

# PRESENT AND FUTURE ASPECTS OF HARMONISATION IN OFFICIAL AND OPERATIONAL PERSONAL DOSIMETRY

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## Abstract

New international standards in the field of personal dosimetry were set up in the recent years. Resulting requirements appointed in the national Radiation Protection Ordinance actuated the discussion about necessary developments and the future structure of the radiation protection surveillance.

The latest evolution of Electronic Personal Dosimeters (EPD) reaches a raised technical level fulfilling the new EC recommendations and the requirements for practical radiation protection in case of external exposure to ionising radiation. The Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany assigned the first type-approvals according to the new requirements for modern EPDs. In some European countries EPDs can already be applied as official dosimeter under certain conditions.

After characterising the present structure of radiation protection surveillance in Germany, proposals for the future developments in official Personal Dose Monitoring System will be discussed in this paper, taking into account the different demands, interests and aims of all the different parties hereto, namely the operators of the installations with their workers kept under surveillance, the government and competent authorities, the manufacturers of modern dosimetric systems and last but not least the official monitoring centres.

## Introduction

The new EURATOM "BASIC-SAFETY-STANDARDS" (Council Directive 96/29/ EURATOM) <sup>(1)</sup> for the protection of the health of workers and the general public against the dangers arising from ionising radiation were to be put into action in the EU member countries. Based on the IRCP-60 recommendations <sup>(2)</sup>, this directive introduced new radiological requirements to the official dosimetry. With the commencement of the new national radiological protection ordinance <sup>(3)</sup>, all provided official dosimeters have to fulfil the new radiological requirements within the national transition period, in particular lower dose limits for the population and occupational radiation exposed workers and dose constraints as well as new operational quantities "deep dose" Hp(10) and "shallow dose" Hp(0,07) for personal monitoring.

In addition, the new IEC 61526 standard <sup>(4)</sup> in Radiation Protection Instrumentation "Measurement of personal dose equivalents Hp(10) and Hp(0,07) for X- and  $\gamma$ -rays, beta and neutron radiation" especially for "Direct reading personal dose equivalent and/or dose equivalent rate dosimeters" suggests to check EPDs for their use as legally approved dosimeters.

In most countries, official dosimetry is carried out using passive dosimeters. But recently substantial efforts have been done in several European countries promising an introduction of EPDs in the official dosimetry in the near future. In some installations in France EPDs can already be applied for official dosimetry on condition of the use of a second dosimetric system whereas in Switzerland it is possible to use EPDs as exclusive legal dosimeters upon request. In UK, EPDs already have replaced passive detection systems as legally approved dosimeters in some specific workplaces <sup>(5)</sup>.

In Germany, EPDs are up to now used only for operational but not for legal personal dosimetry, which is performed using passive dosimeters such as film badges or solid-state detectors. However, recent improvements of performance and reliability of EPDs, as well as their interesting technical features and advantages over passive radiation detection systems inevitably lead to substantial discussions about the acceptance of EPDs for official personal dosimetry.

To find possibilities to apply EPDs for official personal dose monitoring in Germany, a pilot project is currently ongoing. With the collaboration of all involved decision-makers proposals for the inclusion of EPDs in the official dose monitoring are elaborated, reflecting the respective specific interests and demands. Even though the framework of state law and related guidelines does not exclude official use of EPDs, as an intermediate result of this project it is pointed up that binding interpretation of the wording of the laws is mandatory.

## **Present Situation of the German Personal Dose Monitoring**

### *Official Monitoring Service*

Based on the national Radiation Protection and X-ray Ordinance, in Germany the legal personal dosimetry is to be carried out by six accredited monitoring services, meeting the Guideline "Requirements for Personal monitoring services". Appointed by the competent authority according to the state law, these monitoring stations with different regional competence have to provide, distribute and evaluate suitable dosimeters for legal personal dosimetry. Whole-body doses are quantified by measuring the personal dose equivalents  $H_p(10)$  using personal dosimeters worn on the trunk of the body. To be determined as legal by the competent authority, the personal dosimeters have to have a PTB-type approval. Different well-established passive dosimeters are presently used for the official personal dosimetry.

### *Film dosimeter:*

The surveillance of occupational radiation exposed people is mainly carried out using different film badges. At present more than 320.000 film dosimeters are monthly distributed and evaluated by the official measuring centres in Germany. New developments enable the measurement of the effective dose  $H_p(10)$  with a maximum deviation smaller than the permissible overall measuring uncertainty using gliding shadow badges.

Even though the uncertainty of other systems might be slightly smaller, film badges are an excellent choice because they are low priced and intend to provide important information on the conditions of exposure to ionising radiation.

### *Solid-state Dosimeter:*

Besides the film badges, about 32.000 glass-dosimeters are in use to measure Personal Doses due to photon radiation. At last, thermoluminescence detectors are applied in the official personal dosimetry due to neutron radiation using ALBEDO dosimeters (about 5000) as well as in the official extremity dosimetry using different types of finger ring dosimeters (about 12.500).

