INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

ICRP REPORTS

ICRP was established in 1928 at the second International Congress of Radiology to respond to growing concerns about the effects of ionizing radiation being observed in the medical community. At the time it was called the International X-ray and Radium Protection Committee (IXRPC), but was restructured to better take account of uses of radiation outside the medical area and given its present name in 1950. Originally, ICRP published its recommendations and advice as papers in various scientific journals in the fields of medicine and physics. Since 1959, ICRP has its own series of publications, since 1977 in the shape of a scientific journal, Annals of the ICRP, now published by SAGE.

"This article contains the titles and summaries of various ICRP reports"

Publication No. 142

ICRP, 2019. Radiological protection from naturally occurring radioactive material (NORM) in industrial processes.

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

The purpose of this publication is to provide guidance on radiological protection in industries involving naturally occurring radioactive material (NORM). These industries may give rise to multiple hazards and the radiological hazard is not necessarily dominant. The industries are diverse and may involve exposure of people and the environment where protective actions need to be considered. In some cases, there is a potential for significant routine exposure of workers and members of the public if suitable control measures are not considered

Executive Summary

The 2007 Recommendations (ICRP, 2007) introduced changes that affect the calculation of effective dose, and implied a revision of the dose coefficients for internal exposure, published previously in the Publication 30 series (ICRP, 1979a,b, 1980a, 1981, 1988) and Publication 68 (ICRP, 1994b). In addition, new data are now available that support an update of the radionuclide-specific information given in Publications 54 and 78 (ICRP, 1989a, 1997) for the design of monitoring programmes and retrospective assessment of occupational internal doses. Provision of new biokinetic models, dose coefficients, monitoring methods, and bioassay data was performed by Committee 2 and its task groups.

A new series, the Occupational Intakes of Radionuclides (OIR) series, will replace the Publication 30 series and Publications 54, 68, and 78. OIR Part 1 (ICRP, 2015) describes the assessment of internal occupational exposure to radionuclides, biokinetic and dosimetric models, methods of individual and workplace monitoring, and general aspects of retrospective dose assessment.

Publication No. 140

ICRP, 2019. Radiological protection in therapy with radiopharmaceuticals.

Executive Summary

Radiopharmaceuticals are increasingly used for the treatment of various cancers with novel radionuclides, compounds, tracer molecules, and administration techniques. The goal of radiation therapy, including therapy with radiopharmaceuticals, is to optimise the relationship between tumour control probability and potential complications in normal organs and tissues. Essential to this optimisation is the ability to quantify the radiation doses delivered to both tumours and normal tissues. This publication provides an overview of therapeutic procedures and a framework for calculating radiation doses for various treatment approaches.

Executive Summary

In recent publications, such as Publications 117 and 120, the Commission provided practical advice for physicians and other healthcare personnel on measures to protect their patients and themselves during interventional procedures. These measures can only be effective if they are encompassed by a framework of radiological protection elements, and by the availability of professionals with responsibilities in radiological protection. This framework includes a radiological protection programme with a strategy for exposure monitoring, protective garments, education and training, and quality assurance of the programme implementation. Professionals with responsibilities in occupational radiological protection for interventional procedures include: medical physicists; radiological protection specialists; personnel working in dosimetry services; clinical applications support personnel from the suppliers and maintenance companies; staff engaged in training, standardisation of equipment, and procedures; staff responsible for occupational health; hospital administrators responsible for providing financial support; and professional bodies and regulators.

Executive Summary

Despite a longstanding recognition that radiological protection is not only a matter of science, but also ethics, ICRP publications have rarely addressed the ethical foundations of the system of radiological protection explicitly. The purpose of this publication is to describe how the Commission has relied on ethical values, either intentionally or indirectly, in developing the system of radiological protection with the objective of presenting a coherent view of how ethics is part of this system. In so doing, it helps to clarify the inherent value judgements made in achieving the aim of the radiological protection system as underlined by the Commission in Publication 103. Although primarily addressed to the radiological protection community, this publication is also intended to address authorities, operators, workers, medical professionals, patients, the public, and its representatives (e.g. NGOs) acting in the interest of the protection of people and the environment. This publication provides the key steps concerning the scientific, ethical, and practical evolutions of the system of radiological protection since the first ICRP publication in 1928. It then describes the four core ethical values underpinning the present system: beneficence/non-maleficence, prudence, justice, and dignity.

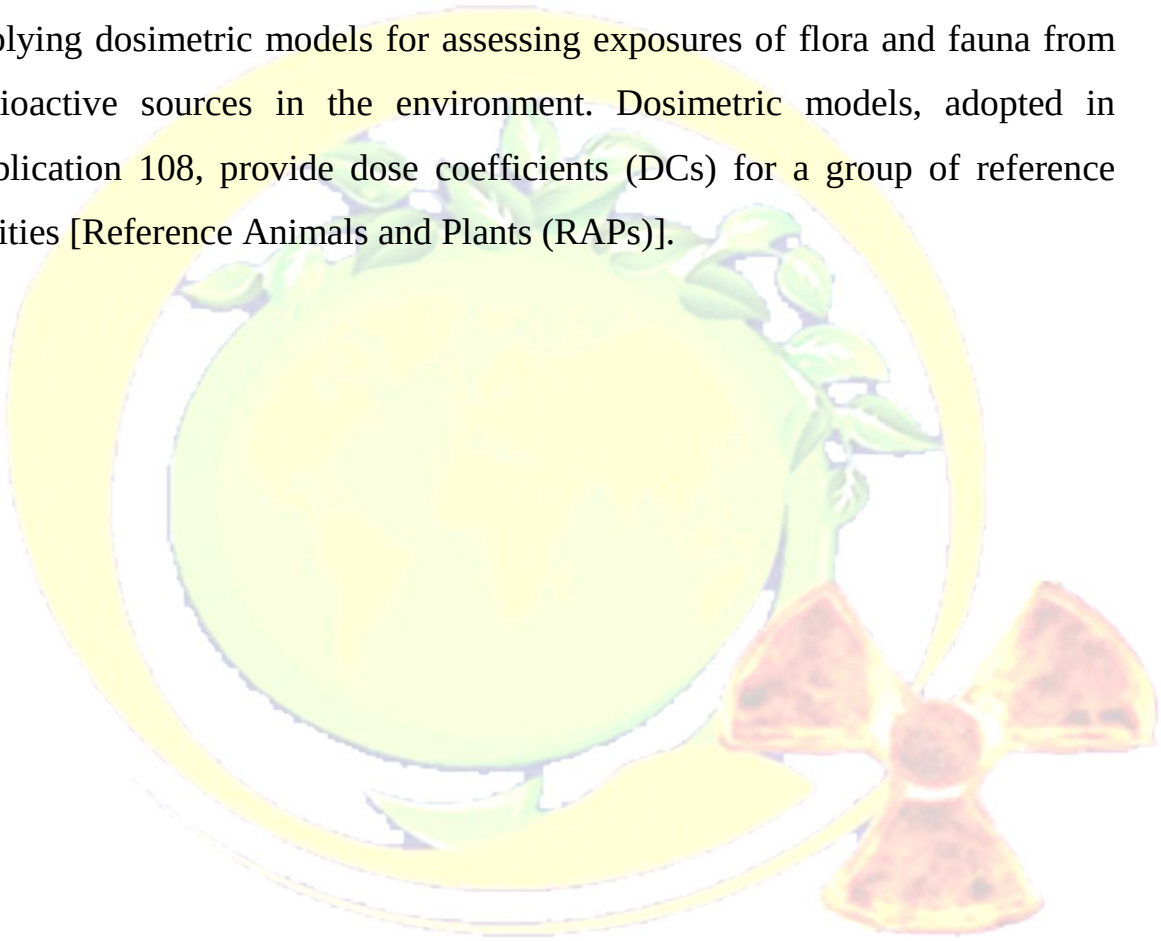
Publication No. 136

ICRP, 2017. Dose coefficients for nonhuman biota environmentally exposed to radiation.

