

EUROPEAN COMMISSION

nuclear science and technology

Development of fundamental data and recommendations for radiological protection (RAD PROT Fundamentals)

Contract N° FIR1-CT-1999-40002

Final report (summary)

Work performed as part of the European Atomic Energy Community's research and training programme in the field of nuclear energy 1998-2002 (Fifth Framework Programme)
Generic research in radiological sciences

2007

Directorate-General for Research
Euratom

Project coordinator

J. Valentin, ICRP, Sweden

Project partners

R. H. Clarke, National Radiological Protection Board, UK

L.-E. Holm, Swedish Radiation Protection Authority, Sweden

C. Streffer, University of Essen, Germany

J.-C. Nénot, Institut de radioprotection et de sûreté nucléaire, France

D. Cancio, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Spain

Introduction

The International Commission on Radiological Protection, ICRP, is a charitable, non-profit, international non-governmental advisory organisation. Its mission is to advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation. ICRP is the primary body in radiological protection, and the European Basic Safety Standards on ionising radiation are explicitly based on the recommendations of ICRP. Under the present contract, further recommendations and guidance are produced by ICRP.

Objectives

The aim of the project is to provide recommendations leading to an appropriate standard of radiological protection, without unduly limiting beneficial practices. They should continue to provide a scientific consensus for EU directives and a basis for rationalisation of the EU nuclear energy programme.

Targeted tasks aim at the production of scientific background reports as well as general recommendations on radiological protection. These targets can be classified as:

- Estimation of biological risks
- Physical and dosimetric modelling
- Access to reference anatomical and physiological information
- Relevant protection when radiation is used in a medical context
- Advice on the application of ICRP recommendations
- Fundamental ICRP recommendations at the start of the 21st century.

Estimation of biological risks. With regard to multifactor diseases, it is concluded that if anything, current risk estimates may be too high. Indeed, this may also be true for current estimates of total genetic risk. In the interim, the genetic risk estimates in ICRP Publication 60 are adequate since they are unlikely to underestimate the true risk.

The radiation weighting factors used at present will also require some amendment in the next fundamental ICRP recommendations, but in the interim, the values in ICRP Publication 60 should be used.

The mammalian embryo and foetus are very radiosensitive during prenatal development. Current recommendations to protect the embryo and foetus are regarded as adequate.

Physical and dosimetric modelling. The provision of data in the shape of the ICRP Databank of Dose Coefficients on CD-ROM has been extremely well received, indicating the importance of authoritative ICRP data.

Past experience is that bioassays and assessments of exposures to inhaled radionuclides can lead to rather differing estimates in different laboratories. The

guidance produced for the Human Respiratory Tract Model will improve the situation significantly.

Reference anatomical and physiological information. ‘Reference Man’, ICRP Publication 23, is still an important and highly valued tool, 29 years after its first printing. However, it is often inadequate in specific situations since it averages over sexes and ages and emphasises Caucasian (‘Western’) man. The provision of more detailed data as one of the results of the present projects solves most of these problems.

Protection when radiation is used in medicine. The response has been enormous to ICRP statements of a more topical nature, including pregnancy (lack of knowledge causes great anxiety and probably unnecessary termination of pregnancies), interventional radiology (many interventionists are unaware of the risk of serious injury or the simple methods to reduce this risk), radiotherapy (serious accidents will increase unless appropriate measures are taken), computed tomography (numbers and doses are increasing and need to be properly justified), information to patients (requires knowledge not only of medicine but also of radiation risks), and diagnostic reference levels (will improve the management of patient doses in medical imaging).

The provision of patient dose data for new radiopharmaceuticals is an indispensable part of the ICRP remit.

Advice on the application of ICRP recommendations. The international development of an explicit assessment framework is needed to determine or demonstrate whether or not non-human species are adequately protected from radiation under different circumstances. With the report produced during the present FP5 project, ICRP is taking the lead in this area.

This includes development of standards for the radiological protection of the environment, as well as for assessments of the effect on man of releases of radionuclides into the environment.

Fundamental ICRP Recommendations. A report on disposal of long-lived waste clarifies the difficult issues of radiological protection criteria and optimisation under the uncertainty imposed by the long time frames. Another report concerning prolonged exposures sets some important guidelines on when remediation against small doses is justified and when it is required, and discusses the existence of radiological and non-radiological reasons for action or non-action.

The process of generating a next set of fundamental recommendations, and the unprecedented level of openness and consultation at the conceptual stage, has been met with enormous public response. This has delayed the process considerably; at the same time, it has already led to quite significant improvements and is without a doubt worthwhile.

