# International System of Radiation Protection

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International Atomic Energy Agency

# Why International System?

# Bad & Good example of international systems

# Why International system?

- You work in country A and dose limit is 20 mSv/yr, another country 50 mSv, yet another 100 mSv, and also 10 mSv.. Result- confusion.
- One month leave for all occupationally exposed
- Badge over lead apron or under lead apron
- Person sitting in the room next to X-ray room wants to be labelled as “occupationally exposed”
- Separate areas for attendants in NM dept

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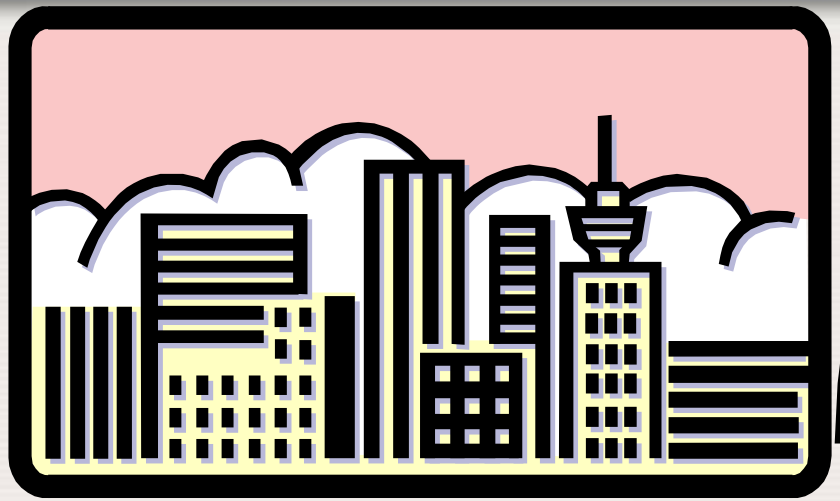
# National Regulatory Authority



- **How to frame regulations?….. Let these be consistent with UK…..No..No…with USA. … Oh no..it should be India, S. Africa…no Europe…**
- **Is there some Harmonised set of regulation?**

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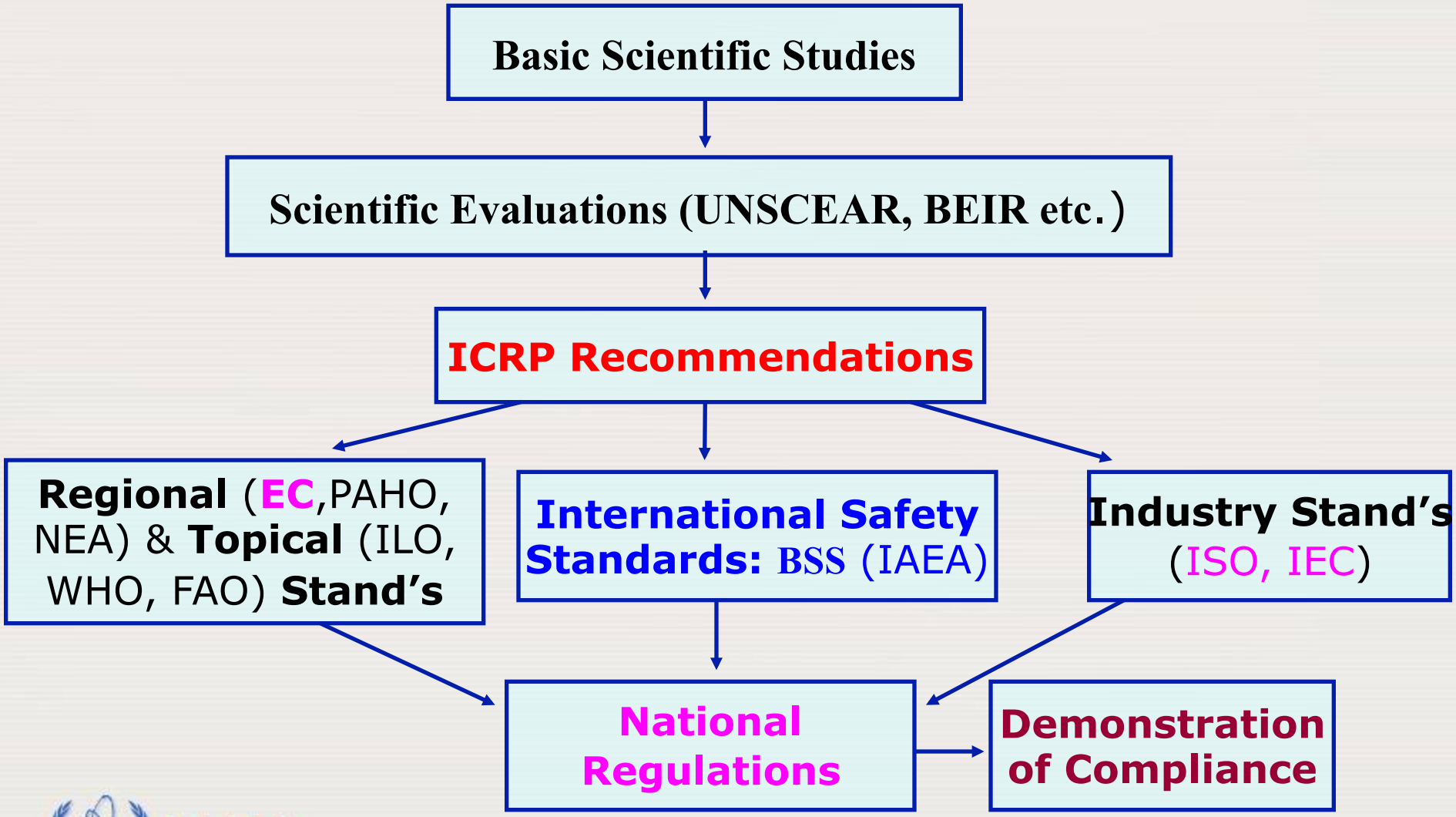
# Organisations in the Cosmic Scheme

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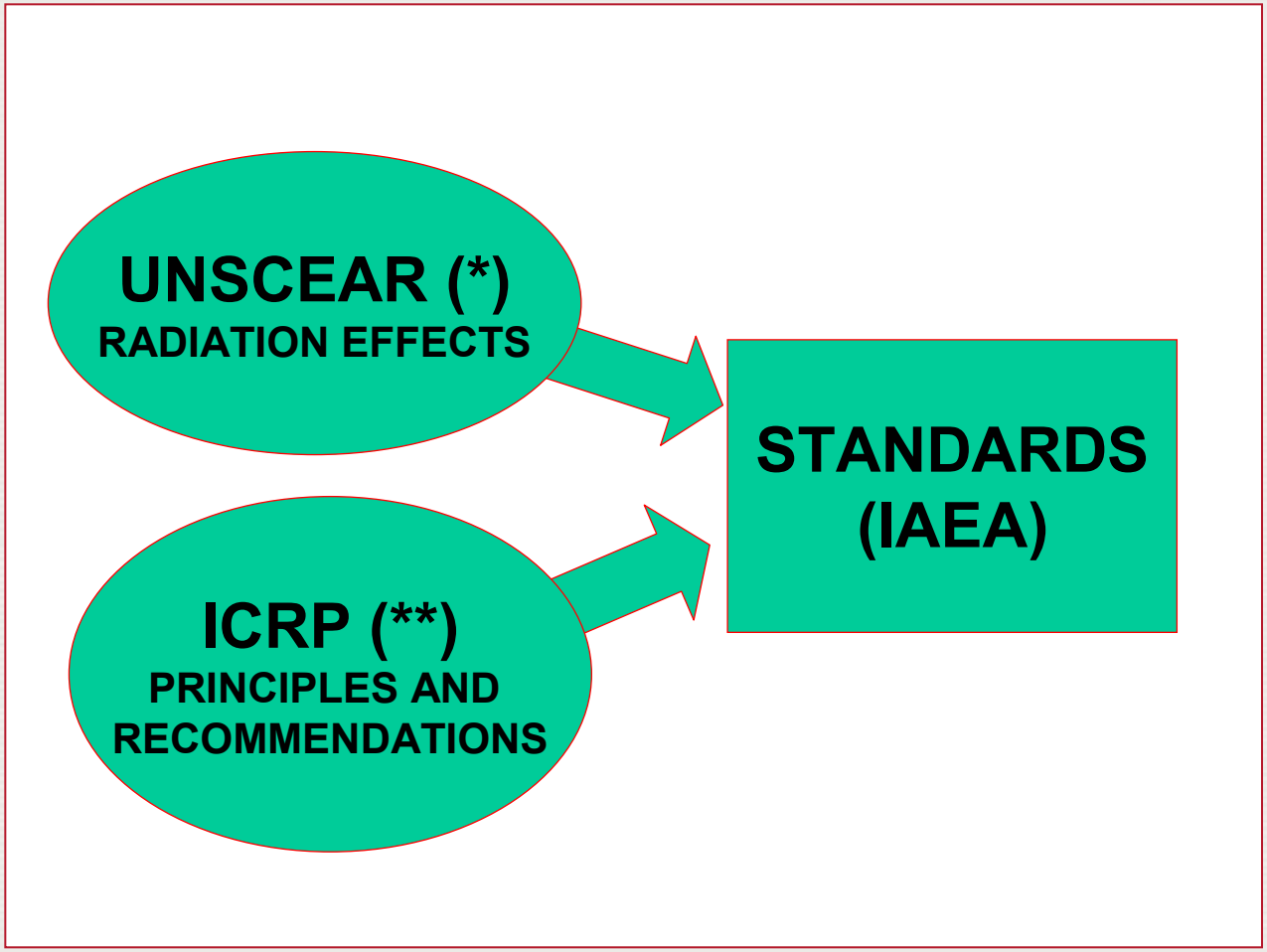
# The Basis for the International Safety Standards