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

The diversity of non-human biota is a specific challenge when developing and applying dosimetric models for assessing exposures of flora and fauna from radioactive sources in the environment. Dosimetric models, adopted in Publication 108, provide dose coefficients (DCs) for a group of reference entities [Reference Animals and Plants (RAPs)].



Executive Summary

The International Commission on Radiological Protection (ICRP) first introduced the term 'diagnostic reference level' (DRL) in 1996 in Publication 73. The concept was subsequently developed further, and practical guidance was provided in 2001. The DRL has been proven to be an effective tool that aids in optimisation of protection in the medical exposure of patients for diagnostic and interventional procedures. However, with time, it has become evident that additional advice is needed. There are issues related to definitions of the terms used in previous guidance, determination of the values for DRLs, the appropriate interval for reevaluating and updating these values, appropriate use of DRLs in clinical practice, methods for practical application of DRLs, and application of the DRL concept to newer imaging technologies. This publication is intended as a further source of information and guidance on these issues. Some terminology has been clarified. In addition, this publication recommends quantities for use as DRLs for various imaging modalities, and provides information on the use of DRLs for interventional procedures and in paediatric imaging. It suggests modifications in the conduct of DRL surveys that take advantage of automated reporting of radiation-dose-related uantities, and highlights the importance of including information on DRLs in training programmes for healthcare workers.

Publication No. 133

ICRP, 2016. The ICRP computational framework for internal dose assessment for reference adults: specific absorbed fractions.

Executive Summary

Dose coefficients for assessment of internal exposures to radionuclides are radiological protection quantities giving either the organ equivalent dose or effective dose per intake of radionuclide following ingestion or inhalation. This series of publications replaces Publications 30 and 68 (ICRP, 1979, 1980, 1981, 1988, 1994b). In addition, other fundamental data needed for computation of the dose coefficients are radionuclide decay data (energies and yields of emitted radiations), which are given in Publication 107 (ICRP, 2008), and specific absorbed fraction (SAF) values – defined as the fraction of the particle energy emitted in a source tissue region that is deposited in a target tissue region per mass of target tissue. This publication provides the technical basis for SAFs relevant to internalised radionuclide activity in the organs of Reference Adult Male and Reference Adult Female as defined in Publications 89 and 110 (ICRP, 2002, 2009). SAFs are given for uniform distributions of mono-energetic photons, electrons, alpha particles, and fission-spectrum neutrons over a range of relevant energies. Electron SAFs include both collision and radiative components of energy deposition. SAF data are matched to source and target organs of the biokinetic models of the OIR publication series, as well as the Publication 100 (ICRP, 2006) Human Alimentary Tract Model and the Publication 66 (ICRP, 1994a) Human Respiratory Tract Model, the latter as revised within Publication 130 (ICRP, 2015).

Executive Summary

In this publication, the International Commission on Radiological Protection (ICRP) provides updated guidance on radiological protection from cosmic radiation in aviation, taking into account the current ICRP system of radiological protection, the latest available data on exposures in aviation, and experience gained worldwide in the management of exposures in aviation. The publication describes the origins of cosmic radiation, how it exposes passengers and aircraft crew, the basic radiological protection principles that apply to this existing exposure situation, and the available protective actions. For implementation of the optimisation principle, the Commission recommends a graded approach proportionate to the level of exposure that may be received by individuals. The objective is to keep the exposure of the most exposed individuals to a reasonable level. The Commission also recommends that information be disseminated to raise awareness about cosmic radiation, and to support informed decisions among concerned stakeholders.

Publication No. 129

ICRP, 2015. Radiological Protection in Cone Beam Computed Tomography (CBCT)

Executive Summary

The objective of this publication is to provide guidance on radiological protection in the new technology of cone beam computed tomography (CBCT).

Publications 87 and 102 dealt with patient dose management in computed tomography (CT) and multi-detector CT. The new applications of CBCT and the associated radiological protection issues are substantially different from those of conventional CT. The perception that CBCT involves lower doses was only true in initial applications. CBCT is now used widely by specialists who have little or no training in radiological protection. This publication provides recommendations on radiation dose management directed at different stakeholders, and covers principles of radiological protection, training, and quality assurance aspects. Advice on appropriate use of CBCT needs to be made widely available. Advice on optimisation of protection when using CBCT equipment needs to be strengthened, particularly with respect to the use of newer features of the equipment. Manufacturers should standardise radiation dose displays on CBCT equipment to assist users in optimisation of protection and comparisons of performance. Additional challenges to radiological protection are introduced when CBCT-capable equipment is used for both fluoroscopy and tomography during the same procedure. Standardised methods need to be established for tracking and reporting of patient radiation doses from these procedures.

Executive Summary

This report provides a compendium of current information relating to radiation dose to patients, including biokinetic models, biokinetic data, dose coefficients for organ and tissue absorbed doses, and effective dose for major radiopharmaceuticals based on the radiation protection guidance given in Publication 60 (ICRP, 1991). These data were mainly compiled from Publications 53, 80, and 106 (ICRP, 1987, 1998, 2008), and related amendments and corrections. This report also includes new information for 82 Rb-chloride, iodide (123 I, 124 I, 125 I, and 131 I) and 123 Ilabelled 2.-carbomethoxy 3.-(4-iodophenyl)-N-(3-fluoropropyl) nortropane (FPCIT).

The coefficients tabulated in this publication will be superseded in due course by values calculated using new International Commission on Radiation Units and Measurements/International Commission on Radiological Protection adult and paediatric reference phantoms and Publication 103 methodology (ICRP, 2007). The data presented in this report are intended for diagnostic nuclear medicine and not for therapeutic applications.

Executive Summary

The goal of external-beam radiotherapy is to provide precise dose localisation in the treatment volume of the target with minimal damage to the surrounding normal tissue. Ion beams, such as protons and carbon ions, provide excellent dose distributions due primarily to their finite range, allowing a significant reduction of undesired exposure of normal tissue. Careful treatment planning is required for the given type and localisation of the tumour to be treated in order to maximise treatment efficiency and minimise the dose to normal tissue. Radiation exposure in outof-field volumes arises from secondary neutrons and photons, particle fragments, and photons from activated materials. These unavoidable doses should be considered from the standpoint of radiological protection of the patient.

