ICRP ref 4827-3252-7089

OPEN SUMMARY

2019 Meeting of Senior Representatives of Organisations in Formal Relations with ICRP

17 September 2019
09:00 – 17:30

OED Nuclear Energy Agency Headquarters
46, quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, Paris, France

Present

Claire Cousins	ICRP Chair
Jacques Lochard	ICRP Vice-Chair
Christopher Clement	ICRP Scientific Secretary
Simon Bouffler	ICRP Main Commission
Donald Cool (by video)	ICRP Main Commission
Dominique Laurier	ICRP Main Commission
David Copplestone	ICRP Committee 4
Pascal Crouail	European ALARA Network (EAN)
Thierry Schneider	European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (NERIS)
Jean-Francois Bottollier-Depois	European Radiation Dosimetry Group (EURADOS)
Hildegarde Vandenhove	European Radioecology Alliance (ALLIANCE)
Penelope Allisy	European Training and Education in Radiation Protection Foundation (EUTERP)
Karla Petrova	Heads of the European Radiological Protection Competent Authorities (HERCA)
Marie-Lorraine Alberico	Heads of the European Radiological Protection Competent Authorities (HERCA)
Rodolfo Cruz Suarez	International Atomic Energy Agency (IAEA)
Thomas Otto	International Commission on Radiation Units and Measurements (ICRU)

Miroslav Voytchev	International Electrotechnical Commission / Nuclear Instrumentation (IEC/TC45)
Jean-Francois Bottollier-Depois	International Electrotechnical Commission / Electrical Equipment in Medical Practice (IEC/TC62)
Roger Coates	International Radiation Protection Association (IRPA)
Dimitris Katsifarakis	International Society of Radiographers & Radiological Technologists (ISRRT)
Madan Rehani (by video from 14:45)	International Organization for Medical Physics (IOMP)
Nathalie Impens	Multidisciplinary European Low Dose Initiative (MELODI)
Yonhee Hah	OECD Nuclear Energy Agency (NEA)
Ted Lazo	OECD Nuclear Energy Agency (NEA)
Jacqueline Garnier-Laplace	OECD Nuclear Energy Agency (NEA)
Borislava Batandjieva-Metcalf	United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
Maria Perez	World Health Organisation (WHO)
Charlotta Sanders	World Nuclear Association (WNA)

Regrets

Conference of Radiation Control Program Directors (CRCPD)
European Alliance for Medical Radiation Protection Research (EURAMED)
European Association of Nuclear Medicine (EANM)
European Commission (EC)
European Nuclear Installations Safety Standards Initiative (ENISS)
European Society of Radiology (ESR)
Ibero American Forum of Radiological and Nuclear Regulatory Organisations (FORO)
IndustriAll Global Union's International Network (INWUN)
Information System on Occupational Exposure (ISOE)
International Labour Organisation (ILO)
International Society of Radiology (ISR)
National Council on Radiation Protection and Measurements (NCRP)

Meeting Summary

Yonhee Hah welcomed the group to the Nuclear Energy Agency.

Claire Cousins welcomed all present, thanked NEA for hosting the meeting, and outlined the programme for the day. Ted Lazo informed the group of logistical arrangements for the day.

Claire Cousins thanked those who had provided written reports in advance, and invited all participants to introduce themselves. Christopher Clement noted that a summary of the meeting will be prepared, which will include all written reports, even if received shortly after the meeting.

David Copplestone introduced the first question, providing context through a short presentation: **In practice, what further is necessary to integrate protection of the environment in radiological protection?** The presentation materials used are attached as Annex A.

Simon Bouffler introduced the second question, providing context through a short presentation: **What would be the practical implications of a more individualised system of radiological protection based on variations in individual response to radiation exposure?** His presentation is summarised as follows:

> *We live at a time of increasing individual empowerment, and at a time when individual lives are highly valued. For example, increasing effort and resources are dedicated in medicine to ensure longer and healthier lives. In medicine there is a move to personalised medicine, but what about protection?*
>
> *The ICRP system of protection aims to avoid tissue injury and minimise the incidence of stochastic effects (largely cancers, but also accounting for possible heritable effects). Common experience tells us that we are all different both in terms of our genetic inheritance, the environments in which we live and lifestyle choices we make. There is growing evidence for genetic factors affecting individual radiation health risk, and that some environmental/lifestyle factors are also of importance (e.g. smoking behaviours and diet).*
>
> *However, what would the practicalities of implementing a more individualised approach in radiation protection entail? Certainly it would be necessary to be able to*

identify and quantify individual risk. In some cases medical treatment is provided pending lifestyle changes. There is likely to be benefits to the patient in medical exposure situations, but the situation is much less clear for occupational and public exposures. While genetic testing for employment is not currently allowed, individuals may opt to seek genetic information currently available publicly.