(*) United Nations Scientific Committee on the Effects of Atomic Radiation

(**) International Commission on Radiological Protection

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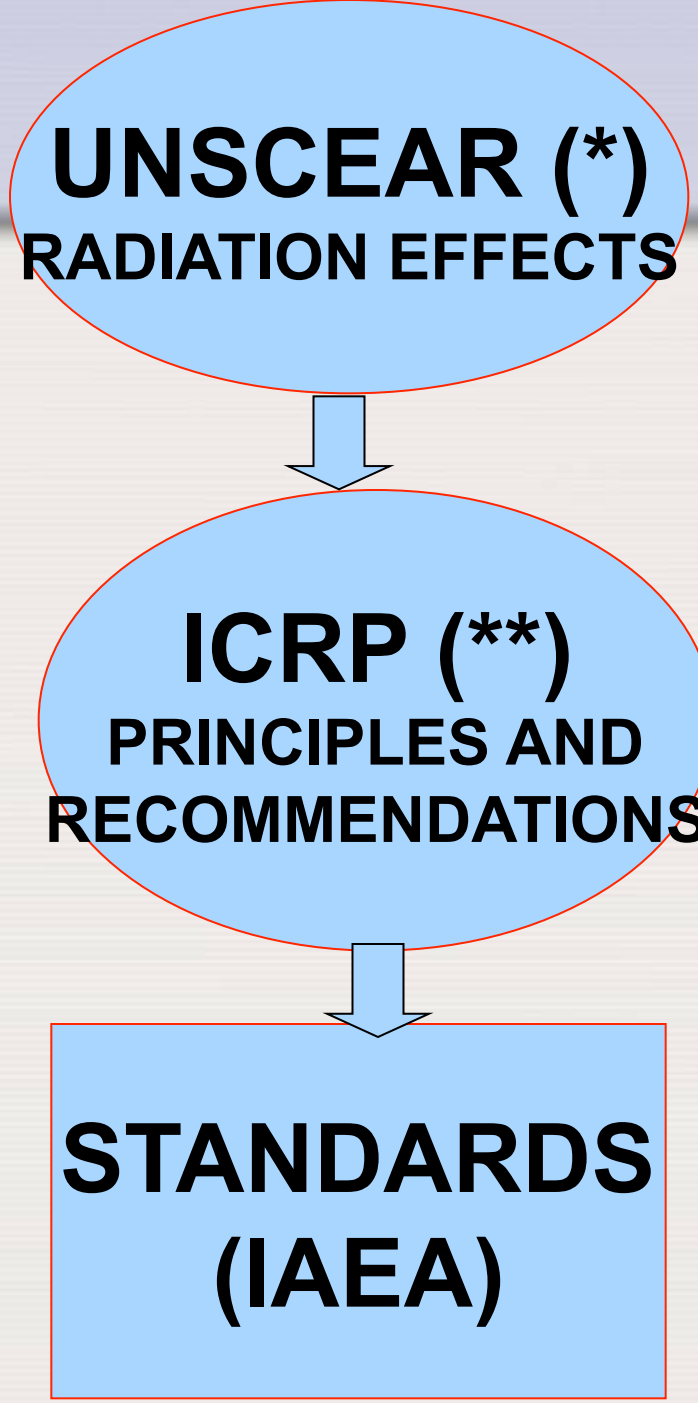


**A matter of interpretation**

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# International Radiation Safety Standard

- **Is it mandatory?**
  - **No**
- **Then what is legally applicable?**
  - **National**
- **What is the role of International Standards?**
  - **Robust, sound standards that countries can adopt**
  - **Where national regulations are lacking, international standards provide acceptable system for legal authorities**
  - **Since it is based on WIDE consensus, most countries tend to adopt it. Essential for seeking IAEA assistance**

# What people know MOST

**ICRP--- Dose limits**

**IAEA--- Iran, Iraq actions**

**UNSCEAR---??**

# What you think that they do?

## ICRP

- Establishes principles of radiation protection
- Provides protection philosophy

## IAEA

- Has programs for promoting
  - Nuclear medicine, radiotherapy and medical physics
  - Radiation protection of patients

# UNSCEAR

- UNSCEAR was established by the General Assembly of the United Nations in 1955.
- Its mandate in the United Nations system is to assess and report levels and effects of exposure to ionizing radiation.
- Governments and organizations throughout the world rely on the Committee's estimates as the scientific basis for evaluating radiation risk and for establishing protective measures.

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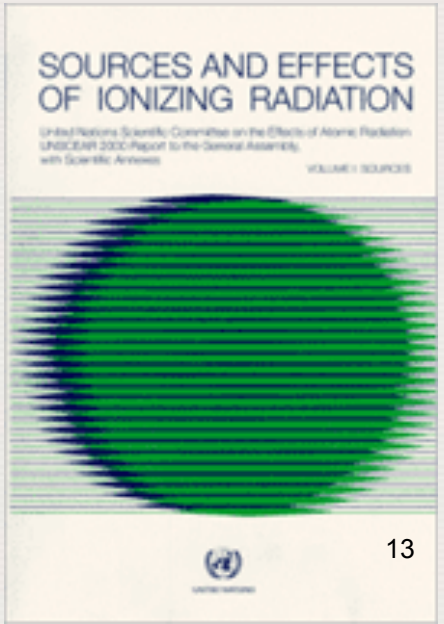
# UNSCEAR

- **The original committee was composed of senior scientists from 15 designated UN Member States, namely Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, Egypt, France, India, Japan, Mexico, Sweden, the UK, the USA and the USSR.**
- **Currently 21 countries**
- **Last report 2010**
- **HQ in Vienna**
- **Meeting once every year**

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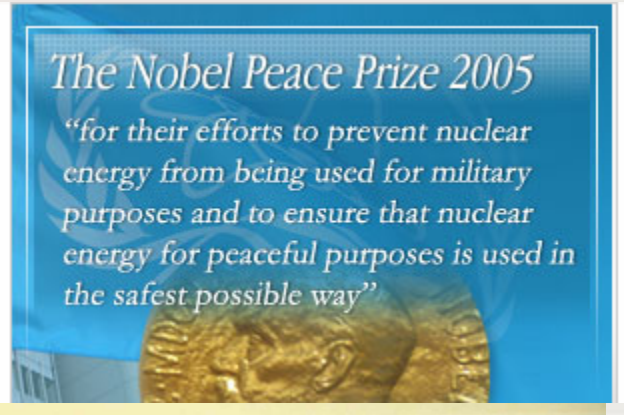
| ICRP | IAEA |
| --- | --- |
| Independent Charity | Independent international organisation under UN family |
| Established to advance for the public benefit the science of Radiological Protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation | Pillars: Safety and Security; Science and Technology; and Safeguards and Verification. |

# IAEA

- **Headquarter in Vienna**
- **2400 staff from> 90 countries**
- **Director General, 6 Deputy DG, Directors, SH, UH**