Executive Summary

In this report, the Commission provides updated guidance on radiological protection against radon exposure. The report has been developed considering the latest ICRP recommendations for the system of radiological protection, all available scientific knowledge about the risks of radon, and the experience gained by many organisations and countries in the control of radon exposure. The report describes the characteristics of radon exposure, covering sources and transfer mechanisms, the health risks associated with radon, and the challenges of managing radon exposure.

The Commission recommends an integrated approach for controlling radon exposure, relying as far as possible on the management of buildings or locations in which radon exposure occurs, whatever the use of the building. This approach is based on the optimisation principle, and is graded reflecting the responsibilities of key stakeholders, notably in workplaces, and the intent of the national authorities to control radon exposure. The report also provides recommendations on managing radon exposure when workers' exposures are considered as occupational, and the appropriate requirements of the Commission should be applied.

ICRP
INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

The use of technologies to provide security screening for individuals and objects has been increasing rapidly, in keeping with the significant increase in security concerns worldwide. Within the spectrum of technologies, the use of ionising radiation to provide backscatter and transmission screening capabilities has also increased. The Commission has previously made a number of statements related to the general topic of deliberate exposures of individuals in non-medical settings.

This report provides advice on how the radiological protection principles recommended by the Commission should be applied within the context of security screening.

Executive Summary

In this report, the Commission describes its framework for protection of the environment and how it should be applied within the Commission's system of protection. The report expands upon its objectives in relation to protection of the environment, in so far as it relates to the protection of animals and plants (biota) in their natural environment, and how these can be met by the use of Reference Animals and Plants (RAPs); their Derived Consideration Reference Levels (DCRLs), which relate radiation effects to doses over and above their normal local background natural radiation levels; and different potential pathways of exposure. The report explains the different types of exposure situations to which its recommendations apply; the key principles that are relevant to protection of the environment; and hence how reference values based on the use of DCRLs can be used to inform on the appropriate level of effort relevant to different exposure situations. Further recommendations are made with regard to how the Commission's recommendations can be implemented to satisfy different forms of environmental protection objectives, which may require the use of representative organisms specific to a site, and how these may be compared with the reference values.

Publication No. 122

ICRP, 2013. Radiological protection in geological disposal of long-lived solid radioactive waste

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report updates and consolidates previous recommendations of the International Commission on Radiological Protection (ICRP) related to solid waste disposal. The recommendations given apply specifically to geological disposal of long-lived solid radioactive waste. The report explains how the ICRP system of radiological protection described in Publication 103 can be applied in the context of the geological disposal of long-lived solid radioactive waste. Although the report is written as a standalone document, previous ICRP recommendations not dealt with in depth in the report are still valid.

Publication No. 121

ICRP, 2013. Radiological protection in paediatric diagnostic and interventional radiology

Executive Summary

Paediatric patients have a higher average risk of developing cancer compared with adults receiving the same dose. The longer life expectancy in children allows more time for any harmful effects of radiation to manifest, and developing organs and tissues are more sensitive to the effects of radiation. This publication aims to provide guiding principles of radiological protection for referring clinicians and clinical staff performing diagnostic imaging and interventional procedures for paediatric patients. It begins with a brief description of the basic concepts of radiological protection, followed by the general aspects of radiological protection, including principles of justification and optimisation. Guidelines and suggestions for radiological protection in specific modalities – radiography and fluoroscopy, interventional radiology, and computed tomography – are subsequently covered in depth. The report concludes with a summary and recommendations.

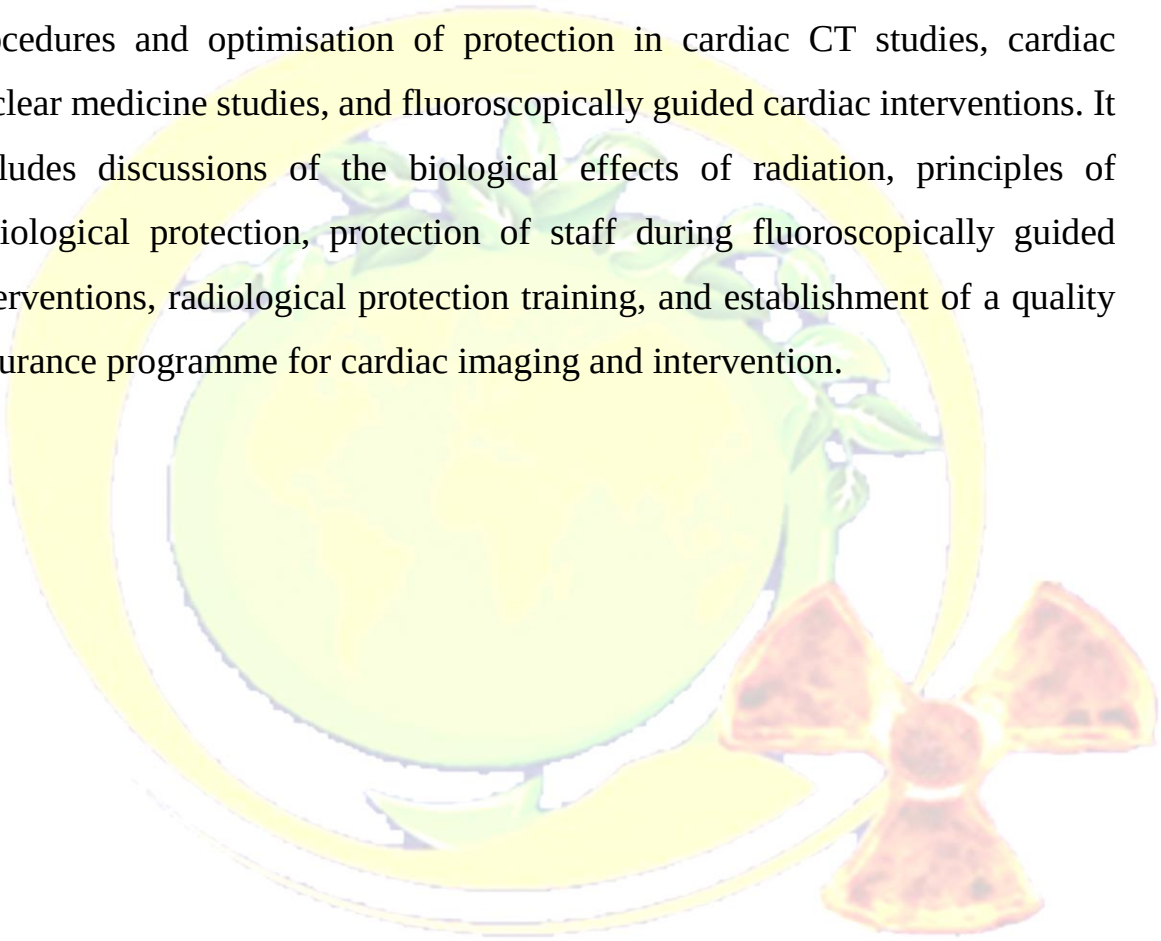
Publication No. 120

ICRP, 2013. Radiological protection in cardiology

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report provides guidance to assist the cardiologist with justification procedures and optimisation of protection in cardiac CT studies, cardiac nuclear medicine studies, and fluoroscopically guided cardiac interventions. It includes discussions of the biological effects of radiation, principles of radiological protection, protection of staff during fluoroscopically guided interventions, radiological protection training, and establishment of a quality assurance programme for cardiac imaging and intervention.



