REPROLAM
Red de Optimización de la Protección Radiológica Ocupacional en LatinoAmérica y el Caribe

NEWSLETTER

NUMBER 6, JULY 2023

REPROLAM WEBINAR: RETROSPECTIVE DOSIMETRY METHODS: LUMINESCENCE AND ELECTRON PARAMAGNETIC RESONANCE (EPR)

JULY 14, 2023 11:00 AM (BRASILIA TIME)



DR. VIRGILIO CORRECHER
CIEMAT - Spain Center for Energy, Environmental, and Technological Research



OSWALDO BAFFA FILHO
University of São Paulo (USP) Faculty of Philosophy, Sciences, and Letters of Ribeirão Preto (FFCLRP) Department of Physics (DF)

Retrospective dosimetry is a technique used to assess radiation exposure in situations where there is no conventional measurement system.

There are two main categories, namely dating and accident dosimetry. The dating of geological or archaeological artifacts is based on the determination of the absorbed dose of natural minerals due to natural background radiation, which is proportional to the age of the artifact at that location. The other category is accident dosimetry, where one is interested in determining the absorbed dose due to a radiation accident or other event, in addition to the normal background radiation.

Examples include the determination of absorbed doses during events such as nuclear weapon explosions, nuclear reactor accidents, or other unintentional radiation release incidents. Since synthetic dosimeters were not in place at that time, the determination of absorbed doses can be estimated using locally available materials, such as bricks, porcelain, glass, etc. The methodology employed is based on variations in the physical or biological properties of different materials that can be altered by the absorption of ionizing radiation energy, which is why ubiquitous materials must be used as dosimeters.

Link :meet.google.com/yyy-dnfv-asi

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TECHNICAL AND REGULATORY IMPLICATIONS OF REDEFINED OPERATIONAL QUANTITIES FOR EXTERNAL RADIATION EXPOSURE

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Introduction

The quantities for radiological protection can be distinguished into three main categories. Physical quantities, such as fluence, kerma and absorbed dose, describe the properties of a radiation field. The International Commission on Radiological Protection (ICRP) has defined protection quantities to compare radiation detriment for stochastic effects with exposure limits and to estimate deterministic effects, e.g., in the lens of the eye or in the local skin. Protection quantities, such as effective dose and organ equivalent dose, are based on physical quantities but modified by risk-related factors. Since they cannot be measured directly, the International Commission on Radiation Units and Measurements (ICRU) has introduced operational quantities, such as personal or ambient dose equivalent, for practical use in radiation protection. These quantities are related to instrument responses by calibration so that the monitored quantities should conservatively approximate the corresponding protection quantities to enable optimization of individual exposures.

While protection quantities are defined in anthropomorphic phantoms, the current set of operational quantities for monitoring of external radiation is calculated in simple geometrical bodies of slabs, cylinders and rods. These inconsistencies are most importantly resulting in significant overestimation of effective dose for low-energy photons and underestimation for high-energy neutrons. ICRU Report 95 has therefore recommended a change of paradigm in the definition of operational quantities.

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REDEFINED OPERATIONAL QUANTITIES

The redefined operational quantities are simply calculated as the product of fluence and the relevant conversion coefficient, as tabulated in ICRU Report 95. For extremity, local skin and lens of the eye, the new operational quantities are in terms of absorbed dose, which helps to distinguish between tissue reactions and stochastic effects (Table 1). Their definition is based on the same anthropomorphic phantoms that are used to calculate protection quantities. Necessarily, the new operational quantities, which are also calculated for a wider range of particle types and energies, have got a much closer relationship with the protection quantities.

Table 1. Comparison of current and new operational quantities.

Current operational quantity	New operational quantity
Ambient dose equivalent H*(10)	Ambient dose H*
Personal dose equivalent Hp(10)	Personal dose Hp
Personal dose equivalent Hp(0.07), Hp(3)	Personal absorbed dose Dp
Directional dose equivalent H′(0.07), H′(3)	Directional absorbed dose D′

IMPACT ASSESSMENT

Building on a comprehensive report published by the European Radiation Dosimetry Group (EURADOS)[1] and an informational review paper authored by the Inter-Agency Committee on Radiation Safety (IACRS)[2], the International Atomic Energy Agency (IAEA) has launched a project to fully assess the costs and benefits associated with introduction of the redefined operational quantities and identify the necessary research to be carried out. The areas of specific interest include dosimeter and instrument design, calibration and reference fields, standardization, regulations, and dose registries as well as radiation protection practices.

DOSIMETER AND INSTRUMENT DESIGN

Most types of personal dosimeters and area monitoring instruments will require a measure of redesign of very different complexity. The performance of multi-element dosimeters may be made acceptable by parametric changes to the dose algorithm or adaptation of filtration, representing a cost-efficient solution. However, there is little scope to optimize the design of single-element dosimeters such as ring dosimeters for extremity monitoring, which apparently do not use an algorithm. In this case, normalization to a different reference energy might help to shift the response to meet the acceptance criteria and possibly mitigate the impact.

