



Radiological protection of the environment

ICRP Symposium on the International System of Radiological Protection



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Chairman ICRP Committee 5

2003 ICRP 91

- Discussed the issue of protection of the environment, including ethics and scope
- Moral duty to protect the environment, and a
- need to demonstrate that steps have been taken to do so
- National and international legislation to satisfy
- But: the need has not arisen from any new or specific concern

2005 Committee 5

Protection of the environment

To ensure that the development and application of ICRP's approaches to environmental protection are:

- compatible with those for radiological protection of man; and
- compatible with those for protection of the environment from other potential hazards.

Committee 5

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2007 ICRP 103

Environmental protection objectives

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.**

Basic questions arising from the presence or expected presence of elevated radionuclides in the environment as a result of any exposure situation

- What are, or will be, the doses to the biota?
- What are, or will be, the effects, or risks of effects, for the biota as a result of such doses?
- What are, or will be, the consequences, if any?
- What would/could one do about it, if anything, and why?

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

Representative person

Radionuclide intake and external exposure

Planned, emergency & existing exposure situations

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

So, needed to examine the science base with regard to the relationships between.....

-exposures and dose,
-doses and effects, and
-effects and consequences

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

- Decided it was necessary to establish some ‘points of reference’

2008 ICRP 108

Concept and Use of Reference Animals and Plants

Reference Animals and Plants (ICRP 108) 2008

- **Points of reference**
- **Sound scientific basis for decision making**
- **To provide conceptual and numerical ‘models’**
- **To examine aspects of dosimetry at different stages in the life cycle of different types of biota**
- **To relate dosimetry to radiation effects, risks, and consequences for different types of biota**
- **Some data sets already available**
- **Be amenable to further controlled experimentation to bridge the inevitable data gaps**
- **But they are not, necessarily, the objects of protection**

Reference Animals and Plants (RAPs)

- **Deer**
- **Rat**
- **Bee**
- **Worm (and egg)**
- **Pine tree**
- **Grass**

- **Duck (and egg)**
- **Frog (egg, tadpole, adult)**
- **Trout (and egg)**

- **Flat fish (and egg)**
- **Crab (and egg and larvae)**
- **Brown seaweed**

Environmental protection: science base

- Simplified models to relate exposure to dose; but better models are being developed
- Effects data – almost all at high dose rates
- Principal effects are mortality, morbidity, reduced reproductive success (fertility or fecundity), chromosomal damage, observed in individuals
- No LNT models, or DDRFs
- In fact, no underlying theories or models of radiation effects on biota in general - so difficult to extrapolate or interpolate amongst different types of organisms

Science base – effects data

Dose rate (mGy d ⁻¹)	<u>Reference Deer</u>	<u>Reference Flatfish</u>
100 - 1000	Reduction in lifespan due to various causes.	Some mortality expected in larvae and hatchlings
10 - 100	Increased morbidity. Possible reduced lifespan. Reduced reproductive success.	Reduced reproductive success
1 - 10	Potential for reduced reproductive success	Possible reduced reproductive success due to reduced fertility
0.1 - 1	Very low probability of various effects	No information
0.01 - 0.1	No observed effects.	No information
< 0.01	Natural background	Natural background

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Derived Consideration Reference Levels DCRL

A DCRL is a band of dose rate, within which there is some chance of deleterious effects, due to ionising radiation, occurring to individuals of that type of Reference Animal or Plant

Additional reference values

Set of Concentration Ratios for all 12 RAPs - most evaluations currently being made are via models, rather than via measurements at actual sites (TG 73)

ICRP 114

Environmental protection: Transfer Parameters
for Reference Animals and Plants

P Strand (Chair), N Beresford, J Brown, D Copplestone, J
Godoy, L Jianguo, R Saxen, T Yankovich

Current activities

Adjusting the existing overall ICRP framework

TG 82

How does environmental protection fit into the ICRP framework of:

- fundamental principles
- categories of exposure
- different exposure situations ?

Current activities

The practical application of RAPs and DCRLs to all exposure situations

Guidance on 'Representative Organisms' and relationships to basic RAP data (C5)

Reference Animals and Plants



**Bands of Derived Consideration Levels
for environmental protection (&Reference CRs)**

Reference Animals and Plants



**Bands of Derived Consideration Levels
for environmental protection (& Reference CRs)**



Representative organisms



Planned, emergency & existing exposure situations

Other current activities

- **What about RBE and radiation weighting factors?
(TG 72)**
- **Improving dosimetric modelling (TG 74)**

So, after starting from scratch....

- Set of RAPs as a foundation for examining the science base
- An analysis of different types of radiation effects for those types of animals and plants
- Set of simple dose models for such types
- Transfer parameters for all 12 RAPs - because most evaluations currently being made are via models (in press)
- Application to different exposure situations

But now.....

- Need to improve the science base
- Integrate more clearly into overall ICRP framework
- Examine application to different exposure situations in more detail
- And improve our interface with:
 - the broader (environmental) scientific community;
 - the nuclear community and its regulators – at all levels;
 - other environmental aspects of the nuclear fuel cycle and of other energy producing industries.

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