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Radiation Dosimetry Network

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Introduction

A collaborative framework of coordination for research in ionising radiation dosimetry has emerged from scientific groups engaged in the different framework programmes (FPs) of the European Commission. The European Radiation Dosimetry Group (EURADOS), conceived in 1981, has acquired the capabilities of coordination for the network of experts necessary to operate so that appropriate specialists groups can be formed in a timely manner to solve problems and promote research identified within EURADOS or upon request from external bodies. EURADOS has shown a special aptitude to contribute to the transfer of research and development issues and of scientific knowledge to a wide range of stakeholders in the use of ionising radiation and in radiation protection. The successive working groups set up during these periods and assigned with specific objectives have altogether contributed to:

- advance the scientific understanding of the dosimetry of ionising radiation;
- promote the technical development of dosimetric methods and instrumentation and their implementation in routine dosimetry;
- assist partners and stakeholders in achieving compatibility of dosimetric procedures used within the EU, and, in general, conformity to international practice; and
- stimulate collaboration and the dissemination of results between European laboratories and neighbouring associations.

The set-up of the present project conducted by EURADOS met a specific context:

- Following Council Directive 96/29/Euratom, the harmonisation of individual monitoring and dosimetry practices is necessary to achieve an equal protection for all occupationally exposed persons in Europe. This issue needs to be continuously assisted after the first initiative successfully carried out under the Fourth Framework Programme (FP4).
- Earlier actions revealed large discrepancies of results from environmental dosimetry systems. This fact complicates the management of situations with increased risk of exposure from a contaminated environment.
- The gathering of knowledge on cosmic radiation dosimetry in the last decade faced the Article 31 Group of Experts (Euratom Treaty) with new needs to validate the existing dose rate data in flight altitudes and provide sound basis for its recommendations.

Furthermore, coordination is essential in key areas of radiation protection dosimetry to periodically promote conferences, intercomparisons and other dissemination activities.

The potential for a lasting network structure and the resources necessary to continuously fulfil the needs of coordination in research and of scientific expertise in dosimetry – including requirements emerging from the EU enlargement – was investigated.

Objectives

The project directly contributed to achieve the objectives of the research and training programme in the field of nuclear energy (Fifth Euratom Framework Programme – Euratom FP5) aiming at developing and implementing a sound radiation protection policy which enables high protection levels to be achieved in practice.

Using the wide group of experts represented in EURADOS and the experience gained in the board to set up and coordinate targeted working groups, the following specific objectives were assigned for this 3-year period:

- to gather information of irradiation facilities and special laboratory equipments designed for dosimetry research which represent often unique and not always well-known resources existing in the EU, and to ensure the dissemination of this information;
- to form a group dealing with the harmonisation of individual monitoring in Europe and the information on new techniques in this field by continuing earlier initiatives with emphasis on practical implementation of individual monitoring and extended to representatives of new EU Member States and other countries from Central and Eastern Europe;
- to foster and improve the harmonisation of environmental radiation monitoring within Europe with the final aim that results reported by different countries facing a nuclear accident situation can be consistent and comparable;
- to bring together all experimental data and results of calculations on aircraft crew dosimetry, with detailed description of methods of measurement and calculation, in particular those used in European expert groups.

Overall, a major goal undertaken within the present project was to strengthen the board membership and operation, namely taking into account the enlargement of the EU achieved during the same period. A strategic objective was to prepare the ground of a lasting network structure. To this end active coordination was also supported in the areas of computational dosimetry, neutron dosimetry and quantitative assessment of internal exposure. Additional means were developed to ensure the appropriate dissemination of the project achievements.

Results

Within the present project, the membership of EURADOS increased from 31 to 50 European institutes and laboratories located in presently 24 different countries. Including 6 of the new Member States entering the EU in 2004, it is broadly representative of the EU and counts also 4 additional European countries (Bulgaria, Croatia, Serbia, and Ukraine).

The dissemination of information and results inside and outside the network was improved by combining several means. In addition to regular scientific papers and special issues published most often in *Radiation Protection Dosimetry*, the EURADOS website and the ERRS Newsletter (*European Research in Radiological Sciences*), co-edited with the European Late Effects Project group (EULEP), were implemented. Moreover, the EURADOS presentation leaflet was broadly distributed to members, correspondents, and at conference events.