CALIBRATION AND REFERENCE FIELDS

Calibration laboratories will see little change for existing radiation types and energy ranges as calibration procedures will remain largely unmodified. The phantoms for calibration of personal dosimeters are the same as those previously recommended and described in applicable standards. The new operational quantities are defined in vacuum, which necessitates the use of charged particle equilibrium to ensure standardization. Consequently, the kerma-approximation conversion coefficients need to be used for calibration, type testing and performance testing over the existing radiation types and energy ranges.

STANDARDIZATION

International and national standards will need to be adapted accordingly. Standards represent a consensus among experts in the field concerned. To ensure that they remain up-to-date and relevant, they are systematically reviewed at least every five years after publication. In view of the redefinition of operational quantities, it may well be that these regular revisions need to be more extensive than they would otherwise be. Some standards, e.g., for performance and type testing, will need prioritizing. Other areas of concern for standardization include calibration, monitoring procedures, dose registries and terminology.

REGULATIONS AND DOSE REGISTRIES

Changes to regulations may be comparatively minor as they largely refer to protection rather than operational quantities. There is a major concern of individual monitoring services regarding possible modifications to their personal dosimeters so that the legislation timeline is of interest for such services and for the industry. There are, however, many supporting documents that need to be updated. These essentially include documents from the IAEA Safety Standards Series that might become obsolete.

Dose registries are capturing estimates of protection quantities originating from measurement of operational quantities. It should therefore be made clear in the databases exactly which operational quantities were used and when the change took place. This is particularly important when data from a dose database will be used for epidemiological studies because the inferred value of effective dose will depend on the operational quantity used to estimate it.

RADIATION PROTECTION PRACTICES

With the new operational quantities, the assessment of effective dose is supposed to be more accurate. However, redefinition of operational quantities will see an apparent reduction in whole-body doses for occupationally exposed workers, particularly for exposure situations involving low-energy photons. For diagnostic and interventional procedures, for example, the dose reduction is estimated to be about a factor of 2. This could lead to a decrease in staff vigilance and a reduction in general awareness of radiation protection. This situation may be overcome by developing an appropriate professional training and communication programme for all stakeholders, including radiation protection officers and experts, regulators, individual monitoring services staff and workers.

CONCLUSIONS

The new operational quantities will achieve the benefits of improved representativeness of protection quantities and wider radiation type and energy coverage. Using the same anthropomorphic phantoms that are used to calculate protection quantities, the system will be intrinsically simplified, made better understandable and, in a sense, more practical, eliminating complex and potentially confusing intermediate steps.

The biggest challenge will be in the area of dosimeter and instrument design. The changes needed to achieve good responses to the new operational quantities will range from simple re-calibration to radical re-design, and some types of dosimeters may become obsolete. Numerous standards documents will require revision. Adequate training and communication strategies will need to be developed to avoid adverse impact on radiation protection and safety culture and maintain trust of workers in individual monitoring.

1 https://eurados.sckcen.be/sites/eurados/files/uploads/Report-Publications/Reports/2022/EURADOS%20Report%202022-02.pdf
2 http://www.iacrs-rp.org/products/iacrs-icru.pdf



SAFETY FIRST

Space dedicated to common understanding and the promotion of Safety Culture through information, analysis, dissemination of experiences and related news.

DOES AN ENVIRONMENT THAT PROMOTES BEHAVIORS CHARACTERISTIC OF A HIGH SAFETY CULTURE EXIST IN MY ORGANIZATION?

Since the first appearance of the definition of Safety Culture in the IAEA document known as INSAG 3 with the Basic Safety Principles in 1988, it has been recognized that the safety environment within an organization is one of the two general components of Safety Culture, along with the utilization of that environment by the personnel to respond to and benefit from it. The existing environment within an organization is crucial in achieving the required behaviors.



When an organization fosters a collaborative environment among all its members, regardless of their role or hierarchy, it facilitates communication, engagement, and participation of everyone in safety matters, and it builds trust to discuss and report safety issues or concerns. This is essential for the safe performance of an organization.

Managers play a crucial role in creating and maintaining these safety environments. They are the ones who set policies, establish Safety Management Systems, and through their leadership style, they can foster collaboration rather than impose their own opinions. They are the ones who stimulate and recognize desired safety behaviors through reward and recognition systems.

A safety, collaboration, and sense of belonging environment will generate attitudes and behaviors that reinforce them, in a cycle that ultimately benefits safety.

Remember, if you are a manager or work to promote Safety Culture, creating environments within the organization that encourage safe behaviors is one of the characteristics of a strong safety culture.

With this writing, we conclude the reflections on the 10 fundamental elements that should be present in an organization for it to have a strong safety culture. Starting from the next newsletter, we will embark on a journey through other interesting aspects of Safety Culture.