What should radiation protection do to take account of this evolving evidence and changing pattern of societal drivers? Where can most ethical 'justice' be gained; how long might it take and where best to apply the information?

Two breakout groups were formed, each addressing both questions:

1. Penelope Allisy (Moderator), Nathalie Impens (Rapporteur), Marie-Lorraine Alberico, Christopher Clement, Claire Cousins, Pascal Crouail, Maria Perez, Thierry Schneider, Donald Cool (by video), and Madan Rehani (by video).

2. Karla Petrova (Moderator), Thomas Otto (Rapporteur), Borislava Batandjieva-Metcalf, Jean-Francois Bottollier-Depois, Roger Coates, Dimitris Katsifarakis, Dominique Laurier, Jacques Lochard, Rodolfo Cruz Suarez, Hildegarde Vandenhove, and Miroslav Voytchev.

Group 1 addressed the environment in the morning, and individualisation in the afternoon, while group 2 did the opposite. David Copplestone joined the discussions on the environment, and Simon Bouffler joined the discussions on individualisation.

Nathalie Impens presented the results of breakout group 1, summarised in the PowerPoint slides in Annex B. Thomas Otto presented the results of breakout group 2, summarised in the PowerPoint slides in Annex C.

Claire Cousins facilitated a general discussion on the results of the breakout groups.

The following points capture some of the comments regarding the question "In practice, what further is necessary to integrate protection of the environment in radiological protection?".

- Case studies can provide practical advice through examples.
- How to move from effects on individuals to the group level?
- Simple communication of radiological protection of the environment is important.

- What level of integration is intended in an Integrated system of radiological protection? Within general environmental protection? Integration of protection of people and the environment?
- At the level of concepts and fundamental principles, protection of people and the environment is already integrated in one system of radiological protection
- Comparing worker, public, and environmental exposures is difficult; guidance from ICRP would be welcome
- A simple, transparent, stable system of radiological protection is needed.

The following points capture some of the comments regarding the question “What would be the practical implications of a more individualised system of radiological protection based on variations in individual response to radiation exposure?”.

- Keep it simple.
- Individualisation of protection is appropriate and useful in medicine, assuming sufficient knowledge base, although ethical questions remain.
- Risks to the public, at least under normal circumstances, are very small compared to other public health issues e.g. related to lifestyle, so individual response to radiation exposure is not critical.
- Application in occupational exposure is more challenging, although employers already take account of many types of personal requirements and sensitivities.

Jacques Lochard concluded with some personal remarks:

- Frameworks already exist that deal with protection of the environment and individual response to radiation exposure, but there is more work to be done on both fronts.
- Simple, practical recommendations and guidance are needed, likely focused on factors to be considered rather than attempting to find a generic solution for all situations.
- Involvement of stakeholders in addressing these complex issues is essential.

Summarising the discussion (not necessarily the position of ICRP):

- The system of radiological protection should be as simple as possible while still being able to handle complex issues.

- Protection of the environment is already integrated into the system of radiological protection, but further advice is needed on how to implement it in practice especially with respect to comparing worker, public, and environmental exposures.
- A degree of individualisation of radiological protection in medicine is already occurring, and is appropriate.
- Individualisation of radiological protection for public and occupational exposures is complicated by incomplete knowledge and complex ethical considerations.
- Individual response is already taken into account in the system of radiological protection; no change is needed based on current knowledge.

Claire Cousins closed the meeting, thanking NEA for hosting, thanking everyone for their active participation, and inviting everyone to suggest topics to be addressed at future such meetings.

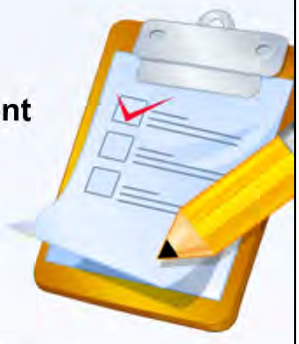
ANNEX A
PRESENTATION MATERIALS FROM DAVID COPPLESTONE

In practice, what further is necessary to integrate protection of the environment in radiological protection?

