The Unified Approach for Radiological Protection

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The System of Radiological Protection

- Recommended by the International Commission on Radiological Protection (ICRP), founded in 1928
- With the objective to contribute to an **appropriate level of protection** against the detrimental effects of ionizing radiation exposure **without unduly limiting** the benefits associated with the use of radiation (Pub 103, §26)
- The system aims primarily to protect human health with the objective to manage and control exposures so that deterministic effects (tissue reactions) are **prevented** and the risks of stochastic effects (cancer) are **reduced** to the extent reasonably achievable (Pub 103, §29)
- The system applies to **all radiation exposure** to any **natural or man-made controllable sources** (Pub 103, §44-45)
**Historical perspective**

- The system of RP was developed gradually during the 20th century integrating advances in *knowledge* about the effects of radiation, the evolution of the *ethical and social values* as well as the feedback *experience* from its practical implementation.

- Until the Second World War the Commission was only dealing with the protection of *medical staffs*.

- After the war the focus was on *nuclear energy* and radiological protection developed to protect workers inside nuclear installations and the public outside. This resulted in a coherent and effective regime of radiological protection based on solid concepts, principles and norms (ICRP 60).

- The reality of *nuclear accidents* together with the threat of malevolent events and the raising concerns on *natural exposures* and exposure *situations inherited from the past* in the nineties profoundly challenged the ICRP 60 system and resulted in the general principles presented in ICRP 103.
Foundations of the RP System

- **Social and Ethical Principles/Values**
  - Beneficence
  - Non-maleficence
  - Autonomy/Dignity
  - Justice
  - Prudence
    - Reasonableness
    - Tolerability
      - Peaceful
      - Vigilant
      - Reaction
    - Accountability
    - Inclusiveness
    - Conservation/biodiversity/sustainability

- **Science**
  - Epidemiology
  - Radiobiology
  - Anatomy
  - Physiology
  - Metrology
  - ……

- **Experience**
  - Hiroshima/Nagasaki
  - Nuclear Installations
  - Industrial/Medical
  - Chernobyl
  - Fukushima
  - ……
Structuration of the System of Protection

- **Principles of protection**
  - Justification
  - Optimisation
  - Limitation

**Categories**
- Occupational
- Public
- Medical (patients)
- Environment (biota)

**Situations**
- Existing
- Planned
- Emergency

**Dose criteria**
- Reference levels
- Dose constraints
- Dose limits

**Requisites**
- Assessment
- Accountability
- Transparency
- Inclusiveness

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- Assessment
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The exposure situations

- Existing exposure situations: …sources that already exists when decisions to control them are taken.

- Planned exposure situations: …deliberate introduction and operation of sources...

- Emergency exposure situations: …from the loss of control of a source.
The categories of exposure

- **Medical exposure**: radiation exposures received by patients in the course of diagnostic, interventional, and therapeutic procedures.

- **Occupational exposure**: radiation exposures incurred at work as a result of exposure situations that can reasonably be regarded as being the responsibility of the operating management.

- **Public exposure**: all radiation exposures of the public other than occupational and medical exposure. From natural and artificial sources.

*Remark: although individuals may fall into the 3 categories respectively as workers, patients or members of the public, the management of each category is kept separated.*
All exposure situations are characterized by a particular individual dose distribution.
The principles of radiological protection

- **The principle of justification**: Any decision that alters the radiation exposure situation should do more good than harm individually or collectively (beneficence; non-maleficence).

- **The principle of optimisation of protection**: All exposures should be kept as low as reasonably achievable, taking into account economic and societal factors (prudence, justice) involving stakeholders as far as possible (respect, dignity).

- **The principle of application of dose limits**: The total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits (justice).

Dose limits traditionally apply only in planned exposure situations.
ICRP 60: a two-speed system

Practices

Dose limit
(multi-sources ceiling level)

Dose constraint
(single-source ceiling level)

Intervention

Action/Intervention levels (floor levels)

Optimisation

What happens below AL/IL?
No further optimisation?
ICRP 103: a unified approach

Planned exposure situations

- Dose limit
- Dose constraint

Optimisation

Emergency and existing exposure situations

- Reference level (ceiling level)

Optimisation
The unified approach should be graded: Why?

- **Controllability** of the exposures
- Approach *proportionate* to the expected **level of risk**
  - **Distribution** of individual doses
  - Prospect of **deterministic** effects (notably the use or not of radionuclides for their **radioactive properties**)
  - Prospect of a radiological **emergency**
  - **Multi-hazard** situation: what is the dominant hazard?
- **Benefit**: societal/individual; direct/indirect
- Possible **counterparts** for groups of exposed individuals (in terms of protection): e.g. workers
- **Economic** and **societal** considerations
Graded approach: How?

- **Characterisation** at the beginning of the process (ExES + EmES)
- **Justification**
  - Of the introduction of a new activity (or category of) (PES)
  - In making the decision as to whether to take action to avert further exposure (ExES + EmES)
- **Optimisation** (cornerstone of the RP system)
  - According to prevailing circumstances
  - RP integrated in conventional health & safety standards
  - Collective / Individual protection
- **Dose criteria**
  - Dose limit: traditionally only in PES
  - From regulatory perspective, flexibility should be considered to use DL when appropriate in ExES
  - DC/RL: selected on a case by case basis according to the characteristics of the exposure situation (Pub 103, Table 5: 3 bands)