The main results achieved in the working groups coordinated within this project include:

Facilities for dosimetry research

The *EURADOS Database of Dosimetry Research Facilities* was developed as an interactive database, storing brief facility portraits in a standardised format and being consultable and regularly updated via Internet. This relational database was first released on the Internet in spring 2003 (www.eurados-db.npl.co.uk). The information can be both updated and queried via World Wide Web interfaces. In this way

- researchers can find an easy-to-use interface with powerful search facilities to retrieve information on facilities and equipment suitable for their work;
- owners or operators of special research equipment and facilities are easily able to enter and update information to make it available to the community of dosimetry researchers.

Harmonisation of individual monitoring (IM) in Europe

The working group has been extended from 16 to 28 European countries, including the states integrated in the EU in 2004 and 6 countries from Central and Eastern Europe. The scope of the group was enlarged to include internal exposure issues and practical aspects of individual monitoring while considering the implementation of recent techniques.

The major result achieved by the working group is the report *Harmonisation of Individual Monitoring in Europe* [Radiat. Prot. Dosim., 112(1), 2004]. The report is gathering a comprehensive portrait of IM implementation in Europe presented in four topics:

- the review of different categories of documents relevant to the implementation of standards in IM with emphasis on their correspondence and their respective contributions;
- the cartography of European IM services regarding the methods used, their approval procedures, legal and technical requirements, and quality assurance in: personal dosimetry of external exposure; IM of internal exposure; exposure to radon and other natural sources;
- the implementation of active personal dose meters (APDs) which occupy a special place to date in IM of external exposure as complementary to passive dosimeters to satisfy the ALARA principle. The status of APD is actually differing from country to country;
- the level of quality control and reliability of reported doses actually achieved in IM appraised from the replies of 88 approved IM services.

Environmental radiation monitoring

The working group continued the action undertaken with the publication of the first technical recommendations [Radiat. Prot. Dosim., 92 1-3, 71-76, 2000] and the intercomparison exercise held in 1999 in Risø (Denmark). The specific achievements of the present period were the organisation of the second intercomparison exercise held at the Physikalisch-Technische Bundesanstalt (Braunschweig, Germany) in 2002 and the analysis and dissemination of the intercomparison's results.

The 2002 exercise welcomed five additional European countries. Overall 13 different countries were represented in the 1999 and 2002 campaigns (about 40 powered instruments and passive integrating dose meters, 12 European national network systems). In 2002, *in situ* gamma spectrometry systems more and more employed in environmental radiation monitoring could be included.

The progress recorded from 1999 to 2002 is already substantial for the harmonisation and improvement of the quantity used for reporting, the calibration and traceability to standards. The report of the 1999 intercomparison was published [Radiat. Prot. Dosim., 103, 3, 197-210, 2003]. The analysis of the 2002 intercomparison was achieved (published in 2005).

Aircraft crew dosimetry

In collaboration with the Directorate-General for Energy and Transport (DG TREN, EC, Luxembourg), EURADOS has replied to the demand of the Article 31 Group of Experts. The working group specially set up represented European groups engaged in dosimetry on board aircraft, with preferably published results. Canada was also represented. The progress was followed by observers of the Article 31 Group of Experts, the Central Joint Aviation Authority (JAA) and DG TREN.

The conclusions of the working group are summarised in the report *Cosmic radiation exposure of aircraft crew: compilation of measured and calculated data*, delivered to the Article 31 Group of Experts (EC catalogue number KO-63-04-690-EN-C, ISBN 92-894-8448-9). This report is providing further guidance to authorities as well as airlines concerned with exposure to cosmic radiation. It is based on the gathering of up to 10 500 ambient dose-equivalent measurements obtained from different groups in 13 institutions. The measurements are compared with calculations from 5 codes including EPCARD. It provides a first analysis of uncertainties reached in aircraft crew dose assessments.