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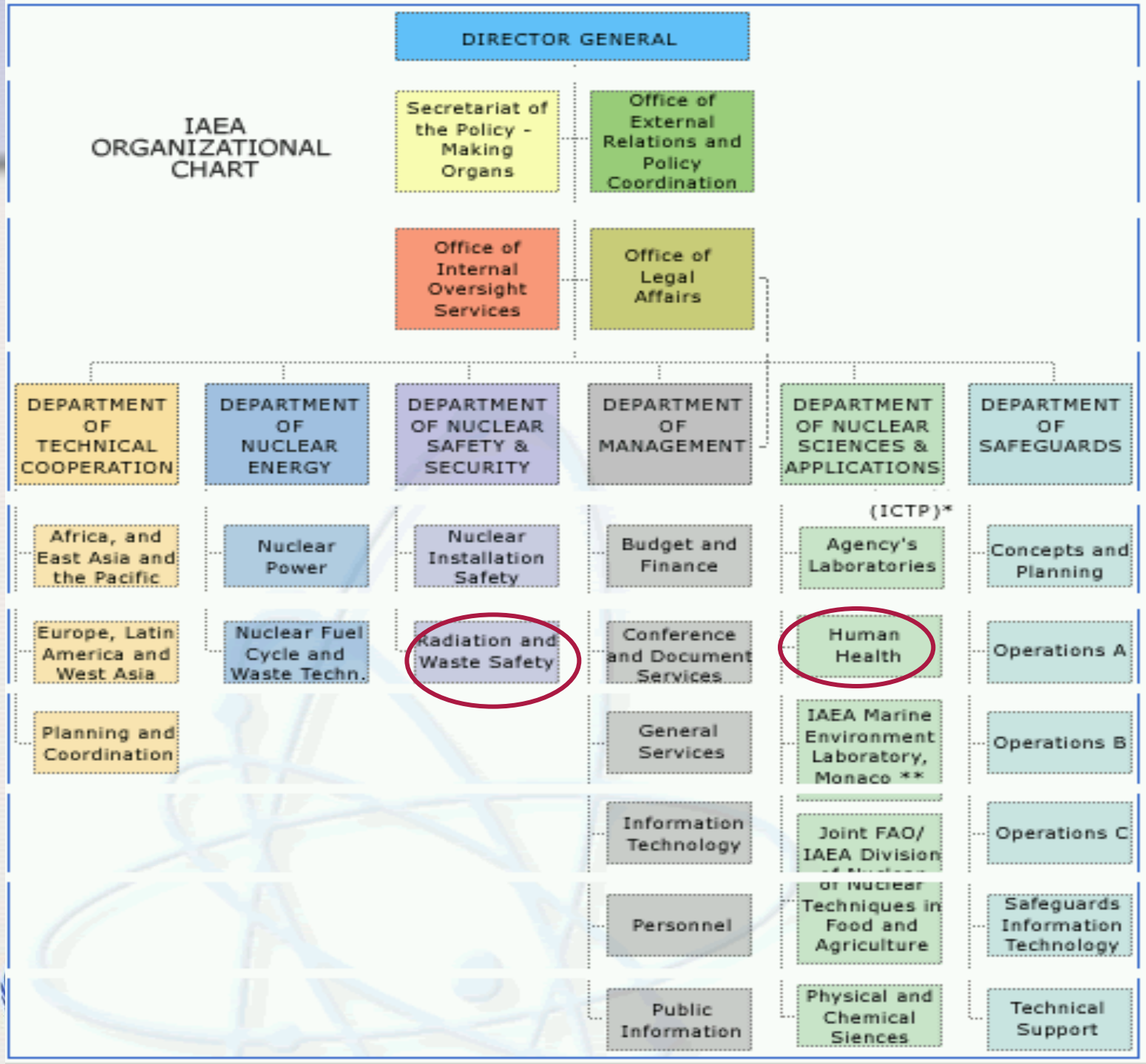
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Operations C
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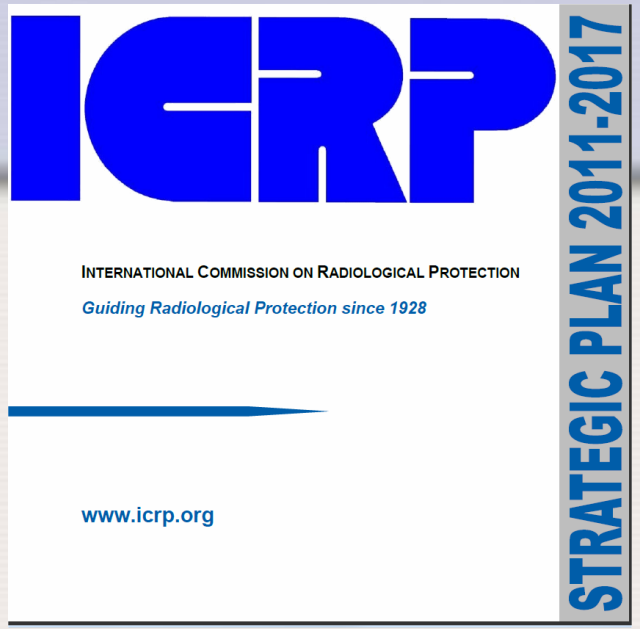
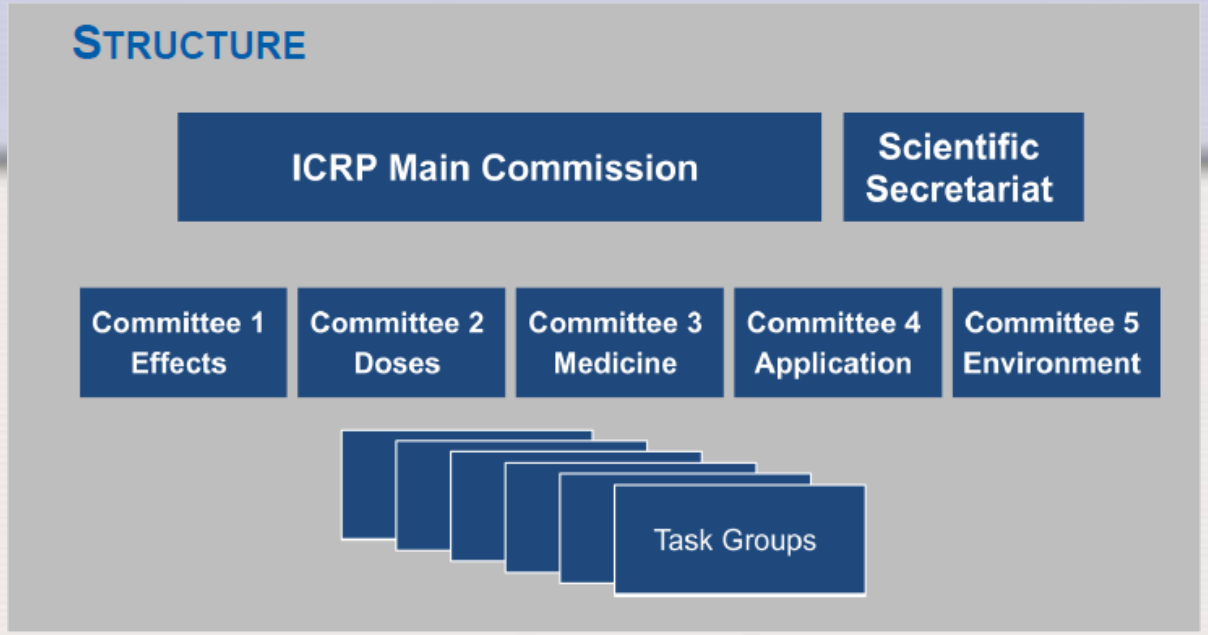
Technical Support




**Committee 3, Protection in Medicine:** develops recommendations and guidance on the protection of patients, staff, and the public against radiation exposure in medicine.

ICRP

## STRATEGIC OBJECTIVES, 2011 – 2017

- **Respond to new challenges in radiological protection.**
- **Improve dissemination of ICRP recommendations and guidance.**

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# Membership of the International Commission on Radiological Protection

as of July 1st 2013

## Main Commission

**Claire Cousins (Chair)**
Jacques Lochard (Vice-chair & C4 Chair)
John Boice
Abel Julio González
John Harrison (C2 Chair)
Carl-Magnus Larsson (C5 Chair)
Jai-Ki Lee
Hua Liu
Hans-Georg Menzel
William Morgan (C1 Chair)
Ohtsura Niwa
Sergey Romanov
Eliseo Vañó (C3 Chair)

## Scientific Secretariat

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Michiya Sasaki (Assistant Scientific Secretary)
Lynn Lemaire (Executive Assistant)
Ian Steadman (Intern)

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Michael Hauptmann
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Sisko Salomaa
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Quanfu Sun
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*Complete ICRP Membership, including the Main Commission, Scientific Secretariat, Committees, Task Groups and Working Parties, totals over 200 experts in radiological protection science and policy from more than 30 countries*

ICRP

## Chairperson
**Dr. Claire Cousins, UK**

**Chris Clement**
**Sc Secretary**

**Main Commission** ***Chair + 12 members***

**C1- Radiation Effects** ***Dr William F Morgan, US***

**C2- Doses from Radiation Exposure** ***Dr John Harrison, UK,***

**C3- Protection in Medicine** ***Dr Eliseo Vano, Spain***

**C4- Application of ICRP Recommend.** ***Dr Jacques Lochard, FR***

**C5-Prot. of the Environment** ***Dr Carl-Magnus-Larsson, Australia***

# ICRP C3 (September 2013) (Protection in Medicine)

- Eliseo Vañó (Chair)
- Kimberly Applegate
- Michel Bourguignon
- Lawrence Dauer
- Sandor Demeter
- Keon Kang
- Pek-Lan Khong
- Reinhard Loose
- Reinhard Loose
- Pedro Ortiz Lopez
- Colin Martin
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- Madan Rehani (Secretary)
- Katrine Åhlström-Riklund
- Pierre Scalliet
- Baorong Yue
- Yoshiharu Yonekura

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# ICRP web site, public area, ICRP activities, Committee 3

## Committee 3
## Protection in Medicine

Committee 3 is concerned with protection of persons and unborn children when ionising radiation is used for medical diagnosis, therapy, or for biomedical research; also, assessment of the medical consequences of accidental exposures.