7th Annual Meeting of Senior Representatives of Organisations in Formal Relations with ICRP
17 September 2019

David Copplestone
Committee 4 / University of Stirling

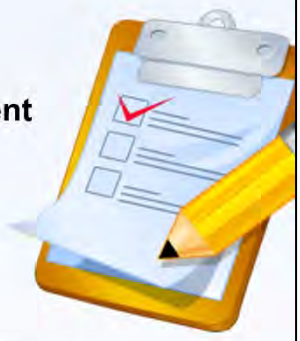
Outline



The ICRP's framework of protection for the environment

- Development history
- RAPs – Reference Animals and Plants - aiming at representing wildlife to assess exposure and effects
- DCRLs – Derived Consideration Reference Levels - as benchmark ranges for assessing radiological risk to wildlife
- How does the system apply in the different exposure situations?

Outline



The ICRP's framework of protection for the environment

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- DCRLs – Derived Consideration Reference Levels - as benchmark ranges for assessing radiological risk to wildlife
- How does the system apply in the different exposure situations?

- **So what is still missing from the integration?**

Why do we care about protection of the environment?

- Increasing acceptance of the limits of, and damage to, natural resources
- A concern for increasing loss of species and natural habitats
- Increasing (e.g. conservation) legislation
- Cumulative impact of all forms of stressors
- Provision of ecosystem services

Quick History of Radiological Protection of the Environment

From ICRP, 1977. ICRP Publication 26. Ann. ICRP

- "…the level of safety required for the protection of all human individuals is thought likely to be adequate to protect other species, although not necessarily individual members of those species. The Commission therefore believes that if man is adequately protected then other living things are also likely to be sufficiently protected."

ICRP, 1991. ICRP Publication 60. Ann. ICRP 21 (1-3)

- "The Commission believes that the standard of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk. Occasionally, individual members of non-human species might be harmed, but not to the extent of endangering whole species or creating imbalance between species."

-> No requirement to assess the impact of released radionuclides on the environment…. But…

Quick History of Radiological Protection of the Environment

Around 2000's, some disturbing issues emerged to bring evidence for or against ICRP statement

- Human radiological protection and the environment only considered as a route for transfer to humans
- Implicit consideration of environment *per se* and of ecological protection goal; lack of demonstration that the environment is being protected; requirement for assessment under a number of national legislation; lack of compatibility with management of other chemical stressors

- Led to:
- ICRP Publication 91: A Framework for Assessing the Impact of Ionising Radiation on Non-human Species

ICRP Publication 103

- *"The Commission considers that it is now necessary to provide advice with regard to all exposure situations. It also believes that **it is necessary to consider a wider range of environmental situations, irrespective of any human connection with them**. ..... The Commission therefore believes that the development of **a clearer framework is required in order to assess the relationships between exposure and dose, and between dose and effect, and the consequences of such effects, for non-human species**, on a common scientific basis."*

ICRP Publication 103

*"The primary aim of the Commission's Recommendations is to contribute to an appropriate level of protection for **people and the environment** against the detrimental effects of radiation exposure without unduly limiting the desirable human actions that may be associated with such exposure"*

*"….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**"*

ICRP 2008 Publication 108

- Introduces the concept and use of RAPs, very basic dose models, dose effects, Dose Coefficients, and Derived Consideration Reference Levels (DCRLs) as a starting point
- Proposes to assess exposure – dose – effect relationships through a pragmatic approach
- No dose 'limits' but comparison of the level of exposure of various organisms to background and DCRLs
- Provides protection targets: Maintain biological diversity, Conservation of species , Protect health and status of Natural habitats, Communities, Ecosystems
- Targets are all related to: Living organisms, Populations or higher levels, Not on individuals (except for endangered species)
- Demonstration through a set of Reference Animals and Plants (RAPs)

Related ICRP Publications

- ICRP 114 examined approaches used to model transfer of radionuclides in the environment
- ICRP 124 considered application of environmental protection in planned, emergency, and existing exposure systems
- ICRP 136 improves and supersedes the DCs in ICRP 108
- ICRP xxx recommends RBE for reference animals and plants (to be published soon)

Reference Animals and Plants

Hypothetical entities used as « points of reference »

- Same principles and same purpose as the reference person
- Defined anatomical, physiological and life-history properties
- To provide conceptual and numerical 'models' and allow 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 during their life cycles

- Some data sets already available, are amenable to further controlled experimentation to bridge the inevitable data gaps
- But they are not, necessarily, the objects of protection.
- Targets of protection are: biological diversity, species, health and status of natural habitats, communities, ecosystems; all related to: living organisms and populations or higher organizational levels