Executive Summary

This report provides a review of early and late effects of radiation in normal tissues and organs with respect to radiation protection. It was instigated following a recommendation in Publication 103, and it provides updated estimates of 'practical' threshold doses for tissue injury defined at the level of 1% incidence. Estimates are given for morbidity and mortality endpoints in all organ systems following acute, fractionated, or chronic exposure. The organ systems comprise the haematopoietic, immune, reproductive, circulatory, respiratory, musculoskeletal, endocrine, and nervous systems; the digestive and urinary tracts; the skin; and the eye.

Executive Summary

This report emphasises that patient dose monitoring is essential whenever fluoroscopy is used.

It is recommended that manufacturers should develop systems to indicate patient dose indices with the possibility of producing patient dose reports that can be transferred to the hospital network, and shielding screens that can be effectively used for the protection of workers using fluoroscopy machines in operating theatres without hindering the clinical task.

Publication No. 116

ICRP, 2010. Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report gives fluence to dose conversion coefficients for both effective dose and organ absorbed doses for various types of external exposures, consistent with the 2007 Recommendations of the ICRP. These coefficients were calculated using the official ICRP/ICRU computational phantoms representing the Reference Adult Male and Reference Adult Female, in conjunction with Monte Carlo codes simulating the transport of radiation within the human body such as EGSnrc, FLUKA, GEANT4, MCNPX, and PHITS.

Publication No. 115

ICRP, 2010. Lung Cancer Risk from Radon and Progeny and Statement on Radon

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

ICRP Publication 65 recommended that doses from radon and its progeny should be calculated using a dose conversion convention based on epidemiological data. It is now concluded that radon and its progeny should be treated in the same way as other radionuclides within the ICRP system of protection; that is, doses from radon and radon progeny should be calculated using ICRP biokinetic and dosimetric models. ICRP will provide dose coefficients per unit exposure to radon and radon progeny for different reference conditions of domestic and occupational exposure, with specified equilibrium factors and aerosol characteristics.

Executive Summary

It is intended that the Commission's approach to protection of the environment be applied to all exposure situations. In some situations, the relevant radionuclide concentrations can be measured directly, but this is not always possible or feasible. In such cases, modelling techniques are used to estimate the radionuclide concentrations. This report is an initial step in addressing the needs of such modelling techniques.

After briefly reviewing the basic factors relating to the accumulation of radionuclides by different types of biota, in different habitats, and at different stages in the life cycle, this report focuses on the approaches used to model the transfer of radionuclides through the environment. It concludes that equilibrium concentration ratios (CRs) are most commonly used to model such transfers, and that they currently offer the most comprehensive data coverage.

The report also reviews the methods used to derive CRs, and describes a means of summarising statistical information from empirical data sets. Emphasis has been placed on using data from field studies, although some data from laboratory experiments have been included for some RAPs.

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Executive Summary

The number of diagnostic and interventional medical procedures using ionising radiations is rising steadily, and procedures resulting in higher patient and staff doses are being performed more frequently. As such, the need for education and training of medical staff (including medical students) and other healthcare professionals in the principles of radiation protection is even more compelling than in the past.

The Commission has made basic recommendations for such education and training of these individuals in ICRP Publications 103 and 105 (ICRP, 2007a,b). The present publication expands considerably on these basic recommendations with regard to various categories of medical practitioners and other healthcare professionals who perform or provide support for diagnostic and interventional procedures utilising ionising radiation and nuclear medicine therapy.

Executive Summary

In this report, the Commission provides guidance for the protection of people living in long-term contaminated areas resulting from either a nuclear accident or a radiation emergency. The report considers the effects of such events on the affected population. This includes the pathways of human exposure, the types of exposed populations, and the characteristics of exposures. Although the focus is on radiation protection considerations, the report also recognises the complexity of post-accident situations, which cannot be managed without addressing all the affected domains of daily life, i.e. environmental, health, economic, social, psychological, cultural, ethical, political, etc. The report explains how the 2007 Recommendations apply to this type of existing exposure situation, including consideration of the justification and optimisation of protection strategies, and the introduction and application of a reference level to drive the optimisation process. The report also considers practical aspects of the implementation of protection strategies, both by authorities and the affected population.

Publication No. 110

ICRP, 2009. Adult Reference Computational Phantoms

Executive Summary

This report describes the development and intended use of the computational phantoms of the Reference Male and Reference Female. In its 2007 Recommendations, ICRP adopted these computational phantoms for forthcoming updates of organ dose coefficients for both internal and external radiation sources (ICRP, 2007). The phantoms are based on medical image data of real people, yet are consistent with the data given in Publication 89 (ICRP, 2002) on the reference anatomical and physiological parameters for both male and female subjects. The reference phantoms are constructed after modifying the voxel models (Golem and Laura) of two individuals whose body height and mass resembled the reference data. The organ masses of both models were adjusted to the ICRP data on the adult Reference Male and Reference Female, without compromising their anatomic realism. This report describes the methods used for this process and the characteristics of the resulting computational phantoms.

Publication No. 109

ICRP, 2009. Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report was prepared to provide advice on the application of the Commission's 2007 Recommendations. The advice includes the preparedness for, and response to, all radiation emergency exposure situations defined as: 'situations that may occur during the operation of a planned situation, or from a malicious act, or from any other unexpected situation and require urgent action in order to avoid or reduce undesirable consequences'. An emergency exposure situation may evolve, in time, into an existing exposure situation. The Commission's advice for these types

of situation is published in two complementary documents (that for emergency exposure situations in this report, that for existing exposure situations following emergency exposure situations in a forthcoming report entitled 'Application of the Commission's recommendations to the protection of individuals living in long-term contaminated territories after a nuclear accident or a radiation emergency').