Committee 3 in Vienna, September 2012

Summaries of Committee 3 Meetings:

- Beijing, 2004
- Geneva 2005
- San Francisco 2006
- Berlin 2007
- Mallorca 2008
- Porto 2009
- Hong Kong 2010
- Washington DC 2011
- Vienna 2012

**Public summary of the C3 annual meetings**

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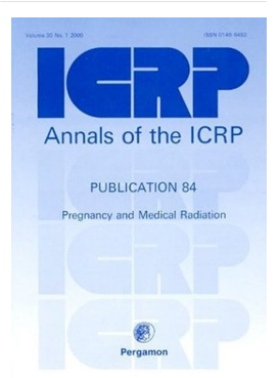
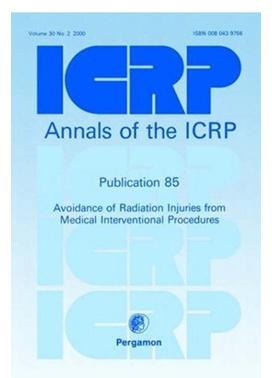
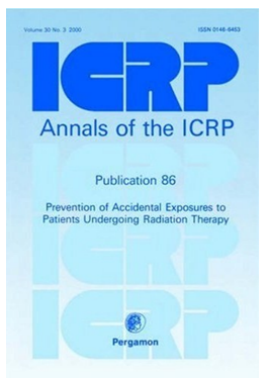
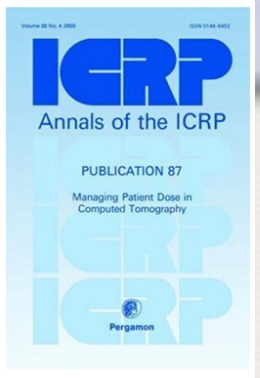
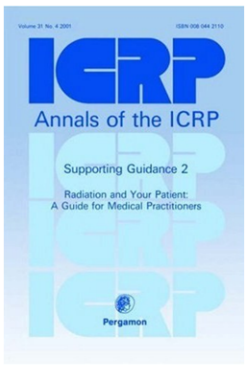
# ICRP C3: 15 publications in 10 years

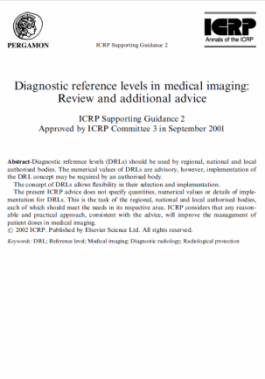




PERGAMON

ICRP Supporting Guidance 2

Diagnostic reference levels in medical imaging: Review and additional advice

ICRP Supporting Guidance 2
Approved by ICRP Committee 3 in September 2001

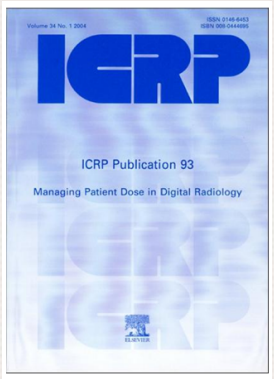
**Abstract**-Diagnostic reference levels (DRLs) should be used by regional, national and local authorised bodies. The numerical values of DRLs are advisory, however, implementation of the DRL concept may be required by an authorised body.

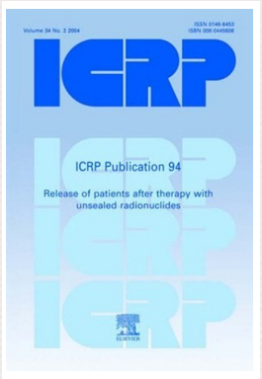
The concept of DRLs allows flexibility in their selection and implementation.

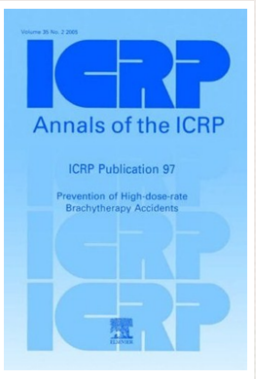
The present ICRP advice does not specify quantities, numerical values or details of implementation for DRLs. This is the task of the regional, national and local authorised bodies, each of which should meet the needs in its respective area. ICRP considers that any reasonable and practical approach, consistent with the advice, will improve the management of patient doses in medical imaging.

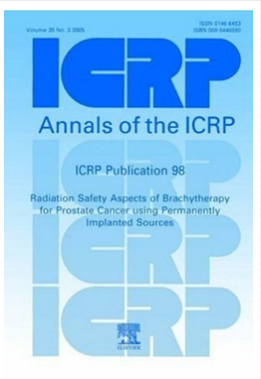


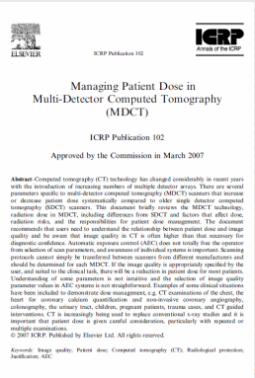
*Keywords:* DRL; Reference level; Medical imaging; Diagnostic radiology; Radiological protection

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ICRP Publication 102

Managing Patient Dose in Multi-Detector Computed Tomography (MDCT)

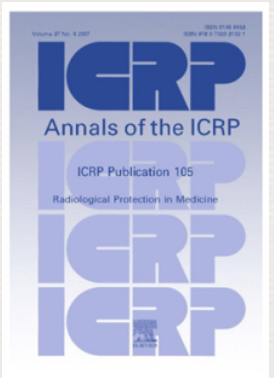
ICRP Publication 102

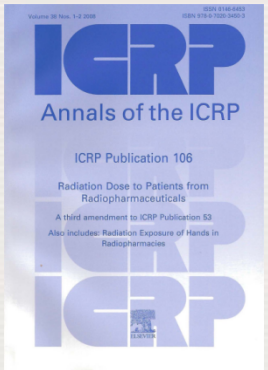
Approved by the Commission in March 2007

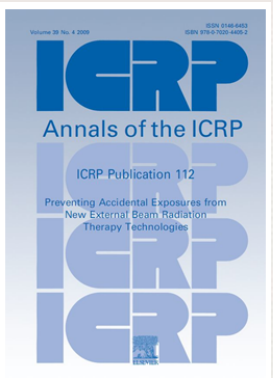
**Abstract**-Computed tomography (CT) technology has changed considerably in recent years with the introduction of increasing numbers of multiple detector arrays. There are several parameters specific to multi-detector computed tomography (MDCT) scanners that increase or decrease patient dose systematically 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. Examples of some clinical situations have been included to demonstrate dose management, e.g. CT examinations of the chest, the heart for coronary calcium quantification and non-invasive coronary angiography, colonography, the urinary tract, children, pregnant patients, trauma cases, and CT guided interventions. CT is increasingly being used to replace conventional x-ray studies and it is important that patient dose is given careful consideration, particularly with repeated or multiple examinations.

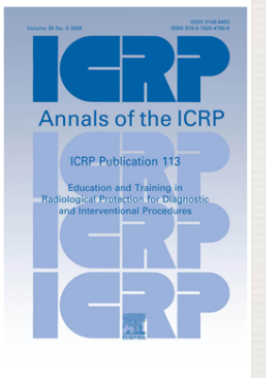


*Keywords:* Image quality; Patient dose; Computed tomography (CT); Radiological protection; Justification; AEC

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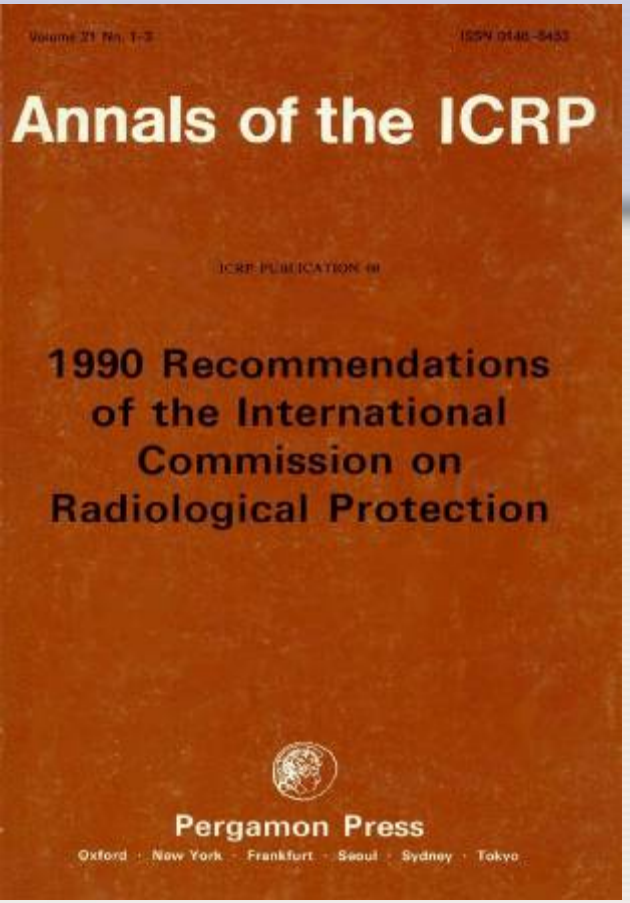
Annals of the ICRP
1990 Recommendations of the International Commission on Radiological Protection
Pergamon Press
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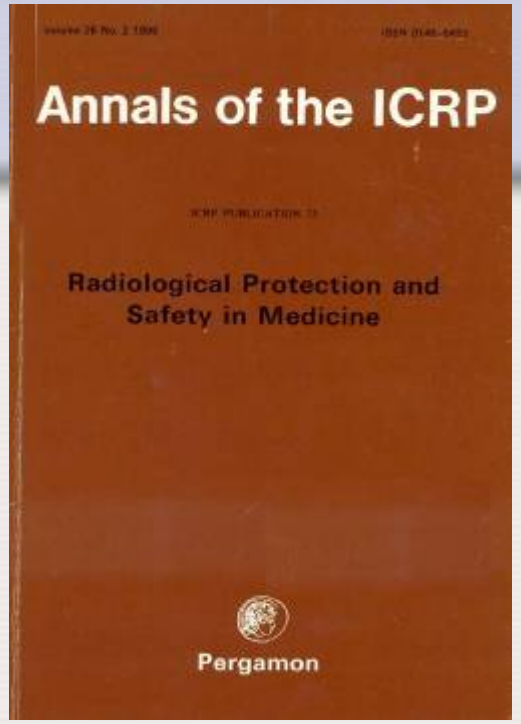
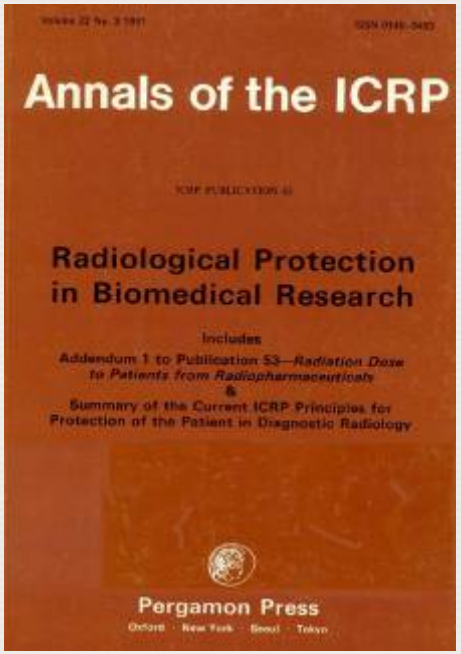
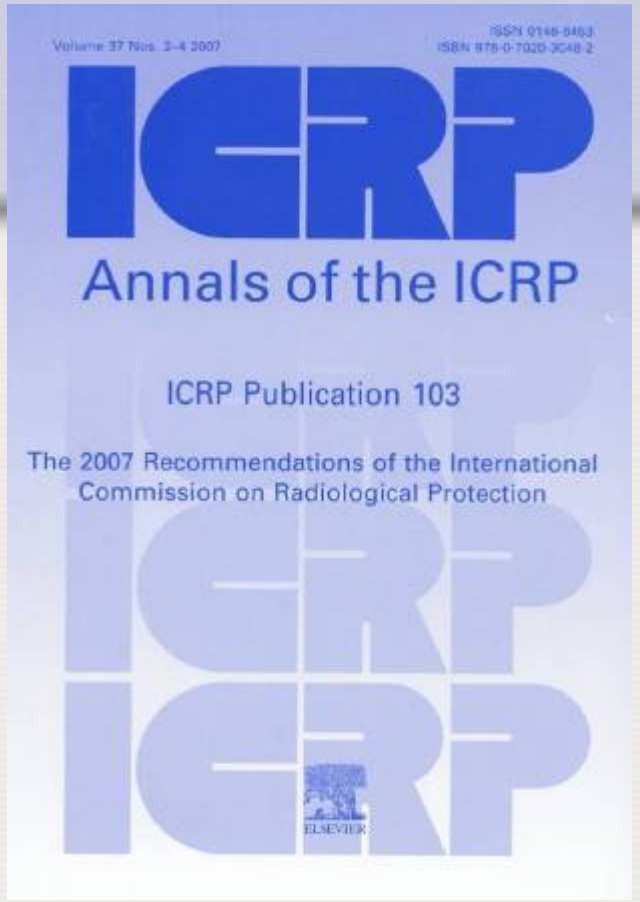