RAPs – the central concept to relate

- Deer
- Rat
- Bee
- Earthworm

- Duck
- Frog
- Trout

- Marine Flatfish
- Crab

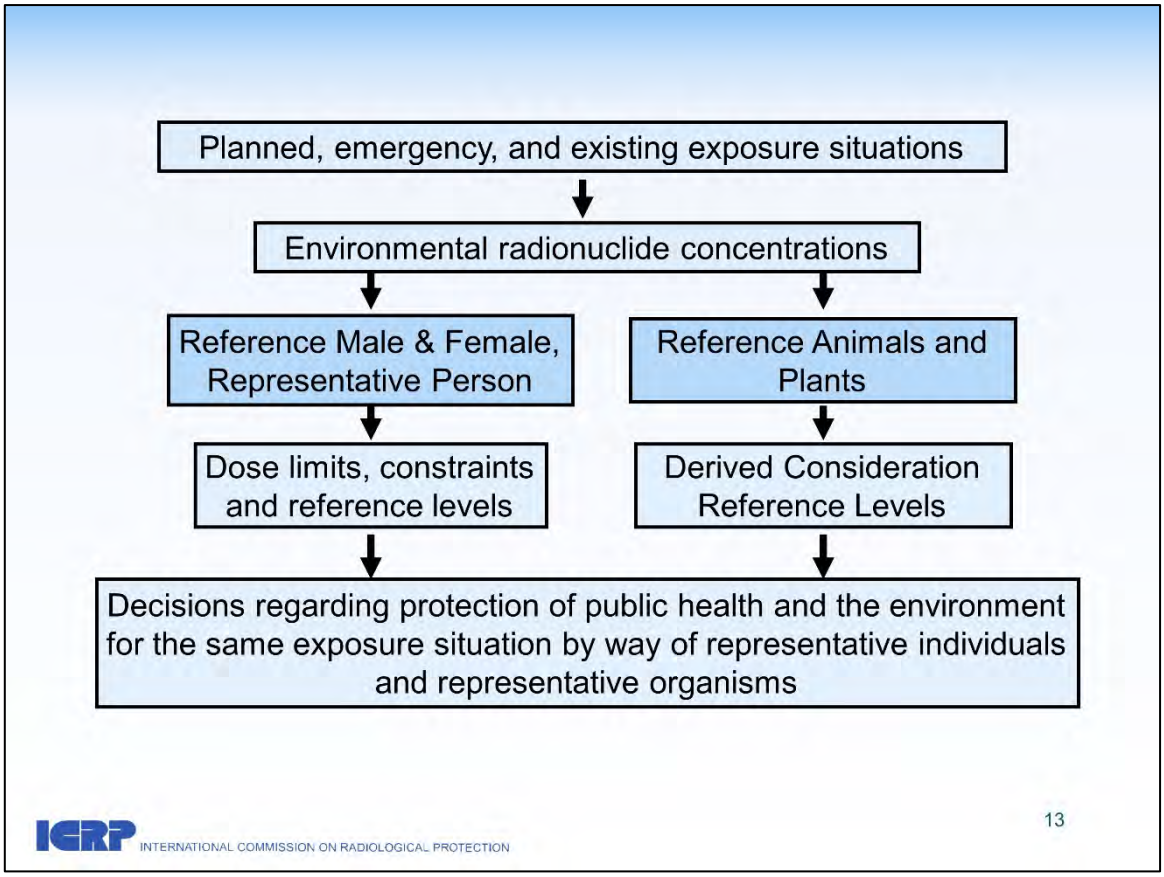
- Pine Tree
- Grass
- Seaweed

- exposure to dose (rate)

