

# **Protection of the General Public and the Environment**

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# **ICRP 103 Recommendations**

**More inclusive framework for exposures beyond the workplace or in medical practice by:**

- broadening primary aim of protecting the public to include protection of the environment**
- improving framework for characterising different exposure situations**
- improving the framework for optimisation under different exposure situations**

## Human health

### **ICRP aims to protect individuals by:**

- **Preventing deterministic effects (seen in individuals, and for which there is a threshold for the effect) and**
- **reducing risks of stochastic effects to the extent reasonably achievable (LNT model)**
- **Based on a knowledge of relationships between exposure, dose, and effect or (by studies on populations) risk of effect**

**Radionuclide intake and external exposure**



**Reference male and Reference female**  
**Male and female equivalent doses ( $H^M_T$  &  $H^F_T$ )**



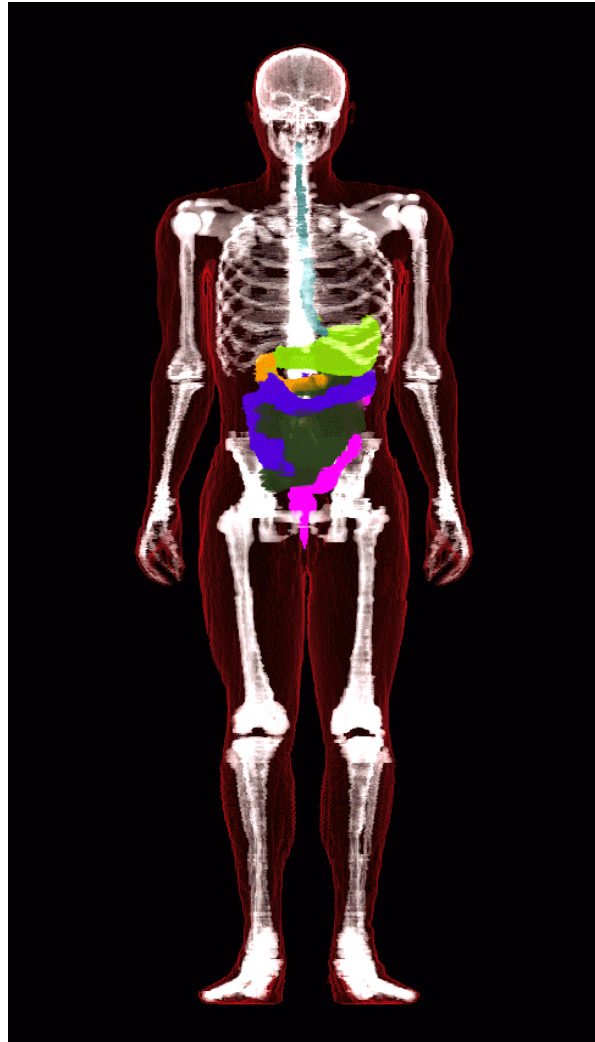
**Reference person**  
**Effective dose ( $E$ )**



**Dose limits, dose constraints, and reference levels**

# Voxel Phantoms

(based on medical tomographic images)



*Reference male and Reference female*  
Male and female equivalent doses ( $H^M_T$  &  $H^F_T$ )

*Reference person*  
Effective dose ( $E$ )

Dose limits, dose constraints, and reference levels

*Reference male and Reference female*  
Male and female equivalent doses ( $H_T^M$  &  $H_T^F$ )

*Reference person*  
Effective dose ( $E$ )

Dose limits, dose constraints, and reference levels

*Representative person*

Radionuclide intake and external exposure

Planned, emergency & existing exposure situations

# Types of Exposure Situations

(practices and interventions)

- *Planned situations*
  - deliberate introduction and control of sources
- *Emergency situations*
  - during operation of a planned situation
  - malicious act, etc
- *Existing situations*
  - already exist when a decision on control has to be taken



# Optimisation

An iterative process of:

- evaluating the exposure situation
- selecting a Constraint or Reference Level
- identifying possible protection options
- selecting and implementing best option  
under the prevailing circumstances
- evaluating the changed exposure situation