Annals of the ICRP
Radiological Protection and Safety in Medicine
Pergamon


Annals of the ICRP
Radiological Protection in Biomedical Research
Includes
Addendum 1 to Publication 53—Radiation Dose to Patients from Radiopharmaceuticals
&
Summary of the Current ICRP Principles for Protection of the Patient in Diagnostic Radiology
Pergamon Press


ICRP
Annals of the ICRP
ICRP Publication 103
The 2007 Recommendations of the International Commission on Radiological Protection
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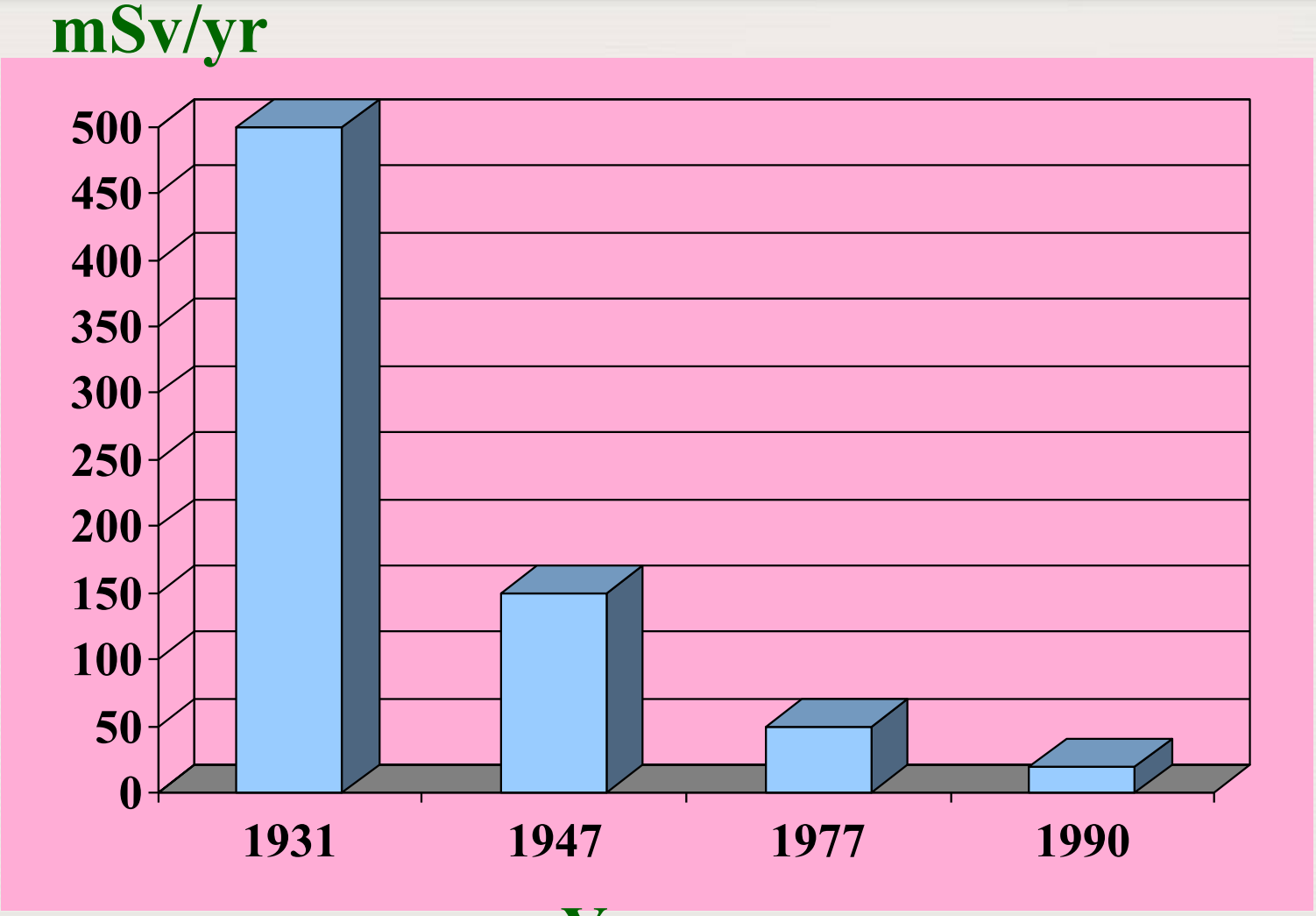
# Ethical Basis for the ICRP System

| | |
|---|---|
| Utilitarian ethics<br>*Judge actions by the consequences* | Deontological* ethics<br>*Some duties are imperative* |
| *Justification*<br>*Do more good than harm* | |
| *Optimisation*<br>*Maximise good > harm* | |
| | *Limitation*<br>*No individual unduly harmed* |

**how* people accomplish their goals( e.g. by duty, obligation)

# Changes in occupational Dose Limit (ICRP)

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# Past ICRP Recommendations

- **At first**: Occupational exposures in medicine
  - **Avoid deterministic harm**
  - 1928: Working hours limited (~1000 mSv)
  - 1934: ~500 mSv
- Then: Occupational exposures
  - 1950: ~150 mSv
- Now: Exposures
  - …**and minimise stochastic harm**
  - 1956: 50 mSv; 5 mSv
  - 1959: Publ. 1; 1964: Publ. 6
  - 1966: Publ. 9, reduce doses if readily achievable
  - 1977: Publ. 26, …if reasonably achievable
  - 1990: Publ. 60: 20 mSv, 1 mSv

# Tissue Weighting factor $W_T$ (ICRP 103 vs 60)

- Breast, gonads, and the treatment of remainder tissues.
- The $W_T$ changes in question are:
  - Breast (new 0.12, old 0.05); Increase by factor 2.4
  - gonads (new 0.08, old 0.20); Decrease by factor 2.5
  - remainder tissues (new 0.12, old 0.05 using a new additive system)

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# 2007 recommendations

**Tissue weighting factor for breast increased from 0.05 to 0.12 (2.4 times, ↑ by 140%) and for gonads decreased from 0.2 to 0.08, by ≈ ↓ 60%**

**Remainder tissues (new 0.12, old 0.05 using a new additive system)**

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# *The Genetic Risk Estimate Is Smaller, But…*

Gonad shielding is still imperative in order to keep doses ALARA !