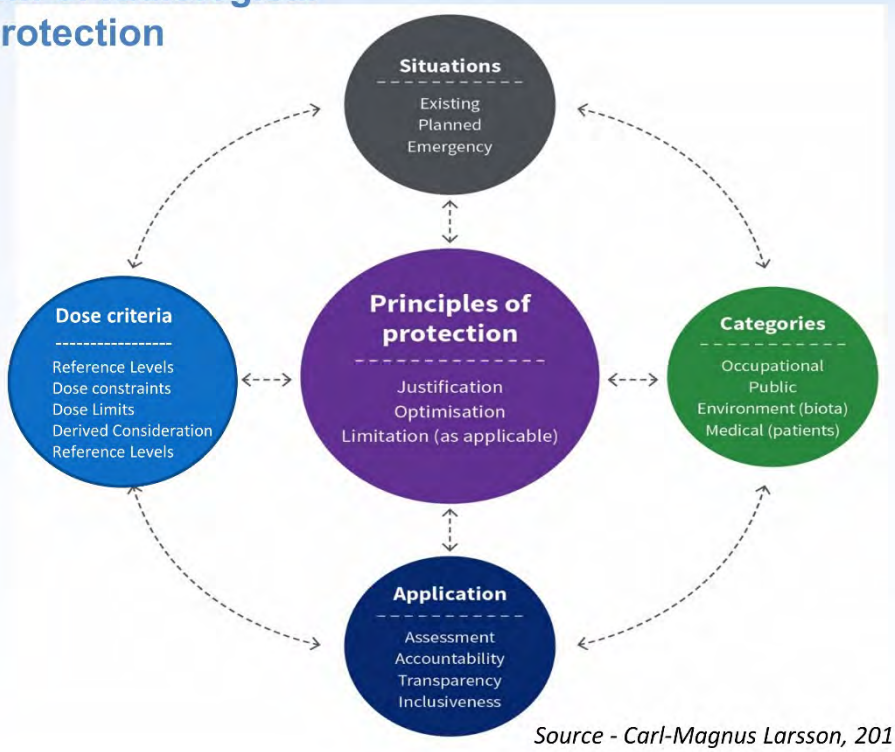
EXPOSURE	
Transfer	Publication 114
Ext/Int exposure & RBE	Publication xxx
DC	Publication 136
RAP	

- and dose (rate) to effects

EFFECT	
Mortality Morbidity	Publication 108
Reproduction	
'Cytogenetic'	
RAP	

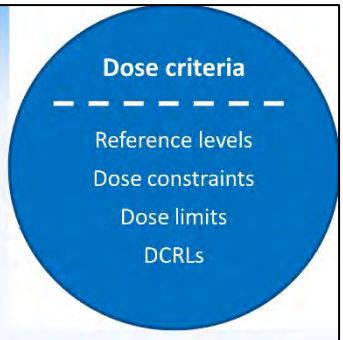


One system of radiological protection



Source - Carl-Magnus Larsson, 2017

Criteria/benchmarks for use in RP



Protection endpoints		Planned exposure	Existing exposure	Emergency exposure
Human health	Workers	Limits		
	Public	Limits	Reference levels	Reference levels
	Patients	N/A		
Environmental health	Biota	Derived Consideration Reference levels		

Endpoints of interest for non-human species

Early Mortality
premature death of organism

Morbidity
reduced well being including effects on growth and behavior

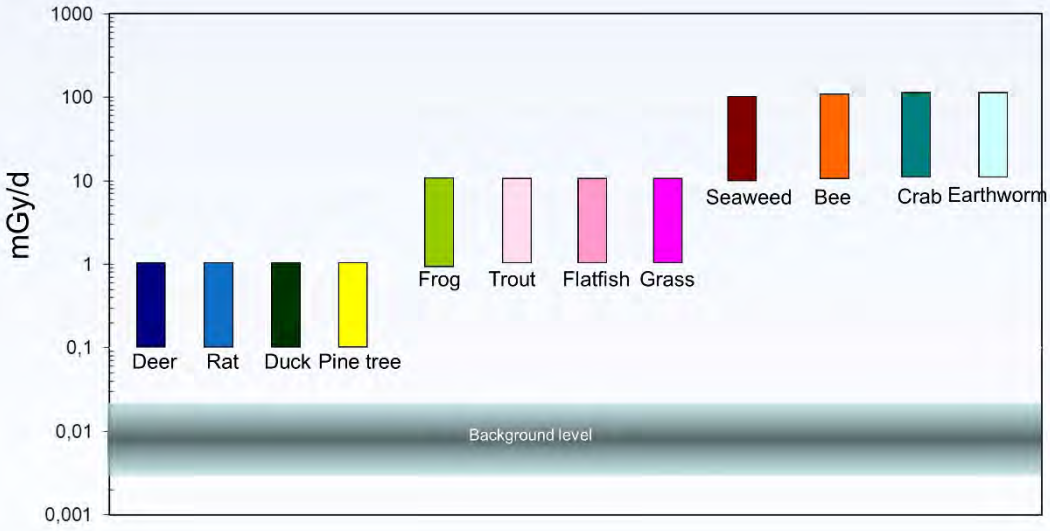
Reproductive Success
reduced fertility and fecundity

- These categories of radiation effects are similar to the endpoints that are often used for risk assessments of other environmental stressors, and are relevant to the needs of nature conservation and other forms of environmental protection
- Reproduction is thought to be a more sensitive effect than mortality

- This knowledge has been used to derive the DCRLs by expert judgement for each RAP-type organism

What is the DCRL?