# Source related guidance

**Setting of *reference levels* or *constraints***

**DOSE BAND**

**emergency situation**

***Reference level:* highest dose below which optimisation implemented**

**20 to 100 mSv  
(acute or annual)**

**existing situation**

***Reference level:* (eg highest planned residual dose for radon in dwellings)**

**1 to 20 mSv a<sup>-1</sup>**

**planned exposure situations**

***Constraints:* already set for public**

**<1 mSv a<sup>-1</sup>**

# **Environmental protection**

## **ICRP aims to:**

- **Prevent or reduce the frequency of deleterious radiation effects to a level where they would have a negligible impact on:**
  - **the maintenance of biological diversity,**
  - **the conservation of species, or**
  - **the health and status of natural habitats, communities, and ecosystems.**

## **Human protection**

**Clear universal health objectives**

**Good relevant scientific knowledge**

**Dose limits, plus ...  
... dose constraints,  
and reference levels for  
optimisation in specific  
controllable circumstances**

## **Environmental protection**

**Various national environmental objectives**

**Limited relevant scientific knowledge**

**No dose limits, but ...  
...numerical guidance needed to  
optimise effort expended on  
assuring that the environment is,  
or can be, protected**

**Thus need to examine (as with human beings) the science base with regard to the relationships between ....**

- **... exposures and doses,**
- **... doses and effects, and**
- **... effects and consequences**

**for different types of animals and plants that are typical of the major environments.**

**Decided to do this by way of a set of Reference Animals and Plants (RAPs) – similar to approach used for human protection**

# ICRP

## Reference Animals and Plants (RAPs)

- **Deer (adult)**
- **Rat (adult)**
- **Duck (egg, adult)**
- **Bee (adult, colony)**
- **Worm (egg, adult)**
- **Pine tree**
- **Grass**

- **Frog (egg, tadpole, adult)**
- **Trout (egg, adult)**
- **Flatfish (egg, adult)**
- **Crab (egg, larvae, adult)**
- **Brown seaweed**

Biological features generalised to the Taxonomic level of 'Family'

# **Dose Conversion Factors** **(Gy day<sup>-1</sup>/ Bq kg<sup>-1</sup>)**

- **All Reference Animals and Plants**  
**(Some for different habitats)**
- **75 radionuclides**
- **External and internal exposure**