# *Implementation Takes Time*

- **ICRP 1977 Recommendations**

  **International standards 1984**

  **National standards ~1989**

- **ICRP 1990 Recommendations**

  **International standards 1996**

  **National standards ~2000**

- **ICRP 2007 Recommendations**

  **International standards 2012**

  **…national standards after 2014?**

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# Carers and comforters

| ICRP 60 | ICRP73 | ICRP 103 |
| --- | --- | --- |
| Nothing of substance | •Introduced<br>•Values of dose constraints to be fixed at the national or local level.<br>•a value in the region of a few mSv per episode is likely to be reasonable, but warns against rigid use. | •Focussed on situations dealing with patients treated with radionuclides<br>•5mSv per episode for comforters and carers, except children and pregnant woman where 1 mSv |

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# Accidental and unintended exposures

- **Specific recommendations with respect to accidental and unintended medical exposures in the period since ICRP 60.**
- **The recommendations given in ICRP 103 are based on Publication 76, 86, 97 and 98.**

# Accidental and unintended exposures

| ICRP 60 | ICRP 73 | ICRP 103 |
|---|---|---|
| No specific recommendation | Design of equipment<br>•Defence in depth<br>•Calibration<br>•Independent confirmation | In addition to ICRP 73,<br>•Incident reporting<br>•External beam RT<br>•Brachytherapy |

# Volunteers for biomedical research

- **Reference Publication 62 for ethical aspects and there is recommendation on the need for the ethics committee.**

# Unjustified exposures

- **These recommendations seem to appear for the first time in ICRP 103**

**Certain exposures should be deemed to be unjustified without further analysis, unless there are exceptional circumstances. These included:**

- **Radiological examination for occupational, health insurance, or legal purposes undertaken without reference to clinical indications, unless the examination is expected to provide useful information on the health of the individual examined or in support of important criminal investigations.**
- **Medical screening of asymptomatic population groups involving radiation exposure, unless the expected advantages for the individuals examined or for the population as a whole are sufficient to compensate for the economic and societal costs, including the radiation detriment.**

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# Patient Consent

- The concept of patient consent is introduced into ICRP 103. The text presents more statements of "fact" or current practice, rather than explicit recommendations with respect to informed consent
- It states that the patient (or legal guardian) consents to exposure and this decision is made with varying degree of informed consent

# Pregnancy

- The pregnant patient has a right to know the magnitude and type of potential effects that might result from *in utero* exposure
- It is essential to ascertain whether a female patient is pregnant prior to radiotherapy and some abdominal interventional procedures.
- Termination of pregnancy at foetal doses above 100 mGy
- The pregnant patient should receive sufficient information to be able to make an informed decision.

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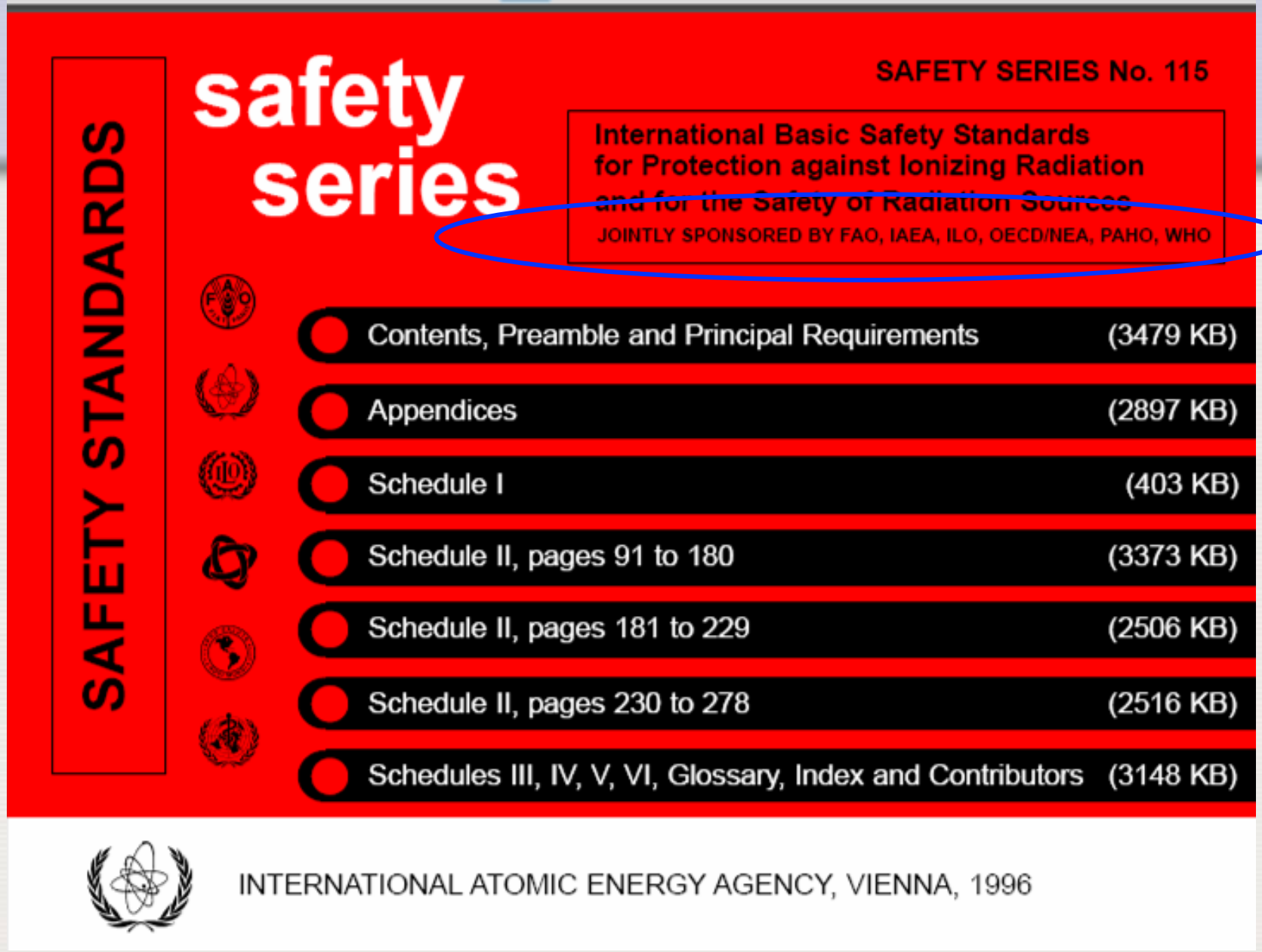
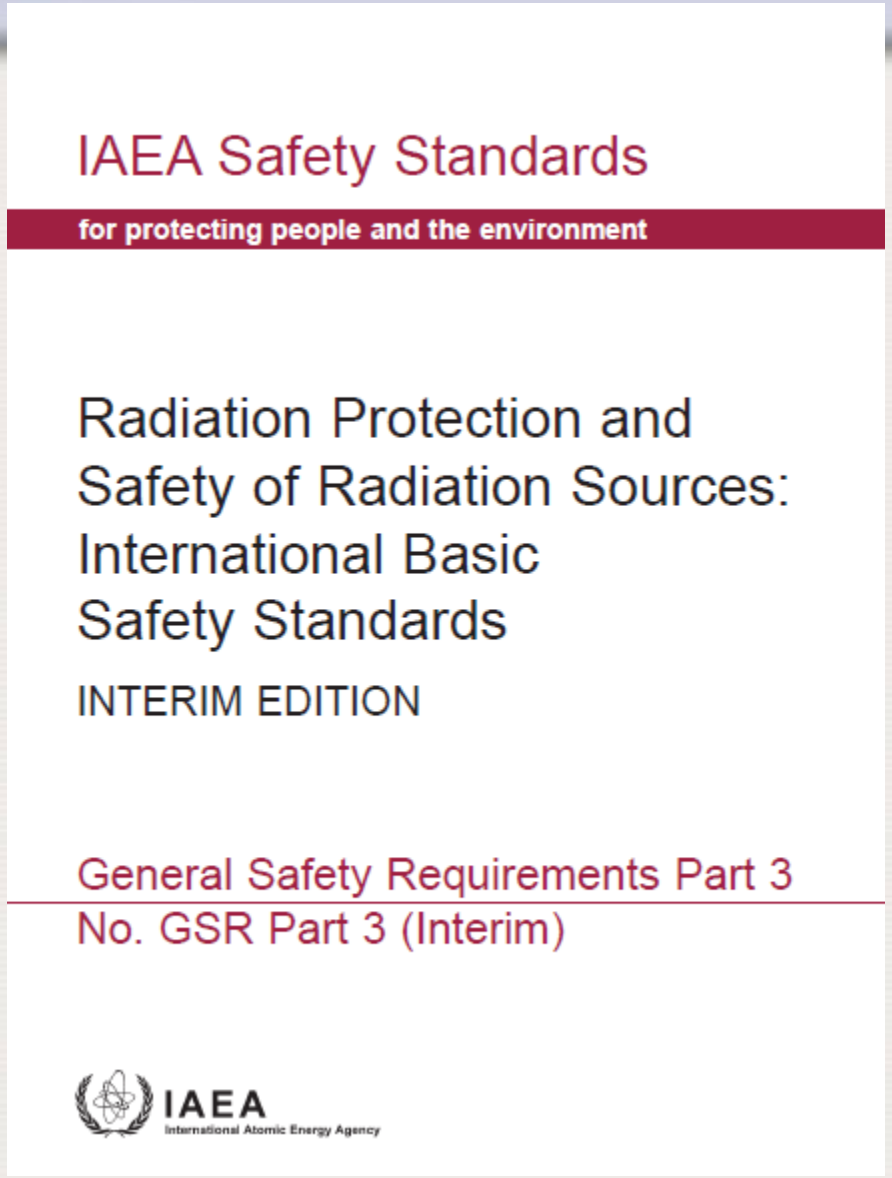
# IAEA- Development of Standards

- The IAEA is the world´s center of cooperation in the nuclear field.
- It was set up as the world´s "Atoms for Peace" organization in 1957 within the United Nations family.