[1] IAEA. IAEA TECHNICAL DOCUMENTS SERIES. TECDOC1995 Safety Culture in Organizations, Facilities and Activities Associated with the Use of Ionizing Radiation Sources, Vienna, 2022.
[2] IAEA, Safety Series No. 75-INSAG 3 Basic Safety Principles for Nuclear Power Plants, Vienna, 1988.
[3] IAEA, INSAG 11. The Safe Management of Sources of Radiation: Principles and Strategies, Vienna, 1999.

SUCCESSFUL EXPERIENCES OF INTEGRATING OCCUPATIONAL HEALTH INTO PRIMARY CARE

The PAHO launches a call to gather successful experiences in this field in the Americas region.

The top eight experiences will receive support to produce an extended report.

PARTICIPATION DEADLINE: June 12 - July 24, 2023

Washington, D.C., June 5, 2023 - The Pan American Health Organization (PAHO) is launching a call to gather successful experiences of integrating occupational health into primary care at the regional level in the Americas.

The purpose of this call is to systematize learnings and inspire the development of new initiatives based on successful experiences in this area.

Once all the experiences have been collected, three experts will evaluate the submitted proposals and select the top eight based on a set of established criteria. The authors of the winning experiences will be invited to participate in a webinar on the integration of occupational health into primary care. The submitted reports will serve as inputs for the development of a guide on integrating occupational health into primary care.

This call is part of the Plan of Action on Workers' Health 2015-2025, which aims to improve access and expand coverage of health services for workers in an integrated manner within national health systems, particularly primary care.

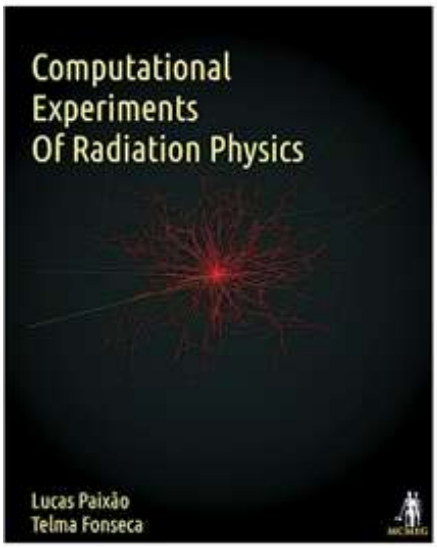
For more information, visit: https://campaigns.paho.org/t/y-e-ptukytk-dtdywvkd-j/

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REPROLAM COMPUTATIONAL SIMULATION GROUP COORDINATION



The book "Computational Experiments in Radiation Physics" by Lucas Paixão and Telma Fonseca, members of REPROLAM, aims to present computational tools for solving problems encountered in laboratory practices of nuclear instrumentation and radiological protection. The purpose of this book is to complement and enhance the didactic material used in teaching and research. The exercises have been developed to promote understanding of the physical phenomena studied in a Radiation Physics course or in a nuclear instrumentation laboratory.

In this way, students do not need advanced knowledge of the Monte Carlo code used.

However, it is expected that the professor using this material to teach a course, or the graduate or undergraduate student using it in their learning process, has a minimum level of knowledge, computational skills, and some experience with the Monte Carlo code used to conduct the experiments, even if they are a beginner.

The first experiment, "Radiation Emission Spectra," deals with simulating the emission of a radioactive source. The second experiment focuses on counting statistics and simulates a counting measurement of a radioactive sample. The third experiment studies the most important dosimetric quantities for describing radiation fields. The inverse square law is addressed in the fourth experiment, where its strictly geometric nature is studied. The fifth experiment is about the photon attenuation law, discussing its exponential behavior. In the sixth experiment, the variation of scattering is studied. The seventh experiment examines the concept of the fundamental dosimetric quantity, absorbed dose, in the practice of radiation dosimetry in radiotherapy. The discussion of charged particle interactions is covered in the eighth experiment, where an estimation of the range of electrons is proposed. Finally, the ninth experiment focuses on simulating a neutron source.

The book is available in both digital and print formats on Amazon. https://a.co/d/aV0lgDO

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The course **"Introduction to the Monte Carlo Method"** is part of the Extension Project - Monte Carlo Modelling Expert Group (MCMEG). It is an online course available for free.

The main focus of this course is to present computer modeling and simulation using the Monte Carlo method (MMC) in various areas such as Nuclear Engineering, Radiation Sciences, Medical Physics, and Radiological Protection.

You can access the course through the website:

https://sites.google.com/view/mcmeg-ufmg/

https://sites.google.com/view/mcmeg-ufmg/in%C3%ADcio/curso-introdu%C3%A7%C3%A3o-ao-m%C3%A9todo-de-monte-carlo?authuser= 0

The Network for Optimization of Occupational Radiological Protection in Latin America and the Caribbean (REPROLAM) is a non-profit, non-political, non-religious, and non-racial scientific and cultural society with an indefinite duration. Its main objective is to promote the optimization of occupational radiological protection. REPROLAM aims to enhance academic and scientific cooperation among its members to ensure adequate radiological protection for workers.

Please visit our website for more information: **http://www.reprolam.com/**
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