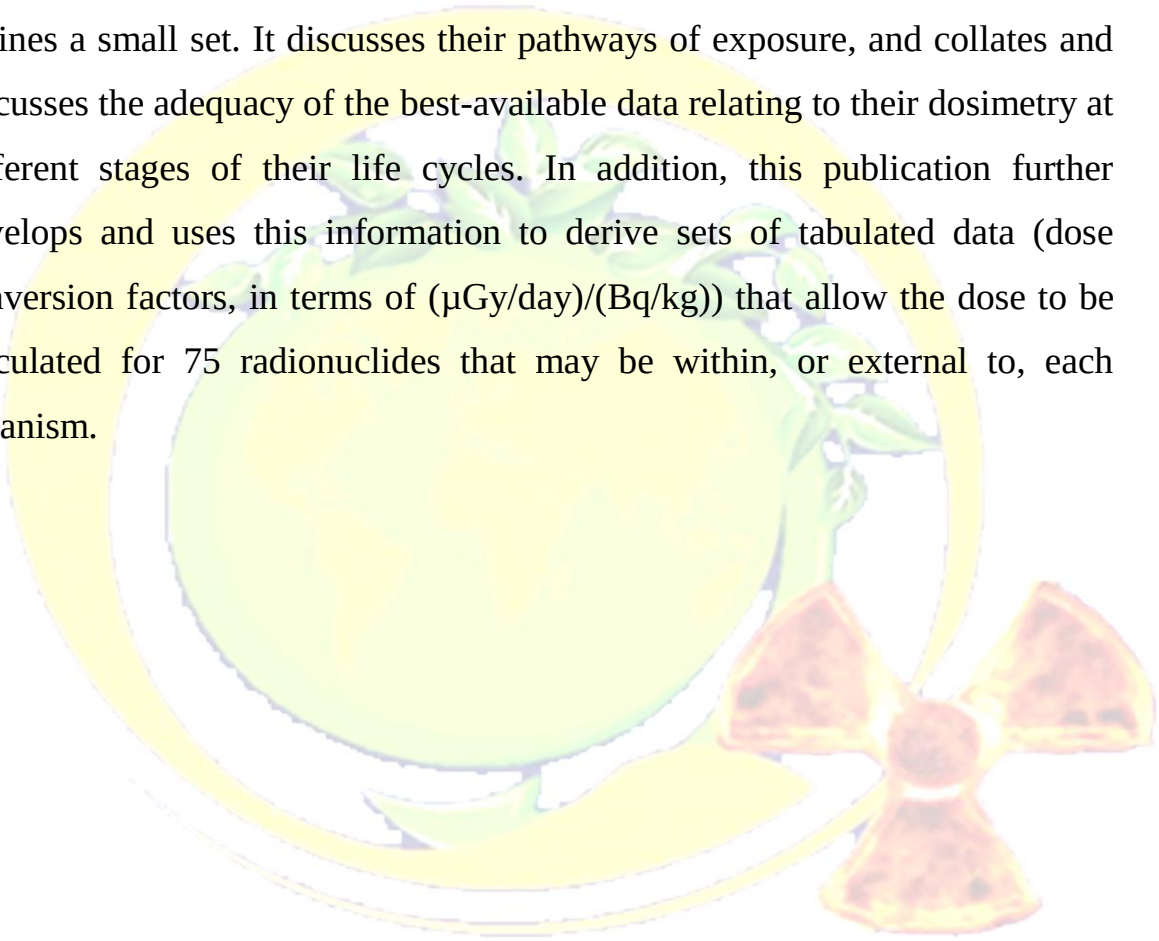
Publication No. 108

ICRP, 2008. Environmental Protection - the Concept and Use of Reference Animals and Plants

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This publication introduces the concept of Reference Animals and Plants, and defines a small set. It discusses their pathways of exposure, and collates and discusses the adequacy of the best-available data relating to their dosimetry at different stages of their life cycles. In addition, this publication further develops and uses this information to derive sets of tabulated data (dose conversion factors, in terms of (μGy/day)/(Bq/kg)) that allow the dose to be calculated for 75 radionuclides that may be within, or external to, each organism.



Executive Summary

In this report, the Commission provides an electronic database of the physical data needed in calculations of radionuclide-specific protection and operational quantities. This database supersedes the data of Publication 38 (ICRP, 1983), and will be used in future ICRP publications of dose coefficients for the intake of or exposure to radionuclides in the workplace and the environment.

The database contains information on the half-lives, decay chains, and yields and energies of radiations emitted in nuclear transformations of 1252 radionuclides of 97 elements. The CD accompanying the publication provides electronic access to complete tables of the emitted radiations, as well as the beta and neutron spectra. The database has been constructed such that user-developed software can extract the data needed for further calculations of a radionuclide of interest. A Windows-based application is provided to display summary information on a user-specified radionuclide, as well as the general characterisation of the nuclides contained in the database. In addition, the application provides a means by which the user can export the emissions of a specified radionuclide for use in subsequent calculations.

Publication No. 105

ICRP, 2007. Radiological Protection in Medicine

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report was prepared to underpin the Commission's 2007 Recommendations with regard to the medical exposure of patients, including their comforters and carers, and volunteers in biomedical research. It addresses the proper application of the fundamental principles (justification, optimisation of protection, and application of dose limits) of the Commission's 2007 Recommendations to these individuals.

Executive Summary

In this report, the Commission recommends approaches to national authorities for their definition of the scope of radiological protection control measures through regulations, by using its principles of justification and optimisation. The report provides advice for deciding the radiation exposure situations that should be covered by the relevant regulations because their regulatory control can be justified, and, conversely, those that may be considered for exclusion from the regulations because their regulatory control is deemed to be unamenable and unjustified. It also provides advice on the situations resulting from regulated circumstances but which may be considered by regulators for exemption from complying with specific requirements because the application of these requirements is unwarranted and exemption is the optimum option. Thus, the report describes exclusion criteria for defining the scope of radiological protection regulations, exemption criteria for planned exposure situations, and the application of these concepts in emergency exposure situations and in existing exposure situations. The report also addresses specific exposure situations such as exposure to low-energy or low-intensity adventitious radiation, cosmic radiation, naturally occurring radioactive materials, radon, commodities, and low-level radioactive waste.