**Plus consensus of >140 Member States**

# Nov 2011

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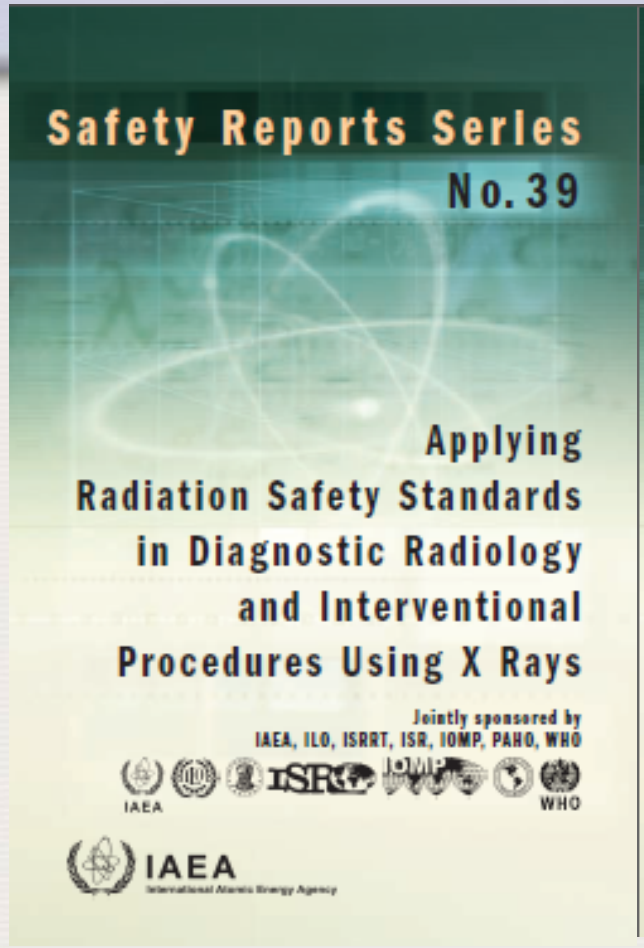


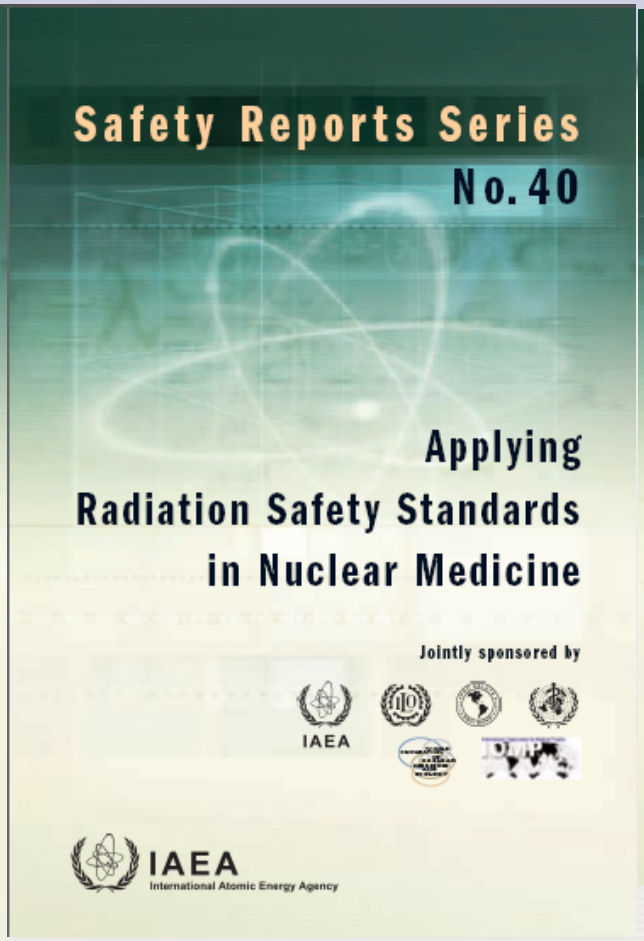


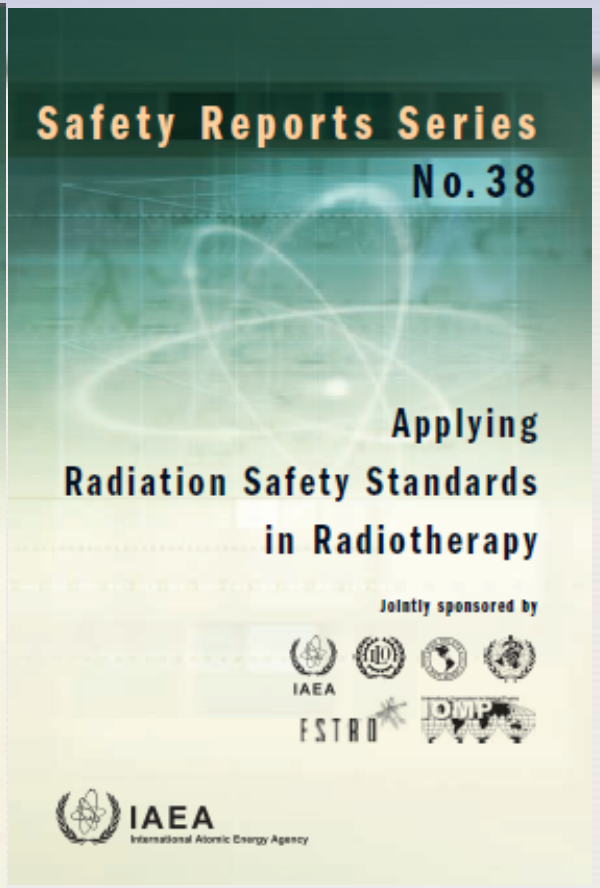


**http://rpop.iaea.org**

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# Website http://rpop.iaea.org

IAEA | Radiation Protection of Patients (RPoP)

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## Be Informed About the *Safe Use* of Ionizing Radiation in Medicine

Information to help health professionals achieve safer use of radiation in medicine for the benefit of patients

**Information For**
Health Professionals
Member States
Patients

**Additonal Resources**
Publications
International Standards
Training

**Special Groups**
Pregnant Women
Children

**Member Area**
Member States Area
Drafts Management Area

**Actions to Protect Patients In:**
- Radiology
- Radiotherapy
- Nuclear Medicine
- Interventional Radiology
- Interventional Cardiology
- Other Specialities & Imaging Modalities

## Latest Literature

**Ferrandino, M.N., Bagrodia, A., Pierre, S.A., Scales, C.D. Jr., Rampersaud, E., Pearle, M.S., Preminger, G.M.,**
Radiation exposure in the acute and short-term management of urolithiasis at 2 academic centers, J. Urol. **181** 2 (Feb. 2009) 668-672.

**Keeley, F.X., Jr, Thornton, M.,**
Radiation safety: Implications for urologists and patients, J. Urol. **181** 2 (Feb. 2009) 443-444.

**Vano, E., Ubeda, C., Leyton, F., Miranda, P., Gonzalez, L.,**
Staff Radiation Doses in Interventional Cardiology: Correlation With Patient Exposure, Pediatr. Cardiol. (Jan. 2009)

## Did You Know That...

3. It is safe to have an X ray examination of the extremities (feet, legs, hands, arms) in pregnancy, provided the examination is clinically justified and radiation protection principles are observed

« Prev Next »

## Latest News

**New Publications on Newer Imaging Techniques released**
Download FREE three new publications on radiation protection in newer imaging techniques (PET/CT, Cardiac CT and CT colonography)

**Cardiologists' Newsletter**
Next issue of the Newsletter of the Asian Network of Cardiologists in Radiation Protection is now available

All News

## Upcoming Events

**Meeting planned to prepare contents for patient information part of this website, Vienna, 4-8 May 2009**
Meeting to discuss framework for patient information, draw guidelines and prepare contents

**Meeting for Smart Card for long term record of patient doses, Vienna, 27-29 April 2009**
The first meeting on this project will be held in IAEA Vienna

All Events

10 million hits/y

≈ 200,000 visits/y, 190 countries

- I can’t sit next to him as he is emitting too much radiation
- I submit my resignation as the background level in this organisation is very high.