- *"A **band of dose rate** within which there is **likely to be some chance of deleterious effects** of ionising radiation occurring **to individuals** of that type of RAP (derived from a knowledge of expected biological effects for that type of organism) that, when considered together with other relevant information, can be used as a point of reference to optimise the level of effort expended on environmental protection, dependent upon the overall management objectives and the relevant exposure situation."*



Dose rate (mGy d^{-1})	Reference Deer	Reference Flatfish
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

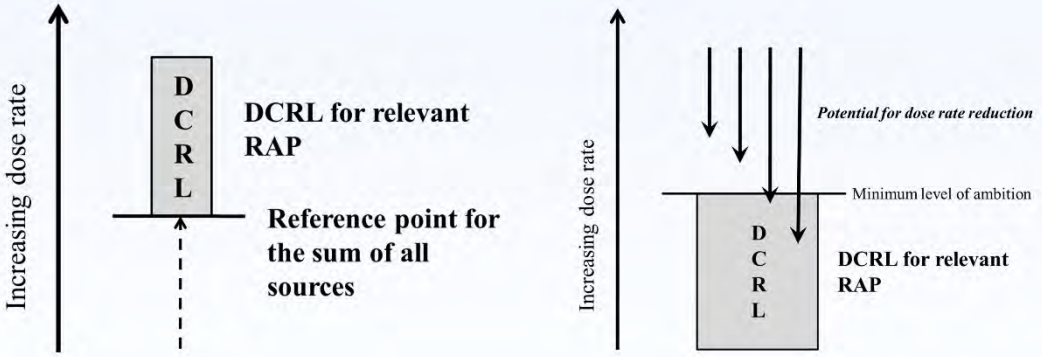
[*Publication 108*]

ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

So how do we use the DCRLs?

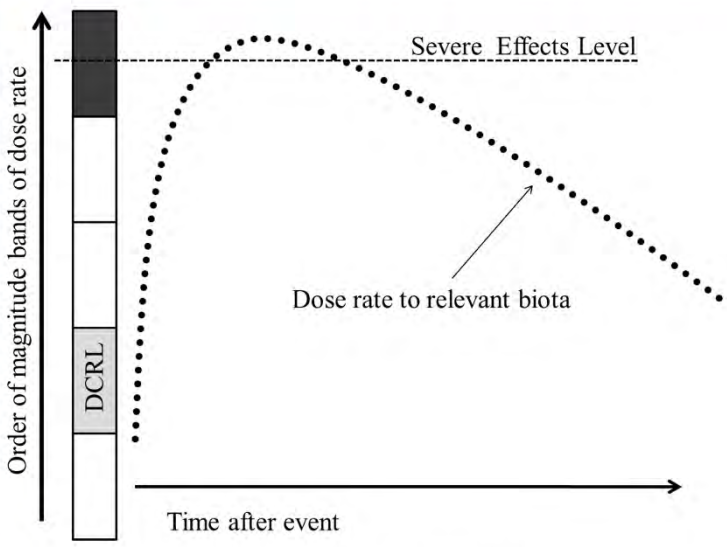
ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Planned and Existing Exposure situations



[ICRP Publication 124]

Emergency Exposure Situations



[ICRP Publication 124]

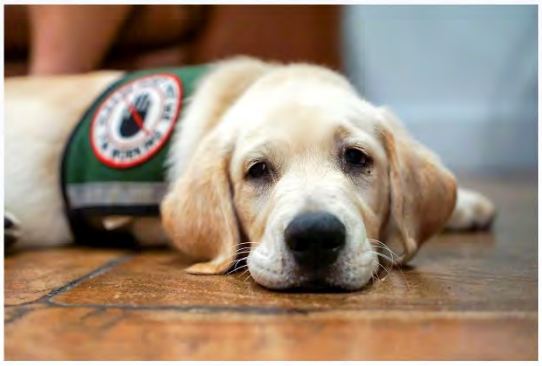
Integration?

One size fits all?

Protection endpoint		Effect category	Dosimetric quantity	Risk
Human health (gender, ages, individual sensitivity…)	Individuals	Tissue reactions; Stochastic effects	Absorbed dose (weighted for RBE); Effective dose	
	Populations			Nominal risk coefficients
Environmental health (RAPs)	Populations	Mortality; morbidity; reproductive success; 'mutations'	Absorbed dose (weighted for RBE)	Risk quotient use of bounds of DCRL range

And not just the 'environment'….