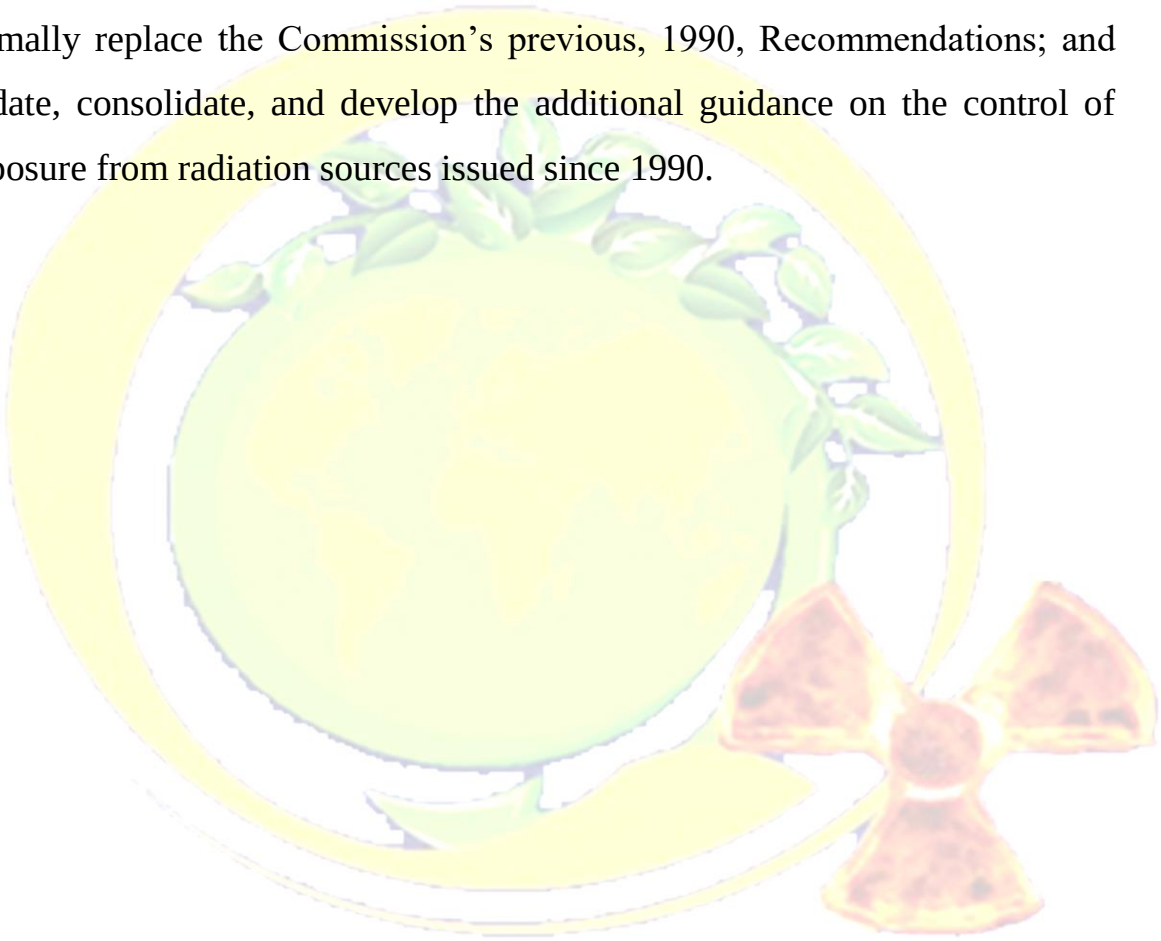
Publication No. 103

ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

These revised Recommendations for a System of Radiological Protection formally replace the Commission's previous, 1990, Recommendations; and update, consolidate, and develop the additional guidance on the control of exposure from radiation sources issued since 1990.



Executive Summary

Computed tomography (CT) technology has changed considerably in recent years with the introduction of increasing numbers of multiple detector arrays. There are several parameters specific to multi-detector computed tomography (MDCT) scanners that increase or decrease patient dose systematically compared to older single detector computed tomography (SDCT) scanners. This document briefly reviews the MDCT technology, radiation dose in MDCT, including differences from SDCT and factors that affect dose, radiation risks, and the responsibilities for patient dose management. The document recommends that users need to understand the relationship between patient dose and image quality and be aware that image quality in CT is often higher than that necessary for diagnostic confidence. Automatic exposure control (AEC) does not totally free the operator from selection of scan parameters, and awareness of individual systems is important. Scanning protocols cannot simply be transferred between scanners from different manufacturers and should be determined for each MDCT. If the image quality is appropriately specified by the user, and suited to the clinical task, there will be a reduction in patient dose for most patients. Understanding of some parameters is not intuitive and the selection of image quality parameter values in AEC systems is not straightforward.

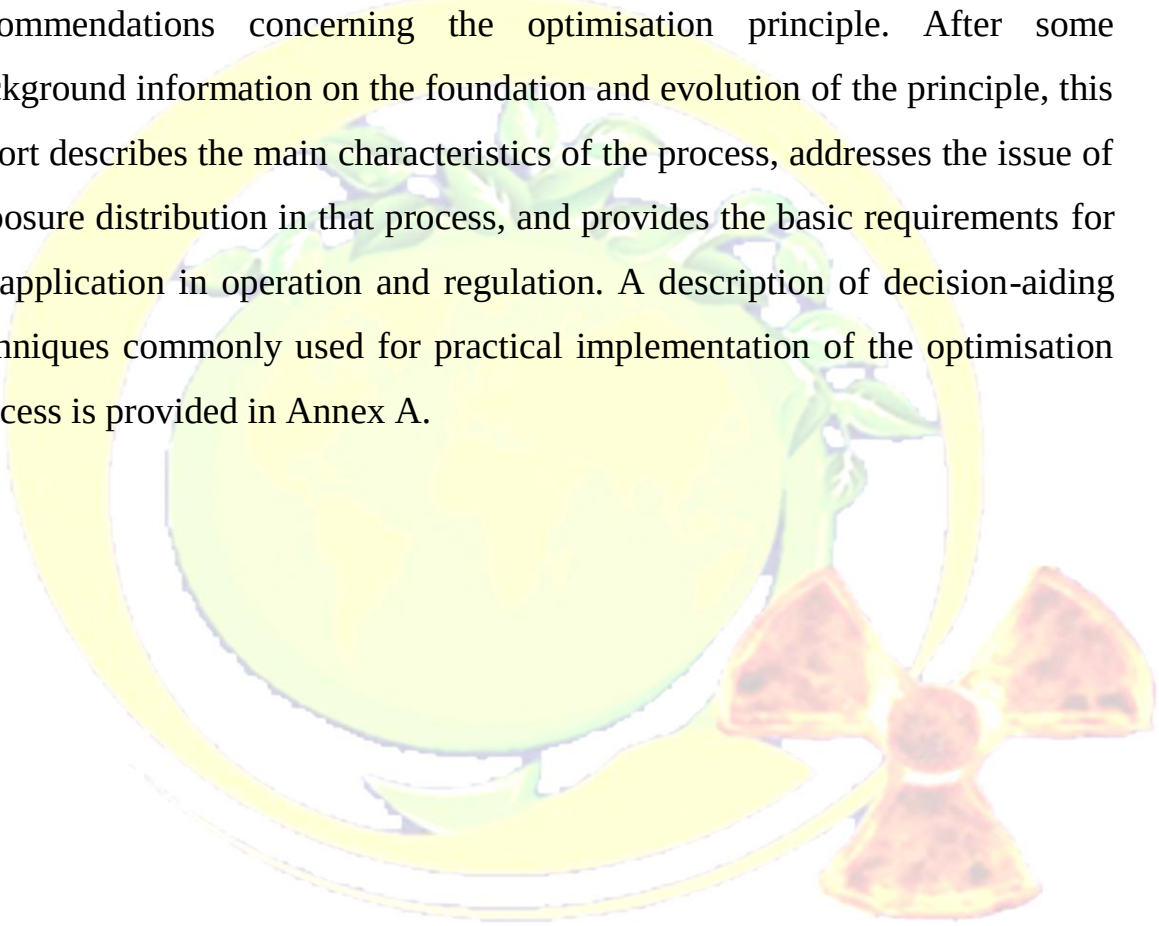
Publication No. 101B

ICRP, 2006. The Optimisation of Radiological Protection - Broadening the Process

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report is a consolidation and an evolution of the Commission's recommendations concerning the optimisation principle. After some background information on the foundation and evolution of the principle, this report describes the main characteristics of the process, addresses the issue of exposure distribution in that process, and provides the basic requirements for its application in operation and regulation. A description of decision-aiding techniques commonly used for practical implementation of the optimisation process is provided in Annex A.



