CCRI(I)/09-10
09 April 2009

Progress Report of the Department 'Radiation Protection Dosimetry'

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Pulsed radiation in radiation protection dosimetry

In the past decade the application of pulsed radiation fields has increased considerably. To give an example, currently nearly all radiation fields used for X-ray diagnostics in human and veterinary medicine or in dentistry, and fields produced by accelerators in therapy and science are pulsed. In addition, the use of active electronic dosemeters (AEDs) has also increased greatly. Even for legal radiation protection dosimetry, the radiation protection community has the intention of replacing in some fields the passive personal dosemeters with active (direct reading) dosemeters. Active electronic dosemeters, i.e. personal and also area dosemeters, have many advantages over passive dosemeters. But one disadvantage is that they are limited with respect to high dose rate measurements. This could be of concern in case of accidental exposure, if this is accompanied by high dose rates. Special care is required in pulsed fields, as these have always enhanced dose rates in the short pulse as compared to a continuous field leading to the same dose.

Any dosemeter, and thus also the AED, should measure the dose correctly in case of an accident or unexpected incident, which may result in higher than expected doses and may even exceed the dose limits. Passive dosemeters are capable of this. But is this also the case for AEDs?

To answer this question, which is closely linked to the PTB's task to type test dosemeters, appropriate reference fields are required. PTB is on the way to establish a special pulsed X-ray facility which can produced pulsed reference radiation fields with well known parameters like pulse duration, high voltage, dose rate in the pulse, which are all traceable to primary standards and can be adjusted independently. It is planned that this facility will be in operation in 2010.

Cooperation in the field of beta dosimetry of PTB and VNIIM

In 2007, the EUROMET comparison No. 739 (KCDB: EUROMET.R(I)-S2) for the unit of the absorbed dose rate in 0.07 mm tissue depth for beta radiation was finished. In this comparison, radiation fields of the radionuclides Sr-90/Y-90, Kr-85, Tl-204, and Pm-147 were compared by means of an ionisation chamber.
Eight laboratories participated in the comparison. The results are published: Behrens et al. 2007 Metrologia **44** 06003 (www.iop.org/EJ/abstract/0026-1394/44/1A/06003)

Following to this comparison an additional bilateral project between the PTB in Germany and the VNIIM in Russia will start in 2009 with the title: Cooperation in the field of beta dosimetry for measurements with the primary ionisation chambers of PTB and VNIIM in the reference fields of beta sources of VNIIM and PTB. This will be performed by an exchange of radioactive sources which is different to the EUROMET comparison finished in 2007.

Fifth EURADOS intercomparison of early warning network systems

The Physikalisch-Technische Bundesanstalt (PTB) has a unique combination of reference measuring sites for the dosimetry of natural environmental radiation (see progress report CCRI(I)/05-06).

As a consequence of the Chernobyl accident early warning systems have been installed in each EU member state to detect nuclear accidents with transboundary implications. The Working Group on Environmental Monitoring (WG 3) of the European Radiation Dosimetry Group (EURADOS) carried out up to now 4 international comparisons to test dosemeters of such early warning systems. The aim was to verify if the measuring results of the dosemeters and the early warning systems, respectively, are in agreement within given limits. Teams from eighteen European countries participated, some of them even several times The intercomparison comprised investigations on the energy and dose rate dependence of the dosemeter response on gamma radiation (investigated with ^{241}Am, ^{57}Co, ^{137}Cs ^{60}Co and ^{226}Ra sources) in an nearly radiation free environment (UDO laboratory in the Asse salt mine), the response to cosmic radiation determined on a swimming platform and the sensitivity of the dosemeter systems to small dose rate variations, similar to that caused by a bypassing radioactive cloud. The latter was studied under realistic free-field conditions by using a new free-field gamma ray irradiation facility. The comparison shows among others that some of the tested dosemeters included in European early warning network systems have not the capability to detect small changes of the dose rate. In addition, some of the detectors have a very high inherent background and most of the detector's readings show significant deviations from the correct dose rate values, due to improper calibrations. The only measuring quantity used in the last comparisons was the ambient dose equivalent rate, $\dot{H}^*(10)$.

A 5th intercomparison is planned for September 2009 and can hopefully be performed. As the future of the UDO laboratory in the Asse salt mine is under consideration at the moment, it is not sure that a 6th comparison will be possible in the near future.