Protection of the Environment

An Overview of the Role of ICRP’s Committee 5

Joint IES-ICRP Symposium on
ENVIRONMENTAL PROTECTION WITHIN THE ICRP SYSTEM OF
RADIOLOGICAL PROTECTION
From science/knowledge to application
Rokkasho, Aomori, Japan
Tuesday, October 4, 2016

Kathryn Higley
Professor and Head, School of Nuclear Science and Engineering, Oregon State University
Chair, ICRP Committee 5
ICRP is an independent, international organization that advances for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionizing radiation.

ICRP is a Registered Charity (a not-for-profit organisation) in the United Kingdom, and has a Scientific Secretariat in Ottawa, Canada.

ICRP is comprised of a Main Commission, a Scientific Secretariat, five standing Committees (on Effects, Doses, Medicine, Application, and the Environment), and a series of Task Groups and Working Parties.
ICRP Management

- Main Commission (MC) and Scientific Secretariat direct, organize, and oversee ICRP.
- Main Commission approves all reports for publication.
- Committees advise MC and direct Task Groups.
- Task Groups
  - Established to undertake a specific task, such as production of a single ICRP report.
  - Generally comprised of a mixture of Committee members and other experts in the field.
- Working Parties
  - Normally formed of Committee members to explore particular issues,
  - May become Task Groups if work is to result in an ICRP publication.
Carl-Magnus Larsson, Australia, Past Chair
Kathryn A. Higley, USA, Chair
Almudena Real, Spain, Vice-Chair
David Copplestone, UK, Secretary
Jacqueline Garnier-Laplace, France
Jianguo Li, China
Kazuo Sakai, Japan
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“C5 is concerned with radiological protection of the environment. It will aim to ensure that the development and application of approaches to environmental protection are compatible with those for radiological protection of man, and with those for protection of the environment from other hazards”
Evolution of Parallel Protection Pathways

Planned, emergency, and existing exposure situations

Environmental radionuclide concentrations

Reference Male & Female, Representative Person

Reference Animals and Plants

Dose limits, constraints and reference levels

Derived Consideration Reference Levels

Decisions regarding protection of public health and the environment for the same exposure situation by way of representative individuals and representative organisms

[Publication 108]
ICRP 91 (2003)

Review of ethics and principles, recommending that the System for Environmental Protection should

- focus on biota;
- consider *adequate protection* on the basis of understanding of effects;
- identify reference animals and plants (RAPs); and
- let the RAPs guide the derivation of
  - exposure scenarios (CFs and DCFs)
  - effects data
  - dose rates benchmarks
(30) ....aim is...preventing and reducing the frequency of deleterious radiation effects to a level where they would have negligible impact on the maintenance of **biological diversity**, the **conservation of species**, or the health and status of **natural habitats, communities and ecosystems**.

(366) .....Reference Animals and Plants.......
<table>
<thead>
<tr>
<th>WILDLIFE GROUP</th>
<th>RAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large terrestrial mammals</td>
<td>Deer</td>
</tr>
<tr>
<td>Small terrestrial mammals</td>
<td>Rat</td>
</tr>
<tr>
<td>Aquatic birds</td>
<td>Duck</td>
</tr>
<tr>
<td>Amphibians</td>
<td>Frog</td>
</tr>
<tr>
<td>Freshwater pelagic fish</td>
<td>Trout</td>
</tr>
<tr>
<td>Marine fish</td>
<td>Flatfish</td>
</tr>
<tr>
<td>Terrestrial insects</td>
<td>Bee</td>
</tr>
<tr>
<td>Marine crustaceans</td>
<td>Crab</td>
</tr>
<tr>
<td>Terrestrial annelids</td>
<td>Earthworm</td>
</tr>
<tr>
<td>Large terrestrial plants</td>
<td>Pine tree</td>
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<tr>
<td>Small terrestrial plants</td>
<td>Wild grass</td>
</tr>
<tr>
<td>Seaweeds</td>
<td>Brown seaweed</td>
</tr>
</tbody>
</table>
ICRP 108 reviews biological characteristics

- Occurrence
- Taxonomy
- Life cycle and life span
- Reproductive strategy
- Physiology
- Ecology
- .....other factors.....
ICRP 108