### *Operational Personal Dosimetry*

Normally, operational personal dosimeters are distributed to the worker kept under surveillance and evaluated by the operator of the plant or installation.

In plants and other installations, operational dosimeters can be stipulated by the competent administrative authority in addition to and independent from the respective legal dosimeters. Recurring calibrations or control measurements are obligatory for those ordered secondary dosimeters. Particularly in NPPs, direct-reading operational dosimeters must be applied. For this purpose EPDs are in use.

## **Eligible requests for the innovation of personal dose monitoring**

Within the scope of the implementation of new standards and recommendations, substantial demands and requests reflecting the state of the art were raised for modern radiation protection.

Besides the adherence of international recommendations, the focus of government and authorities is the surveillance of the compliance of dose limits and to assure the official control of the national physical radiation protection.

Especially in installations with stipulated additional direct reading dosimeters the current situation of the official dose monitoring using passive detectors turned out to be unsatisfying. Because of possible differences between the promptly available operational doses using EPDs and the official doses provided by evaluating e.g. film dosimeters not until the following month, the main interest of the operators of NPPs is to legalise EPDs. Additionally, modern electronical dosimetry systems provide more reliably doses. Thus the use of EPDs would implicate better and cheaper radiation protection in NPPs.

The majority of international and national ordinances and guidelines traditionally are passed based on the supposition that official dosimetry can only be performed using passive dosimeters. Recent developments and improvements of active dosimetric systems were not taking into consideration. Thus, existing recommendations cannot be applied to modern EPDs in an unequivocal way. In order to develop and produce most modern and suitable dosimeters fast and economically, manufacturers shall be entitled to demand explicit and reliable specifications. The licensed monitoring services are officially mandated to provide suitable dosimeters and to ensure the routinely evaluation of the personal doses. They have to reconcile securing of the best possible protection of occupational radiation exposed workers and cost-

covering running of the measuring service. In order to meet their official mandate now and in the future, monitoring services should use state of the art technology and, forward looking, participate in technical progress.

### **Electronic Personal Dosimeter**

Currently, electronic dosimeters are predominantly used as a secondary dosimeter. However, continuous improvements in technique and data security led to modern EPDs, meeting the requirements for Personal Dosimeters according to the national Radiation Protection Ordinance and related guide-lines <sup>(6)</sup>. Several models of EPDs are already type tested as personal dosimeter by the PTB, and consequently showing their possibilities for official personal dosimetry. This potential is underlined by extensive experiences with EPDs gained in NPPs as well as in the NATO for many years.

In contrast to all passive detection systems, direct reading EPDs with alarm devices lead to dose reduction for monitored people and thus enable active and practical radiation protection. Information about dose and/or dose rate is available in real time. Acoustic personal warning signals allow immediate reaction in case of a sudden increase of the radiation exposure.

Compared to current available passive dosimetric systems, the occurrence of erroneous handling (not wearing in the control areas, exchanged assignment, etc.) or manipulation of EPDs appears to be negligible. Provided that suitable radiological properties are warranted by the type-approval, EPD systems would consequently provide comparative reliable personal doses.

### **Personal Dose Monitoring in the Future**

In the future, personal dose monitoring will undergo technical and structural changes, due to new legislation, harmonisation and liberalisation within the European Community as well as technological progress. The importance of innovation in personal dosimetry is underlined by founding the a EURADOS working group "Harmonisation of Individual Monitoring", funded by the European Commission in the fifth framework program and other participating institutes.

Next to established passive detectors modern active systems will increasingly play an important role in official personal dose monitoring. This innovation will be accompanied with new techniques of dose evaluation and data processing applied in the radiation protection surveillance. In NPPs and other installations, where direct reading operational dosimeters are required or reasonable, the application of official EPDs should be demanded. Ongoing developments of electronic dosimeters (EDs) will be pushed to meet also the request of modern and accurate systems measuring neutron or neutron/photon radiation fields. Additionally, EPDs providing detailed information about exposure condition, as it is possible evaluating film dosimeters, are in the stage of development.

For the future, wireless remote monitoring of people working outside or with open activities means a further evolution in the field of personal dosimetry. Specified workers could be kept under surveillance applying real-time dosimetry systems in online monitoring stations for both, photons and neutrons.

In addition, it is considered important to further pursue harmonisation along these lines by forming

### **Conclusion**

An increasing number of institutes as well as individuals kept under surveillance according the Radiation Protection and X-ray Ordinance demand a more transparent and reliable official personal dosimetry. As a matter of principle modern, EPDs are able to meet these requests.

In order to realise legal personal dosimetry using EPDs binding specifications and requirements are inevitable. Therefore, the existing ordinances and guidelines are to be interpreted in terms of legally used EPDs or upgraded in the case of need.

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