# EXCLUSION

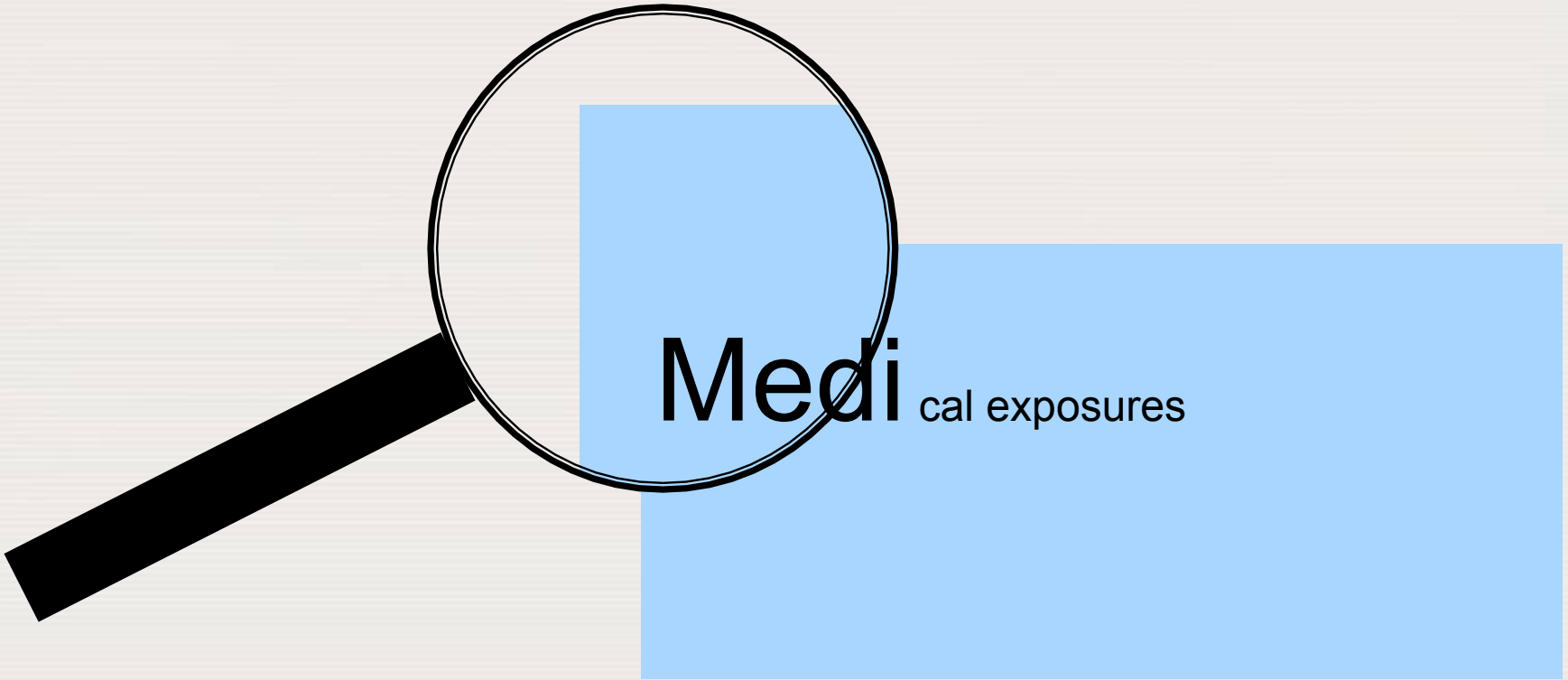
**Exposure which is unamenable to control,**

**Is EXCLUDED from the standards**

**e.g. $^{40}K$ in the body,**

**cosmic radiation at earth's surface**

# Medical exposures & the BSS



# Radiation accident

- I am not responsible. My staff in Radiology department is responsible for this.
- BSS lists responsibilities

# New terms

- Distinguishing the roles of the “referrer” and the “doer”, namely:
  - *Referring medical practitioner*
  - *Radiological medical practitioner*

    (Note: these can be the same person, e.g. a dentist, a radiation oncologist)
- Medical physicist (based on IOMP definition)
- Medical radiation technologist
  - Radiographer,…

# Revised BSS & the medical physicist

- The MP has a mandated role in:
  - Therapeutic uses of radiation:
    - The requirements for calibration, dosimetry and QA, including the acceptance and commissioning of medical radiological equipment
      - Are fulfilled by or under the supervision of a medical physicist
  - Diagnostic uses & image-guided interventional procedures
    - The requirements for imaging, calibration, dosimetry and QA, including the acceptance and commissioning of medical radiological equipment
      - Are fulfilled by or under the oversight of or with the documented advice of a medical physicist
      - Whose degree of involvement is determined by the complexity of the radiological procedures and the associated radiation risks

- I want 30 days compensatory leave on account of work with radiation.
- Radiation risk allowance
- Milk, special food

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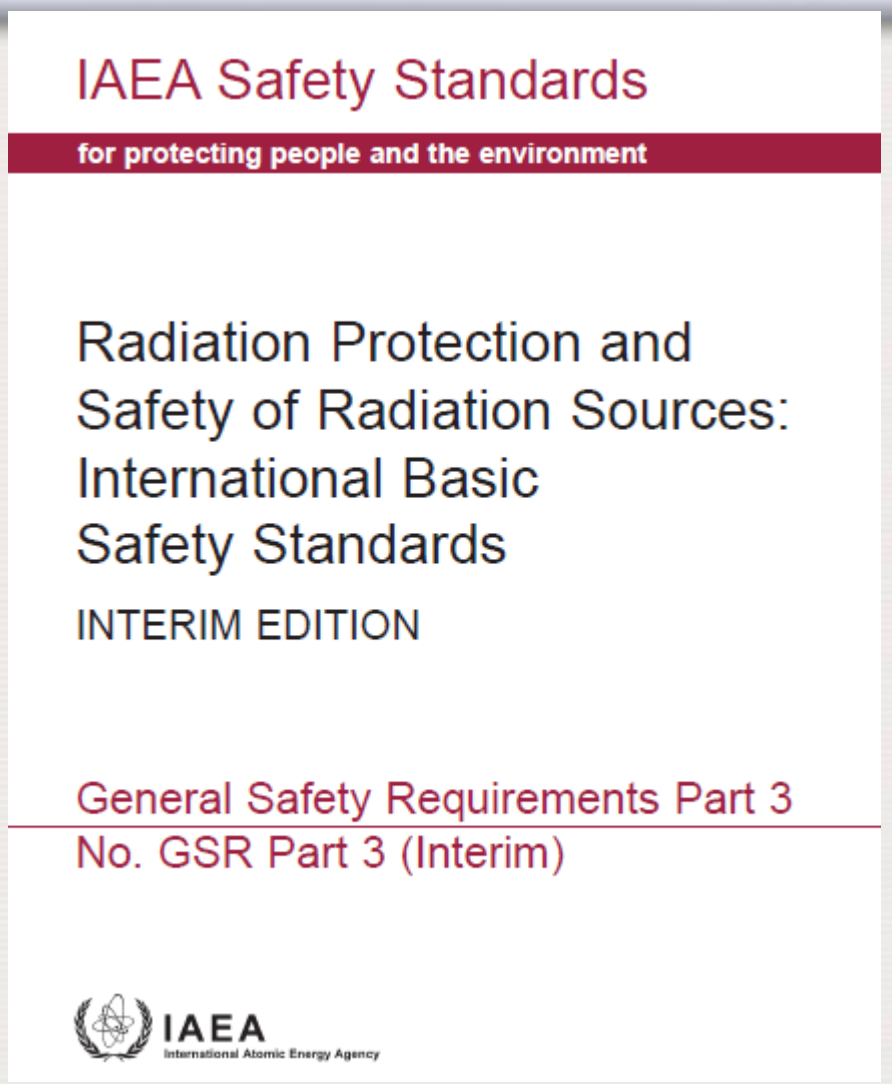
# Conditions of service

**Special compensatory arrangements**

- Special compensatory arrangements, or preferential consideration with respect to salary, special insurance coverage, working hours, length of vacation, additional holidays or retirement benefits, **shall neither be granted nor be used as substitutes for measures for protection and safety in accordance with the requirements of these Standards.**

# International BSS

- **Most important document for Member States of the IAEA pertaining to radiation safety regulatory requirements**

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# Does BSS recognize Medical Physicist?

# YES

# Medical Physicist

## A health professional,

- with specialist education and training in the concepts and techniques of applying physics in medicine, and
- competent to practise independently in one or more of the subfields (specialties) of medical physics.

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# Education and Training Requirements

## What is responsibility of the Government?

# Governments Responsibilities

**The government shall ensure that requirements are established for:**

- (a) education, training, qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety;
- (b) the formal recognition of qualified experts;
- (c) the competence of organizations that have responsibilities relating to protection and safety.

# Responsibilities of Regulatory bodies

- **Shall ensure the application of the requirements for education, training,**
- **Qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety.**

# Responsibilities of principal parties

- The relevant principal parties and other parties having specified responsibilities in relation to protection and safety shall ensure that all **personnel engaged in activities relevant to protection and safety have appropriate education, training and qualification** so that they understand their responsibilities and can perform their duties competently, with appropriate judgement and in accordance with procedures.

# Is there a requirements for specialization?

**Yes, this is "New" in revised BSS**

- The regulatory body shall require that health professionals with responsibilities for medical exposure **are specialized in the appropriate area and that they meet the requirements for education, training and competence in the relevant specialty.**

# Who should assess competence?

- **Competence of persons is normally assessed by the State by having a formal mechanism for registration, accreditation or certification of medical physicists in the various specialties (e.g. diagnostic radiology, radiation therapy, nuclear medicine).**

- States that have yet to develop such a mechanism would need to assess the education, training and competence of any individual proposed by the licensee to act as a medical physicist and to decide, on the basis either of international accreditation standards or standards of a State where such an accreditation system exists, whether such an individual could undertake the functions of a medical physicist, within the required specialty.

# Recap

- Why international system?
- Which parties are involved?
- Consensus of >140 members states, besides co-sponsors
- ICRP, UNSCEAR, IAEA
- Main points in international system of RP (responsibilities, conditions of service, justification, optimization)

# Thank You

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