In parallel to these four tasks, active coordination allowed achieving several complementary actions relevant to this field, leading to the following issues:

- the dissemination within the EURADOS experts and member institutes and also to a larger audience of the progress achieved within the QUADOS project (*Quality assurance of computational tools for dosimetry*, contract FIGD-CT2000-20062);
- the publication of the handbook *Neutron and Photon Spectrometry Techniques for Radiation Protection* [Radiat. Prot. Dosim., 107(1-3), 2003];
- the publication of the proceedings of the workshop *Neutron field spectrometry in science, technology and radiation protection – NEUSPEC 2000*, held in Pisa in June 2000 [Nuclear Instruments and Methods, 476(1-2), 2002];
- the issue and proceedings publication [Rad. Prot. Dosim. Vol. 110, 1-4, 2004] for the 9th symposium on neutron dosimetry, *Advances in Nuclear Particle Dosimetry for Radiation Protection and Medicine – NEUDOS 9*, held in Delft (the Netherlands);
- the organisation of annual board meetings including in 2004 the symposium *Biological and Physical Dosimetry for Radiation Protection* jointly organised with EULEP [Radiat. Prot. Dosim. 112, 4, 2004].

Implications

The benefits of a sustainable group were clearly confirmed. At the same time, selected working groups assigned with specific objectives were conducted while the necessary coordination was achieved in areas where new questions arise or which are partly covered in separate projects. In the future, the emphasis is put on the need to continuously perform a dynamic link between R&D and expertise and operational issues towards improved performance and compatibility of ionising radiation dosimetry practices throughout the EU.

An important achievement of the present project was also to meet the requirement of EU enlargement, which in turn increases the requirement of appropriate resources towards future activities.

The present project led to results which are available for use in future activities, including:

- reviews and comprehensive publication in open scientific journals; and
- three operational websites: www.eurados.org; www.euradnews.org; www.eurados-db.npl.co.uk.

The coordination carried out in this project targeted key areas of ionising radiation dosimetry. In particular a fundamental basis of ensuring reliable radiation protection is the provision of quality assurance in measurements. The quality of measurements in radiation protection dosimetry relies increasingly on the use of computational methods and on the extent to which a reliable uncertainty can be stated. Furthermore the areas of internal dosimetry and neutron dosimetry dealt with in different projects carried out in FP5 need further support and an integration framework.

The coordination of selected research activities will be carried out within the forthcoming Coordination Action CONRAD in FP6 (areas of computational dosimetry, internal dosimetry, complex field radiation dosimetry at workplaces, and radiation protection dosimetry of medical staff).

The interest of European institutions and services for the harmonisation of individual monitoring in Europe indicates a clear motivation for keeping a lasting working group linked to representatives of all EU Member States and other European countries that:

- maintains databases on regulations and on relevant and technical aspects of IM services
- evaluates developments in the field of dosimetry for radiation protection
- organises periodically intercomparisons of IM Services, workshops and training courses on dosimetry for radiation protection
- disseminates the findings in reports and publications in the open literature.

The present project ended with the setting-up of a dedicated workshop, *Individual Monitoring of Ionising Radiation – IM 2005*, held in Vienna in 2005 (im2005.healthphysics.at) and the perspective of an intercomparison of APD systems in collaboration with the IAEA.

In the area of environmental radiation monitoring, the target of further exercises would be to resolve remaining discrepancies, to guarantee a high quality of results and to enlarge progressively the participants group, in particular to involve more national early-warning networks in the process of harmonisation. With the earlier and the present project the basis for a lasting network exists, provided that two conditions are met:

- the support of a suitable infrastructure for the characterisation and intercomparison of environmental radiation monitoring systems;
- the support of a permanent network capable of coordinating the organisation of periodic exercises and carrying out their evaluation and dissemination.

The exposure to cosmic radiation during civil air flights is a typical application in which fostering research and expertise work and preserving effective coordination is important, in particular due to the complex radiation field unique in terms of both the range and particle types. The aircraft crew dosimetry working group achieved important conclusions:

- A very good agreement is observed between dose-equivalent measurements performed on board aircraft taking into account the large variety of instruments and methods used.
- The agreement between measured and calculated dose values validates most methods of calculation as conservative for compliance with radiation protection requirements.
- Uncertainties of calculated and measured values are within ICRP requirements.

A European cosmic radiation advisory group is thought worthwhile being formed. Such a group should in particular be able to provide dose assessments following solar particle events (SPE) – and update the estimates as necessary – and to present information to the national authorities and through these to airlines, unions, and the European public.