Publication No. 101A

ICRP, 2006. Assessing Dose of the Representative Person for the Purpose of the Radiation Protection of the Public

Executive Summary

This report explains the process of estimating annual dose and recognises that a number of different methods are available for this purpose. These methods range from deterministic calculations to more complex probabilistic techniques. In addition, a mixture of these techniques may be applied. In selecting characteristics of the representative person, three important concepts should be borne in mind: reasonableness, sustainability, and homogeneity. Each concept is explained and examples are provided to illustrate their roles. Doses to the public are prospective (may occur in the future) or retrospective (occurred in the past). Prospective doses are for hypothetical individuals who may or may not exist in the future, while retrospective doses are generally calculated for specific individuals.

Publication No. 99

ICRP, 2005. Low-dose Extrapolation of Radiation-related Cancer Risk

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report considers the evidence relating to cancer risk associated with exposure to low doses of low linear energy transfer radiation, and particularly doses below current recommended limits for protection of radiation workers and the general public. The focus is on evidence regarding linearity of the dose–response relationship for all cancers considered as a group, but not necessarily individually, at low doses [the so-called linear, non-threshold (LNT) hypothesis]. It looks at the possibility of establishing a universal threshold dose below which there is no risk of radiation-related cancer. The report is organised by scientific discipline, beginning with epidemiological studies of exposed human populations. Extrapolation of risk estimates based on observations at moderate to high doses continues to be the primary basis for estimation of radiation-related risk at low doses and dose rates.

Executive Summary

The use of permanent radioactive implants (I-125 or Pd-103 seeds) to treat selected localised prostate cancer patients has been increasing rapidly all over the world for the last 15 years. It is estimated that more than 50,000 patients are treated this way every year in the world, and this number is anticipated to increase in the near future.

Although no accidents or adverse effects involving medical staff and/or members of the patient's family have been reported to date, this brachytherapy technique raises a number of radiation safety issues that need specific recommendations from the ICRP.

All data concerning the dose received by people approaching patients after implantation have been reviewed. Those doses have been either been measured directly or calculated. The available data show that, in the vast majority of cases, the dose to comforters and carers remains well below the recommended limit of 1 mSv/year. Only the (rare) case where the patient's partner is pregnant at the time of implantation may need specific precautions.

Publication No. 97

ICRP, 2005. Prevention of High-dose-rate Brachytherapy Accidents

Executive Summary

High-dose-rate (HDR) brachytherapy is a rapidly growing technique that has been replacing low-dose-rate (LDR) procedures over the last few years in both industrialised and developing countries. It is estimated that about 500,000 procedures (administrations of treatment) are performed by HDR units annually. LDR equipment has been discontinued by many manufacturers over the last few years, leaving HDR brachytherapy as the major alternative. HDR brachytherapy techniques deliver a very high dose, of the order of 1.6–5.0 Gy/min, so mistakes can lead to under- or over dosage with the potential for clinical adverse effects. More than 500 HDR accidents (including one death) have been reported along the entire chain of procedures from source packing to delivery of dose. Human error has been the prime cause of radiation events. In the present report, the International Commission on Radiological Protection concludes that many accidents could have been prevented if staff had had functional monitoring equipment and paid attention to the results. Since iridium has a relatively short half-life, the HDR sources need to be replaced approximately every 4 months. Over 10,000 HDR sources are transported annually, with the resultant potential for accidents; therefore, appropriate procedures and regulations must be observed. A number of specific recommendations on procedures and equipment are given in this report.

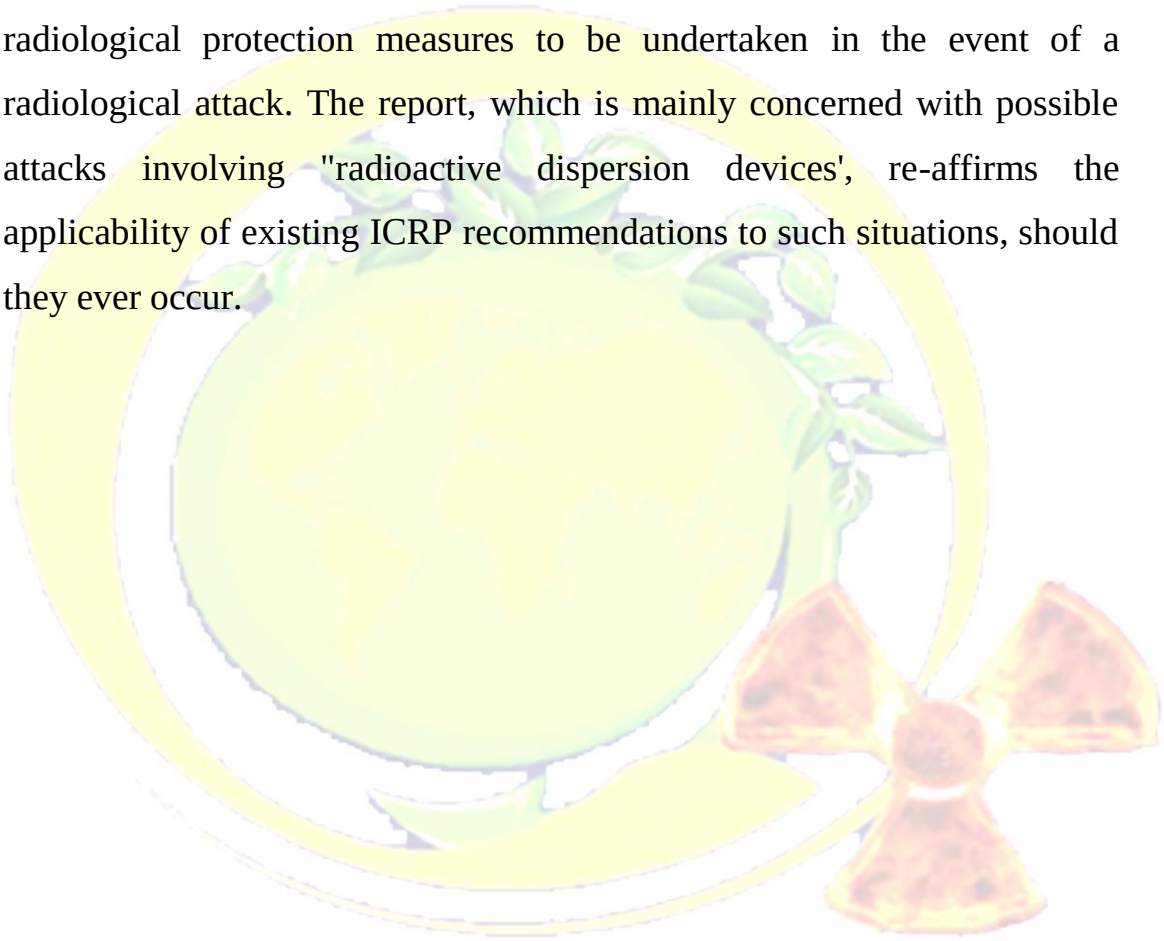
Publication No. 96

ICRP, 2005. Protecting People against Radiation Exposure in the Event of a Radiological Attack

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report responds to a widely perceived need for professional advice on radiological protection measures to be undertaken in the event of a radiological attack. The report, which is mainly concerned with possible attacks involving "radioactive dispersion devices', re-affirms the applicability of existing ICRP recommendations to such situations, should they ever occur.



