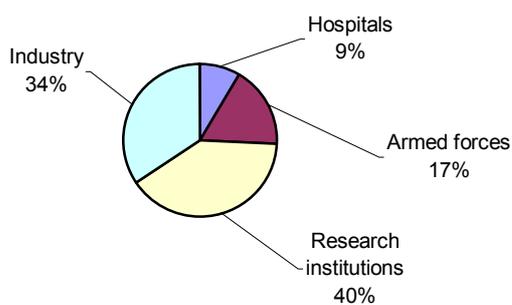
The LMRI provided technical support and irradiation facilities to 3 university students who done several experimental work with some relevance to LMRI experimental activity.

Collaboration with other research groups, outside ITN, is also a predominant objective, and again this year the LMRI provided irradiation experimental facilities and dosimetry to several research groups outside ITN.

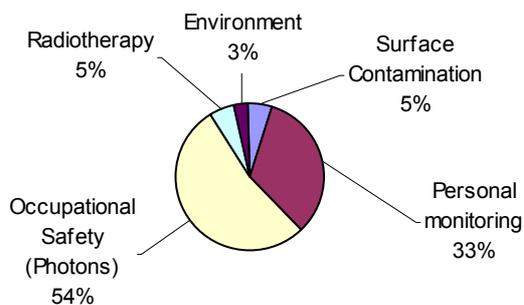
Calibration services were provided to the community mainly for industry, universities, hospitals, armed forces and departments of ITN.

Metrological control of instruments for measurement of ionising radiation is being carried out under a contract with Portuguese Institute of Quality and is the enforcement of Portaria 423/98 de 21 de Julho. Metrological control includes calibration and type testing. During 2004 were calibrated 63 dosimeters. About 500 TLD dosimeters were irradiated. The following figures can quantify the work done in this particular area.

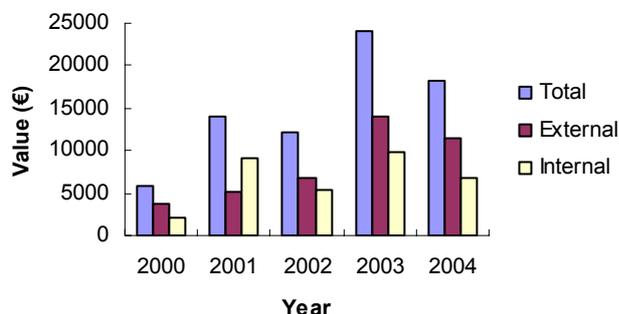
Intruments calibrated by users activity



Instruments calibrated by type of use



Services Values - LMRI

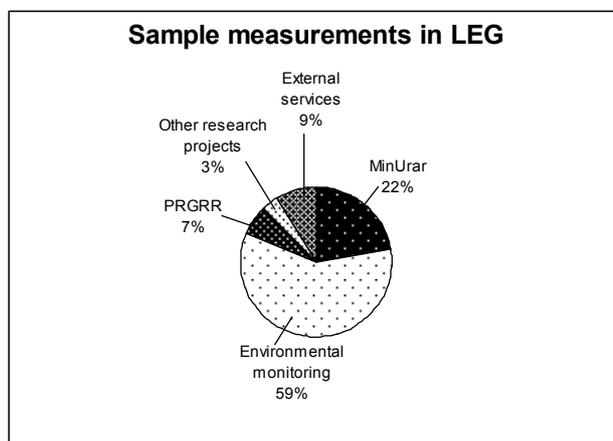


Gamma Spectrometry Laboratory

Lídia Silva, Jorge Gouveia, Luís Ramos, Gonçalo Carvalho and Carlos Oliveira

The Gamma Spectrometry Laboratory collaborates with all department. Over 900 samples have been analyzed, of which 59% for the environmental monitoring program, 22% for the MinUrar project, 9% for external entities, 7% for the PRGRR group, and 3% for other research work.

Sample measurements in LEG



Distribution of samples in the gamma spectrometry laboratory

