SCK•CEN
STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

Radiation Protection Dosimetry and Calibration

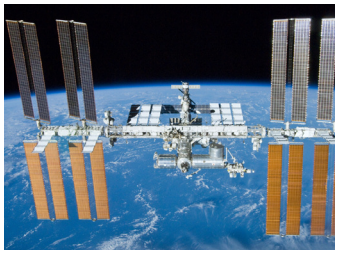
Background

The expert group Radiation Protection Dosimetry and Calibration (RDC) is conducting research and services related to the quantification and characterisation of radiation doses.

The main research lines are situated in the field of:
- Personal dosimetry and dosimetric techniques
- Medical dosimetric applications
- Space dosimetry
- Neutron dosimetry
- Retrospective dosimetry
- Internal dosimetry

We provide services for internal and external customers in the following fields:
- Personal and environmental dosimetry
- Anthropogammametry
- Nuclear (dosimetry) calibrations
- Instrumentation

Many of the activities of the laboratories are accredited by the Belgian accreditation organisation BELAC according to ISO 17025. The expert group has a solid expertise in thermoluminescence (TL) and optically stimulated luminescence (OSL) dosimetry techniques, and in Monte Carlo modelling techniques.



Objectives

The research and the services provided by the RDC expert group are strongly related to each other. Our research aims at the methodological development of radiation detection techniques for both external and internal exposures. We provide services for other SCK•CEN groups and for external customers. The maintenance of a strict quality assurance of our services in combination with the strong scientific background of the personnel is our main priority.

Main activities

The activities of the expert group Radiation Protection Dosimetry and Calibration comprise research and services.

RESEARCH

Personal dosimetry and dosimetric techniques

Personal dosimetry is a well-established field, where, however, constantly new developments are introduced. Our group is testing and improving several new techniques, and introduces them in practical applications. We focus on active personal dosemeters, thermoluminescent and optically stimulated luminescent detectors. For this last technique we have developed different read-out set-ups, to study several materials. Monte Carlo techniques are very important for dosimetric research. We have many years of experience in these techniques, using different codes for all types of radiation protection applications.

Medical dosimetric applications

Taking into account the increasing number and complexity of medical applications and the fast development of new techniques and equipment, there is an increasing radiation exposure for patients and medical staff. The dominant research activities are on measurement and simulation techniques, optimization of patient doses (also with respect to image quality), and on medical staff radiation protection. Special attention is given to the optimization of patient doses for the so-called high-dose procedures, like computed tomography and interventional procedures and for radiation sensitive groups, like paediatric patients.

In radiation therapy we focus on the determination of peripheral doses and on-line dosimetry, to improve quality assurance of the treatment and radioprotection of patients. We also take a close look to screening programmes, investigating the balance between dose and image quality for 2D mammography and innovative 3D techniques.

For exposure of medical staff, the focus is on optimizing the working procedures in the medical field with respect to radiation protection. It involves the improvement of our knowledge on extremity and eye lens exposures, combined with an optimization in the use of active personal dosemeters.

Space dosimetry
Living in space conditions is a challenge for future technology and science. An important aspect is the ionizing radiation present in space. Different programmes are established in collaboration with international expert groups, mainly focused around the DOBIES project (Dosimetry for Biological Experiments in Space). The dose is measured in different places in the International Space Station ISS to assess the dose by using a combination of dosimetric techniques.

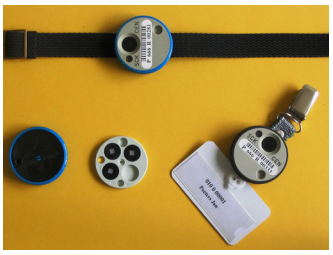
Neutron Dosimetry
Neutron dosimetry is still far less developed than gamma dosimetry. In the field of neutron dosimetry the applications go from nuclear power plants, particle accelerators, space dosimetry to radiation therapy. We are collaborating with different partners to characterize neutron fields in workplace situations. Also different available detector techniques are tested and characterized.

Retrospective dosimetry
Retrospective dosimetry is a technique which enables the after-the-fact determination of overexposure using common materials which are available in the public domain. Building materials such as brick and roof tiles include heated materials (ceramics) which can act as a dosemeter. Also personal objects can be very useful as fortuitous dosemeter in the case of a radiological incident. Telephone chip-cards, ID-cards, cellular phones, laptops and related items contain electronic components or modules which might be optically and/or thermally luminescent.

Internal dosimetry
The estimation of the dose obtained from an internal contamination is done by investigating the activity which is retained inside the body. This activity can be estimated by the direct measurement of the gamma rays emitted from inside the body or by indirect methods (e.g. activity in urine samples). In the anthropogammametry laboratory of SCK•CEN we focus on the improvement of the direct measurements. This can be done by using modular physical phantoms (varying in length and weight) and by use of Monte Carlo code to simulate different counting geometries for the calibration of the measurement setup. In this way we can reduce the uncertainty on the reported activity and as such reduce the uncertainty on the calculated internal dose.

SERVICES

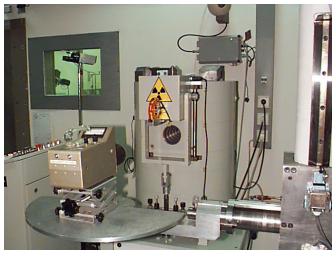
Personal and environmental dosimetry
Personal dosimetry is the monitoring of workers that are exposed to ionizing radiation, both in industry and hospitals. We offer different types of dosemeters, all based on the thermoluminescent detectors. Extremity dosimetry with ring dosemeters is of benefit when local exposures of the hands can be important. Environmental dosimetry has as primary interest the impact of "man-made" irradiation on the general public. We monitor the environmental radiation with passive measuring stations, again using thermoluminescent detectors.



Anthropogammametry
Direct measurement of the radiation emitted by the body or an organ provides a quick and convenient estimate of activity inside the body. In SCK•CEN's Anthropogammametry Laboratory people working in nuclear facilities are screened for internal contaminations. In routine we do whole body and lung measurements. We also have calibrated set-ups for wound and thyroid measurements in case of incidents.

Nuclear Calibrations
The Laboratory for Nuclear Calibrations (LNK) of the Belgian Nuclear Research Centre is the designated metrology laboratory in Belgium for the ionizing radiations, sub-field of dosimetry. LNK is member of the Belgian Metrology Network (BELMET) since 2012 and in 2013 also became member of EURAMET. LNK is member of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories (SSDL Network), as well.

LNK disposes of several radioactive sources for the calibration of a wide range of nuclear equipment, from personal dosemeters to survey monitors and radiation therapy ionization chambers. The available sources can also be used when irradiations with very precise doses or dose rates are needed for research purposes.



Instrumentation
The main task of this laboratory is the maintenance of SCK•CEN equipment. In addition, we perform repairs on other installations, equipment and measuring chains. The laboratory also installs new monitors and systems.

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