Methods. The reports of ICRP are based on review and evaluation of the scientific literature, assessment of consequences and analysis of the requirements of radiological protection, and synthesis of advice and recommendations. Most ICRP members are active and leading research workers in biology, physics, and medicine.

Thus, the members participate actively in generating the basic research data on which ICRP reports are based, although the actual ICRP work comprises review, analysis, and synthesis but not laboratory work. Some reports, notably those concerning dosimetry, do constitute basic data generation through computer-based modelling.

Results

Through this contract, ICRP has produced 14 printed reports with advice and recommendations on radiological protection, 2 CD-ROMs with data for radiological protection purposes, and 2 discussion papers. The topics covered are as follows:

Estimation of biological risks. (1) Risk estimation for multifactor disease (lower than feared at one time, i.e. existing recommendations provide sufficient protection); (2) biological effects after prenatal irradiation (when a female worker is known to be pregnant, it continues to be appropriate that a higher standard of protection against radiation is afforded to the conceptus); (3) relative biological effectiveness (RBE), quality factor (Q), and radiation weighting factor (w_R) (amended weighting factors are proposed, but not yet finally adopted, for protons and neutrons).

Physical and dosimetric modelling. (1) Doses to the embryo and foetus from intakes of radionuclides by the mother (uses new biokinetic and dosimetric models); (2) practical application of the ICRP Human Respiratory Tract Model (gives guidance on applying this model when using specific information – can give more reliable assessments of intake and/or dose than using reference values); (3) the ICRP database of dose coefficients on CD-ROM (two parts so far, covering workers and members of the public, and embryo and foetus; extends the database in printed reports considerably).

Access to reference anatomical and physiological information. Basic anatomical and physiological data for use in radiological protection (extends and amends the ‘Reference Man’ report from 1975 by using sex- and age-specific information when available and discussing differences between different populations; this will be important in many more areas than radiological protection).

Relevant protection when radiation is used in a medical context. (1) Radiation dose to patients from radiopharmaceuticals (an ongoing project where information about new radiopharmaceuticals is added when they appear); (2) pregnancy and medical radiation (lack of knowledge causes unfounded anxiety and probably unwarranted terminations of pregnancy – advice is given on minimising risks); (3) accident prevention and safety in radiotherapy (education and quality assurance as well as accident reporting are imperative to avoid increasing numbers of serious accidents); (4) avoiding injury in interventional radiology (non-specialists performing interventional radiology are often unaware of the potential for serious injury as well as the simple measures required to avoid injury); (5) managing patient dose in computed tomography (justification of use for particular kinds of patients and optimisation of protection are particularly important in this high-dose modality with increasing usage); (6) guidance for medical practitioners on information about radiation to patients and on diagnostic reference levels (‘FAQs’ are compiled and answered; the value of reference levels as tools in optimisation is explained).

Advice on the application of ICRP recommendations. A framework for assessing the impact of ionising radiation on non-human species (fills an important conceptual gap but does not reflect any particular concern over environmental radiation hazards).

Fundamental ICRP recommendations at the start of the 21st century. (1) Radiological protection aspects of disposal of long-lived solid radioactive waste (protection requirements are complied with if reasonable measures have been taken to satisfy a constraint for natural processes and to reduce the probability or consequences of inadvertent human intrusion); (2) protection of the public in situations of prolonged radiation exposure (addresses practices, interventions, and natural radiation sources, providing quantitative generic reference levels for interventions); (3) conceptual aspects of the next fundamental recommendations from ICRP (2 discussion papers published to encourage interaction between on the one hand the scientific and public communities and on the other hand ICRP in order to achieve recommendations in line with societal and scientific requirements).

In addition, through continued collaboration with OECD/NEA and IRPA and using the Internet, the entire radiological community worldwide has been engaged in thorough discussions about the next fundamental recommendations of ICRP.

Implications

ICRP recommendations and advice are published. Such printed reports is the direct result of the work of ICRP. The recommendations are also available in electronic format through our publisher's website.

Within Europe and in other industrialised countries, ICRP reports are readily available through libraries, in print, as electronic files, or both. Through collaboration with WHO, the electronic versions are available at no cost in the 69 poorest developing countries and at a discounted price in some 40 further countries.

In addition, ICRP has its own website presenting its work to the scientific community and the general public alike. Thus, dissemination of ICRP results is ensured.

European legislation such as the Basic Safety Standards Directive as well as national guidance are based on ICRP recommendations and much of the funding of ICRP comes from national radiological protection authorities. A similar situation exists outside Europe; the International Basic Safety Standards of the UN system are also based on ICRP recommendations. Thus, ICRP results will be properly exploited.