DCCs for simple geometries

Trunk and branch
ICRP 108
Derived Consideration Reference Levels, DCRLs

Benchmarks from other studies/systems

Background level
Concentration Ratios for 39 elements and 12 RAPs

- with associated statistics;
- based on existing field and laboratory data;
- using new methodology to derive data (‘surrogate data’) where such are missing;
- taking into account life cycle stages and habitats, when possible; and
- discussing the robustness of the data
ICRP 124

Application in planned exposure situations

Increasing dose rate

DCRL for relevant RAP

Reference point for the sum of all sources
ICRP 124

Application in existing exposure situations

Increasing dose rate

Potential for dose rate reduction

Minimum level of ambition

DCRL for relevant RAP
ICRP 124

Application in emergency exposure situations

Severe Effects Level

Dose rate to relevant biota

Order of magnitude bands of dose rate

Time after event
ICRP EP/RP System

Organism biology and ecology

Source Term Dispersion

P108
P114
P124
C5

Outside of scope

Decision

Application

Broader context
RP and EP

DCRL
RAP
Dose/Effect/Response

Dose rate

Decision

DCRL
RAP

Source Term Dispersion

RAP
Transfer CR
DCC
RAP

Outside of scope

P108
P114
P124
C5
### ICRP Environmental Protection (EP) System Components

#### Exposure Situation

<table>
<thead>
<tr>
<th>EXPOSURE</th>
<th>EFFECT</th>
<th>CONCERN</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>Mortality Morbidity</td>
<td>Derived Consideration Reference Level DCRL</td>
<td>Planned</td>
</tr>
<tr>
<td>Ext/Int exposure &amp; RBE</td>
<td>Reproduction</td>
<td>‘Cytogenetic’</td>
<td>Emergency</td>
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<tr>
<td>DCC</td>
<td>‘Cytogenetic’</td>
<td>Derived Consideration Reference Level DCRL</td>
<td>Existing</td>
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<tr>
<td>RAP biology</td>
<td>RAP biology</td>
<td>RAP biology</td>
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</tbody>
</table>

#### Management

- Planned
- Emergency
- Existing

#### Protection

[Publications 91, 103, 108, 114, 124; TGs 72, 74, 99, x]
**Improved Dosimetry, TG74**

- **Purpose**
  - Expand data to *Publication 107*
  - Expand exposure scenarios
  - Explore allometric relationships
  - Develop a ‘DCC calculator’
TG72 & 74 Reports

Annals of the ICRP

ICRP PUBLICATION XXX

RBE and Reference Animals and Plants

TG72 Main Report
- Annex A: RBE – general
- Annex B: Tritium
- Annex C: Alpha

TG74 Main Report
- Annex A: Radon
- Annex B: Allometric relationships
- Appendix C: DCCs
Software tool BiotaDCC

- Simple
- Flexible
- Fast
- Web-based
Objective of TG99:
to gather and update basic data and guidance for the best use and practices of RAPs in support of the application of the system of radiological protection of the environment in planned, emergency and existing exposure situations.
Compilation of data on biology, life cycle, stable element ratios, exposure scenarios, transfer, effects, models, conclusions.

Vlad the crab

Reference Animal: A numerical approximation of organisms within a certain group of wildlife (large herbivorous mammal).

Representative Organism: A typical organism representative of its environment (kangaroo).
Application TG?

Planned situations

Max. concentrations of radionuclides in air, water and ‘soil’

Authorised Release Rates

Representative Persons

Dose constraints

Representative organisms

DCRLs

[Source: Jan Pentreath]
## Summary – the evolution of ICRP EP

<table>
<thead>
<tr>
<th>Element</th>
<th>P91</th>
<th>P108</th>
<th>P114</th>
<th>P124</th>
<th>TG72</th>
<th>TG74</th>
<th>TG99</th>
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<td>RAPs biology</td>
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<td>Exposure/DCC</td>
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[ICRP Logo]
Conclusions

- A robust system has evolved that is compatible with the RP system for man and the EP system developed for other hazards
- Considering the environment in its own right is appropriate and facilitates communication
- Simple to apply using default RAPs databases – but can also cope with complex exposure situations
- Priority during this term to
  - Consolidation
  - Broadening the scientific basis
  - Improving applicability
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