- **Issues with individual animals**
  - Veterinary exposures of companion animals
  - Service animals



Other challenges

- The challenge of field results…
- Are the DCRLs in the right place?
- Do RAPs represent wider wildlife groups?
- Evidence of 'subtle' effects of radiation

Field result controversy

20 August 2010 Last updated at 10:17

Chernobyl species decline linked to DNA

By Victoria Gill
Science reporter, BBC News

The scientists have studied the exclusion zone for more than a decade

Scientists working in Chernobyl have found a way to predict which species there are likely to be most severely damaged by radioactive contamination.

The secret to a species' vulnerability, they say, lies in its DNA.

This discovery could reveal which species are most likely to decline or even become extinct in response to other types of environmental stress.

The researchers published their findings in the Journal of Evolutionary Biology.

Related stories

Mammals decline in Chernobyl zone

Last Updated: Thursday, 20 April 2006, 05:55 GMT 06:55 UK

E-mail this to a friend Printable version

Wildlife defies Chernobyl radiation

By Stephen Mulvey
BBC News

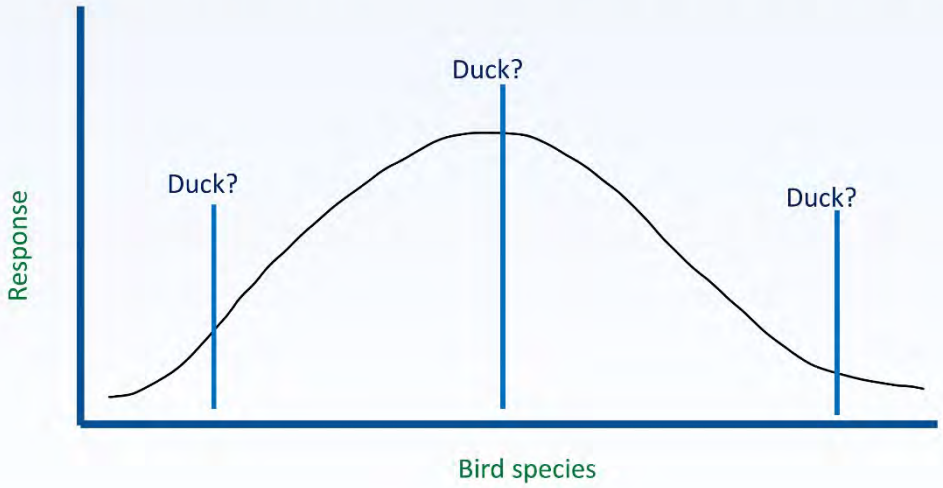
It contains some of the most contaminated land in the world, yet it has become a haven for wildlife - a nature reserve in all but name.

The exclusion zone around the Chernobyl nuclear power station is teeming with life.

As humans were evacuated from the area 20 years ago, animals moved in. Existing populations multiplied and species not seen for decades, such as the lynx and eagle owl, began to return.

There are even tantalising footprints of a bear, an animal that has not trodden this part

How representative are the RAPs?



'My' thoughts on what's needed

- How representative are the RAPs?
- What are the key factors determining interspecies vulnerability to radiation?
- Combined ecological stressors (how does this fit with humans too)
- Understanding the consequences (in integration terms) of different endpoints for humans and the environment

But…!

- While there is an increased need to demonstrate that plans and animals are protected
- We do have ONE system of radiological protection (needs work but the pieces are there)
- Update to the RAPs (TG99)
- Understanding implications of management decisions incorporating environmental decisions (e.g. TG105)
- Aiming for fit for purpose, robust and integrated system

ANNEX B

PRESENTATION FROM GROUP 1

Breakout group 1

Q1: In practice, what further is necessary to integrate protection of the environment in radiological protection?

Members of the breakout group: EAN, HERCA, MELODI, WHO, WNA, EUTERP, EPRI

ICRP

Defining the scope of the question

- What is the environment:
  - With / without the non-biota?
  - Environment where humans are present, or broader?
- Different exposure scenarios require different approach
  - Planned / existing / emergency

Agreements within the breakout group

- RP system needs to evolve towards an integrated system
- RP system should be simple and understandable for the public
- Role of ICRP:
  - Prepare for advice to the different scenarios
  - Take into account the relevant stakeholders
  - Provide tools to help decision makers

Further statements of breakout group

- RP system should build upon basic research, but outcome of this research should be rationalised towards pragmatic guidance
- Look at other ecological stressors, learn from their approaches where relevant
- Take into account that in reality there are multiple stressors
- Integrated RP system may have different end points for human / other biota. This is not an issue, but stochastic effects difficult to calculate and take into account the long term effects.