Publication No. 95

ICRP, 2004. Doses to Infants from Ingestion of Radionuclides in Mothers' Milk

Executive Summary

In the present report, ICRP provides information on radiation doses to the infant due to intakes of radionuclides in maternal milk. As in Publication 88 (ICRP, 2001) on doses to the embryo and fetus following intakes of radionuclides by the mother, intakes by female members of the public and female workers are addressed. Acute and chronic intakes are considered at various times before and during pregnancy as well as during the period of breastfeeding. Dose coefficients per unit intake by the mother (Sv/Bq) are given for the selected radionuclides of the same 31 elements for which age-specific biokinetic models were given in Publications 56, 67, 69, and 71. For these elements, doses were calculated for the most radiologically significant natural or artificial radionuclides that might be released into the environment due to various human activities. Dose coefficients are also given in this report for radionuclides of an additional four elements: sodium, magnesium, phosphorus, and potassium.

Publication No. 94

ICRP, 2004. Release of Patients after Therapy with Unsealed Radionuclides

Executive Summary

After some therapeutic nuclear medicine procedures with unsealed radionuclides, precautions may be needed to limit doses to other people, but this is rarely the case after diagnostic procedures. Iodine-131 results in the largest dose to medical staff, the public, caregivers, and relatives. Other radionuclides used in therapy are usually simple beta emitters (e.g. phosphorus-32, strontium-89, and yttrium-90) that pose much less risk. Dose limits apply to exposure of the public and medical staff from patients. Previously, the ICRP has recommended that a source-related dose constraint for optimisation of a few mSv/episode applies to relatives, visitors, and caregivers at home, rather than a dose limit. The present report recommends that young children and infants, as well as visitors not engaged in direct care or comforting, should be treated as members of the public (i.e. be subject to the public dose limit).

Executive Summary

Digital techniques have the potential to improve the practice of radiology but they also risk the overuse of radiation. The main advantages of digital imaging, i.e. wide dynamic range, post processing, multiple viewing options, and electronic transfer and archiving possibilities, are clear but overexposures can occur without an adverse impact on image quality. In conventional radiography, excessive exposure produces a black film. In digital systems, good images are obtained for a large range of doses. It is very easy to obtain (and delete) images with digital fluoroscopy systems, and there may be a tendency to obtain more images than necessary.

Executive Summary

In its 1990 recommendations, the ICRP considered the radiation risks after exposure during prenatal development. This report is a critical review of new experimental animal data on biological effects and evaluations of human studies after prenatal radiation published since the 1990 recommendations. Thus, the report discusses the effects after radiation exposure during pre-implantation, organogenesis, and fetogenesis. The aetiology of long-term effects on brain development is discussed, as well as evidence from studies in man on the effects of in-utero radiation exposure on neurological and mental processes. Animal studies of carcinogenic risk from in-utero radiation and the epidemiology of childhood cancer are discussed, and the carcinogenic risk to man from in-utero radiation is assessed. Open questions and needs for future research are elaborated. The report reiterates that the mammalian embryo and fetus are highly radiosensitive. The nature and sensitivity of induced biological effects depend upon dose and developmental stage at irradiation. The various effects, as studied in experimental systems and in man, are discussed in detail. It is concluded that the findings in the report strengthen and supplement the 1990 recommendations of the ICRP.

Publication No. 89

ICRP, 2002. Basic Anatomical and Physiological Data for Use in Radiological Protection Reference Values

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This report presents detailed information on age- and gender-related differences in the anatomical and physiological characteristics of reference individuals. These reference values provide needed input to prospective dosimetry calculations for radiation protection purposes for both workers and members of the general public. The purpose of this report is to consolidate and unify in one publication, important new information on reference anatomical and physiological values that has become available since Publication 23 was published by the ICRP in 1975. There are two aspects of this work. The first is to revise and extend the information in Publication 23 as appropriate. The second is to provide additional information on individual variation among grossly normal individuals resulting from differences in age, gender, race, or other factors.

Publication No. 88

ICRP, 2001. Doses to the Embryo and Fetus from Intakes of Radionuclides by the Mother

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

In its Publications 56, 67, 69, 71, and 72, ICRP has provided age-specific biokinetic models and, using those models, compiled dose coefficients (doses per unit intake) for intakes of radionuclides by members of the public. Committed effective doses for the inhalation or ingestion of radionuclides by workers who are occupationally exposed were given in Publication 68 based on the most recent dosimetric and biokinetic models for adults.

Executive Summary

Computed tomography (CT) examinations can involve relatively high doses to patients. The doses can often approach or exceed levels known with certainty to increase the probability of cancer. The frequency of CT examinations is increasing worldwide and the variety of examinations is also increasing. However, in contrast to the common trend in diagnostic radiology, the rapid developments in CT have not led in general to a reduction of patient doses per examination. Therefore, management of patient dose is crucial. Proper justification of examinations, use of the appropriate technical parameters during examinations, proper quality control, and application of diagnostic reference levels of dose as appropriate would all contribute to this end. There is also scope for further technical development of the equipment used. The present publication aims to provide information in all these respects in order to provide assistance in the successful management of patient dose.

Publication No. 86

ICRP, 2000. Prevention of Accidents to Patients Undergoing Radiation Therapy

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

This publication aims to assist in the prevention of accidental exposures involving patients undergoing treatment from external beam or solid brachytherapy sources. It does not directly deal with therapy involving unsealed sources. The document is addressed to a diverse audience of professionals directly involved in radiotherapy procedures, hospital administrators, and health and regulatory authorities. The approach adopted is to describe illustrative severe accidents, discuss the causes of these events and contributory factors, summarise the sometimes devastating consequences of these events, and provide recommendations on the prevention of such events. The measures discussed include institutional arrangements, staff training, quality assurance programmes, adequate supervision, clear definition of responsibilities, and prompt reporting.

Publication No. 85

ICRP, 2000. Avoidance of Radiation Injuries from Medical Interventional Procedures

Executive Summary

Interventional radiology (fluoroscopically-guided) techniques are being used by an increasing number of clinicians not adequately trained in radiation safety or radiobiology. Many of these interventionists are not aware of the potential for injury from these procedures or the simple methods for decreasing their incidence. Many patients are not being counselled on the radiation risks, nor followed up when radiation doses from difficult procedures may lead to injury. Some patients are suffering radiation-induced skin injuries and younger patients may face an increased risk of future cancer. Interventionists are having their practice limited or suffering injury, and are exposing their staff to high doses. A concluding list of recommendations is given. Annexes list procedures, patient and staff doses, a sample local clinical protocol, dose quantities used, and a procurement checklist.

Publication No. 84

ICRP, 2000. Pregnancy and Medical Radiation

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Executive Summary

ICRP Publication 84 concerns the management of pregnant patients as well as pregnant workers in medical establishments where ionising radiation is used. Thousands of pregnant patients and medical radiation workers are exposed to radiation each year. Lack of knowledge is responsible for great anxiety and probably unnecessary termination of many pregnancies. This report discusses how to deal with these problems. It is written primarily for physicians, but will also be useful for medical and health physicists, nurses, technologists, and administrators. It is not intended as a complete reference work, but rather to provide a practical approach that can be used in varying situations.