**Possible Derived Consideration (Reference) Levels**

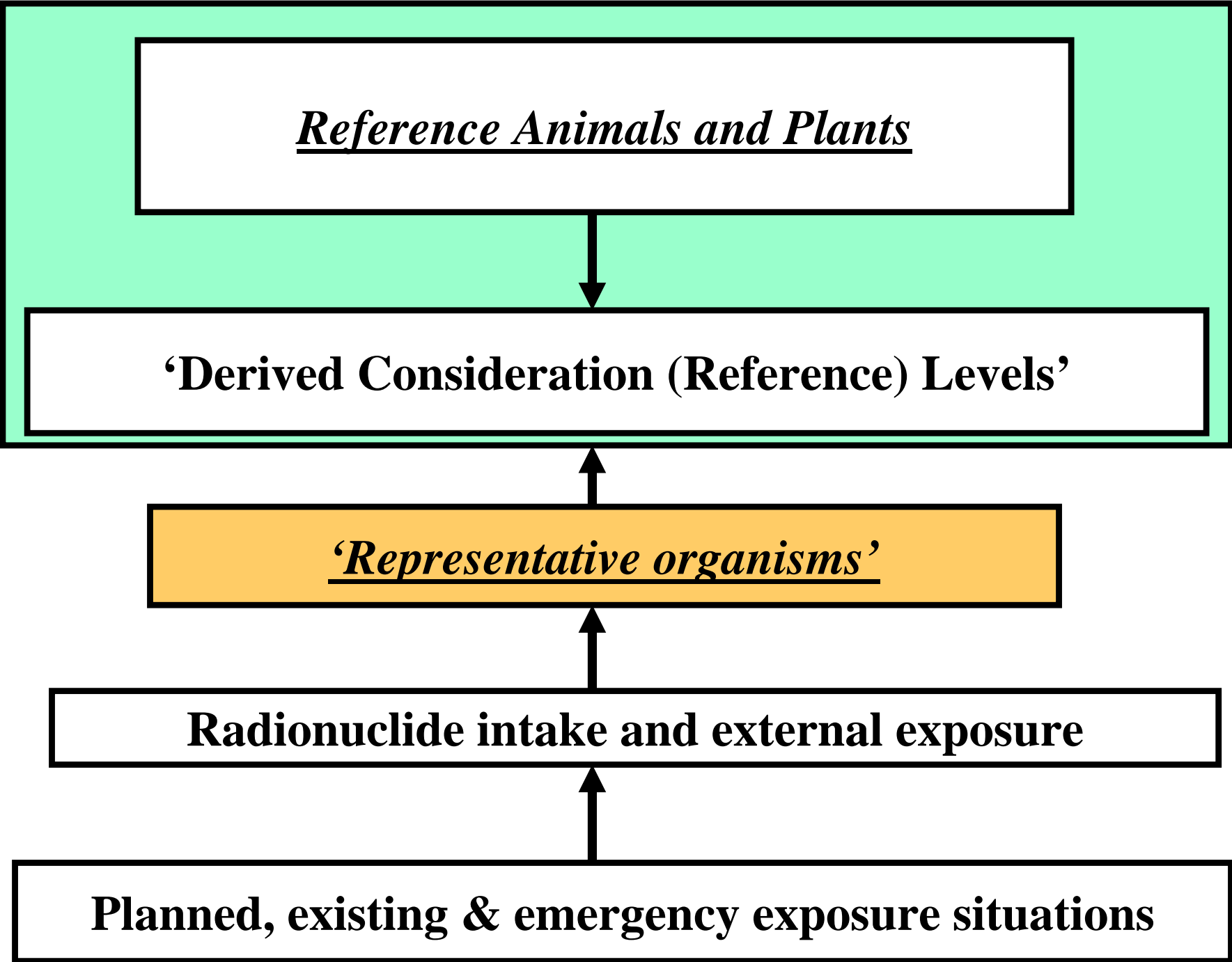
<b>Dose rate (mGy d<sup>-1</sup>)</b>	<b>Reference Rat</b>	<b>Reference Duck</b>
<b>100 - 1000</b>	<b>Reduction in lifespan due to various causes.</b>	<b>Potential lethal effects on hatchlings.</b>
<b>10 - 100</b>	<b>Increased morbidity. Possible reduced lifespan. Reduced reproductive success.</b>	<b>Increased morbidity.</b>
<b>1 - 10</b>	<b>Potential for reduced reproductive success (reduced fertility)</b>	<b>Potential for reduced reproductive success (hatchling viability).</b>
<b>0.1 - 1</b>	<b>Very low probability of effects</b>	<b>No information</b>
<b>0.01 – 0.1</b>	<b>No observed effects.</b>	<b>No information</b>
<b>&lt; 0.01</b>	<b>Natural background</b>	<b>Natural background</b>



*Reference Animals and Plants*



**‘Derived Consideration (Reference) Levels’**



*Reference Animals and Plants*

**‘Derived Consideration (Reference) Levels’**

*‘Representative organisms’*

**Radionuclide intake and external exposure**

**Planned, existing & emergency exposure situations**

**The basis of 'considerations' (to 'optimise' the actual or potential effort expended on environmental protection) would be expected to include the following:**

- legal obligations**
- type of exposure situation**
- range of dose rates & expected effects**
- size of area affected, time span**
- types of fauna and flora actually exposed**
- fractions of populations exposed**
- importance of the area**
- degree of 'precaution' deemed necessary**

**Protection at community or ecosystem level**

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graph TD; A[Protection at community or ecosystem level] --> B[Population status of species typical of the ecosystem]; B --> C[Key biological parameters affecting population status of typical species]; C --> D[Basis for decision making on what action (if any) to take];
```

**Population status of species typical of the ecosystem**

**Key biological parameters affecting population status of typical species**

**Basis for decision making on what action (if any) to take**

**Protection at community or ecosystem level**

```
graph TD; A[Protection at community or ecosystem level] --> B[Population status of species typical of the ecosystem  
Representative organisms]; B --> C[Key biological parameters affecting population status of typical species  
(Mortality, morbidity, reduced reproductive success, chromosomal damage)]; C --> D[Derived Consideration (Reference) Levels for decision making  
(Based on dose rates likely to affect such biological parameters in such types)]; D --> E[Reference Animals and Plants  
(Typical biotic types of major ecosystems)];
```

**Population status of species typical of the ecosystem**  
*Representative organisms*

**Key biological parameters affecting population status of typical species**  
(Mortality, morbidity, reduced reproductive success, chromosomal damage)

**Derived Consideration (Reference) Levels for decision making**  
(Based on dose rates likely to affect such biological parameters in such types)

*Reference Animals and Plants*  
(Typical biotic types of major ecosystems)

# A Common Framework