Varia

- RP system should be simple but able to tackle complex situations
- Communication to stakeholders should be simple
- Stakeholders depend on the scenario but can be: RP experts, environmental experts, policy makers, politicians and the public

Breakout group 1

Q2: What would be the practical implications of a more individualised system of radiological protection based on variations in individual response to radiation exposure?

Members of the group: EAN, HERCA, MELODI, WHO, WNA, EUTERP, EPRI ICRP

ICRP

- **ICRP** already takes into account the radiosensitive populations (e.g. young, pregnant women); limits are already based on covering 99% of the population for tissue reactions ; The dose limits are established to ensure that the thresholds are not exceeded.

Factors influencing individual sensitivity

- Individual sensitivity depends mainly on genetic, and epigenetic constitution, the latter reflecting the life-course experience, such as age, life style, smoking,…

Caveats from many group members regarding a more individualised system

- Difficult to explain
- Complex legislation
- Ethical aspects:
  - Privacy issues – personal data
  - Potential insurance misuse
  - Who owns the information on individual sensitivity?; eg If individual possesses these data, should they declare it to insurances???
  - Concerns about compensation issues

Different scenarios

- Medical: therapy / diagnosis
  - Arguments pro improving individual radiological protection:
    - High number of diagnoses, treatments
    - Tests are being developed (but still difficult to interpret)
- Workers
  - translation from medical = difficult as different doses and dose rates, so mechanisms may differ. However there are some data that monogenic diseases (e.g. ataxia telangiectasia) increase the individual risk. However individual should be free to decide him/herself within the existing legal framework.
  - Some space agencies already decide on the basis of individual sensitivity on the tasks of astronauts.
- Population: not doable to further refine

ANNEX B
PRESENTATION FROM GROUP 2

Q1 Objectives

- The environment shall be considered by radiation protection
- Environmental protection is entering national regulations as broadly described objectives, but no specific criteria
- Regulators lack competent personnel for assessing radioecological situation
- A training of RP experts for environmental impact and protection is desirable, and vice-versa

Q1 Present Status

- Radiation protection is not the only concern in environmental protection and conservation of species, other players more important
- We cannot sit back and “wait for more evidence”, this would not be accepted by the public
- Environmental studies of radiation exposure don’t have to be expensive
- ALARA approach already takes into account economic, social *and environmental* effects

Q1 Consequences for RP System

- The radiation protection system is sound and does not need to be altered to take into account the environment
- "DCRL are our minimum ambition in remediation after an accidental situation":
  Attention: soon DCRL may be considered as limits

→ Fears that RP system may become disproportionate

Q1 To-Do list

- Scientific base of environmental effects must be improved:
  - Radioecological studies at accident sites (Chernobyl, Fukushima, …)
  - Radiological endpoints of biota
  - A plethora of scientific studies can be imagined, but which ones are relevant ?
- Balanced communication to the public
- Remediation of accident sites: total clean-up (and thus, destruction) is contrary to environmental protection.

Q2 Basic Assumptions

- There is variation on radiation sensitivity between members of the population (a fact)
- There are means to predict the variation, based on genetic or environmental effects (presently, a hypothesis)

- How should these two statements influence radiation protection practice ?

Q2 Public and Patients

- General public:
  - Lifestyle choices (diet, exercise, …) have higher influence on incidence of illness and lifespan that potential effects of radiation exposure (< 1 mSv/y)
  - Cannot monitor the whole population with dosimeters
- Patients
  - Individual sensitivity shall be taken into account to optimize treatment outcome.
  - This is between the doctor and his patient

Q2 Workers

- Thanks to optimization, effective dose of professionally exposed persons usually low
- Factors of 2 in individual sensitivity can be absorbed by the present system of protection
- *How should we react if some sensitivity variations are a factor of 10 ?*
- Individual sensitivities shall not become a reason for professional discrimination
- Voluntary job adjustments or changes possible, but who bears the cost ?

Q2 Change RP systems ?

- No change of RP system (effective dose, justification, limitation, optimization, exposures ituations, …) recommended
- Individual sesnitivities to be taken into account by
  - Education
  - Communication
  - Optimisation