NKS Seminar: Research, Operations and Beyond
Stockholm, May 2022

Conservatism, Reasonableness and Low Dose Decision-Making

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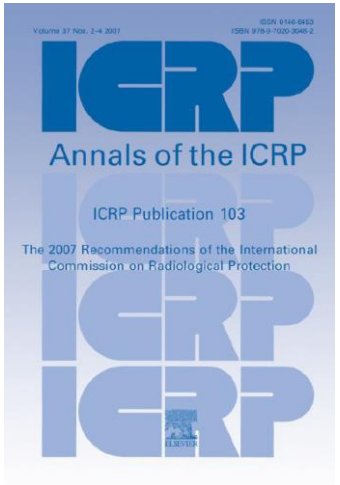
Why change?

- The ICRP-based System of Protection evolves:
  - ICRP Publication 1 1959
  - ICRP Publication 9 1966
  - ICRP Publication 26 1977
  - ICRP Publication 60 1990
  - ICRP Publication 103 2007
  - **ICRP Publication ??? 2029/2030??**



ICRP have announced a review process which will cover the next ~ 8 years

So how do you want the system to evolve during this review????

The broader context

But its not just the ‘system of protection’ itself – its also **how we implement it**!

- As RP professionals
- In public policy and as regulators

As a profession we are perhaps too cautious – and we are certainly very conservative in our general approaches.

Are we fixated on ‘ever lower doses’ and forever chasing µSvs?

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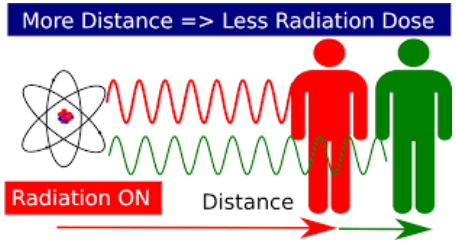

IRPA System of Protection Consultation

Practitioner's views on the System of Protection - and how it can be communicated

- General perceptions: complexity & 'understandability'
- Presentation of uncertainty in risk estimates at low dose
- Context of natural background exposure
- Dose limitation and dose limits
- ALARA and Reasonableness (+ Conservatism & Graded Approach)
- Communication and public understanding

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Memorandum

IRPA Consultation: is the system of protection 'fit for purpose' and can it be readily communicated? Views of the radiation protection professionals

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Abstract

The system of protection, which provides the basic underpinning philosophy and principles for radiation protection, is constantly evolving in the light of developing scientific understanding and practical experience. Over recent times there has been significant learning from experiences relating to the Fukushima accident, and there is also increasing recognition of the importance of enhancing public understanding of radiation and risk. The practical application of radiation protection is undertaken by thousands of practitioners around the world, and it is IRPA's task to ensure that this experience is fed back for the benefit of all. This Memorandum reports the outcome of IRPA's consultation on the system of protection. The principal issues raised in the consultation include general perceptions of the system, risk uncertainties at low dose, the context of natural background exposure, dose limits and limitation, ALARA and reasonableness, and public understanding and communication of radiation and risk.

[1] President, International Radiation Protection Association (IRPA). Corresponding author on behalf of IRPA.
[2] Memorandum approved by the IRPA Executive Council: Ana María Bombas (Argentina), Marie-Claire Cantone (Italy), Christopher Clement (Canada), Roger Coates (UK), Eduardo Gallego (Spain), Bernard Le Guen (France), Alfred Hefner (Austria), Klaus Henrichs (Germany), Jong Kyung Kim (Korea), Sigurdur Magnusson (Iceland), Richard Toohey (USA), Hiroko Yoshida (Japan).
[3] Former President, IRPA.

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Report published in Journal of Radiological Protection 2018 (open access)
- see IRPA website

IRPA System of Protection Consultation

Subtext

Have we gradually developed an over-complex system which is becoming removed from ‘common sense’?

Is the system, and the way it is implemented, delivering reasonable ‘value for money’ for society?

Memorandum

IRPA Consultation: is the system of protection ‘fit for purpose’ and can it be readily communicated? Views of the radiation protection professionals

IRPA Consultation with the AS - Top tier issues arising

Practical Protection Issues

Prudence and Conservatism

ALARA and Reasonableness

- and the Graded Approach

Low dose risks

Essentially relating to how to make decisions at low doses!

Prudence and Conservatism

Prudence – what does it mean?

"*The ability to recognise and follow the most suitable or sensible course of action*"

Also: *'wisdom', 'suitable', 'sensible', 'care', 'caution', 'good judgement', 'carefully considered choices'*

- At the level of principle who could possibly disagree?

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- At the level of principle who could possibly disagree?

But these concepts are judgemental

What is 'suitable', 'sensible' or 'good judgement' in one situation (eg high risk level) may not be appropriate at a much lower risk level

Should we take the same approach at 100mSv and 0.01 mSv??

An analogy - Prudent Walking

Glacier walking in the High Alps

An analogy - Prudent Walking

Glacier walking in the High Alps

Summer walk around my village

Prudence and conservatism

In day to day practice, prudence has translated into the need for a *conservative approach*

– in assessments, safety cases and operational approaches.

This requirement is often reflected in international and regulatory guidance and expectations.

- But this inevitably introduces an intrinsic bias towards lower and lower doses.

If we over-estimate doses, this can lead to a misallocation of resources

So the key question is: **How much prudence and conservatism is appropriate in various practical situations?**

Clearance - a Case Study in prudence and conservatism

Clearance allows the removal of material (including wastes and reusable material) from regulatory control.

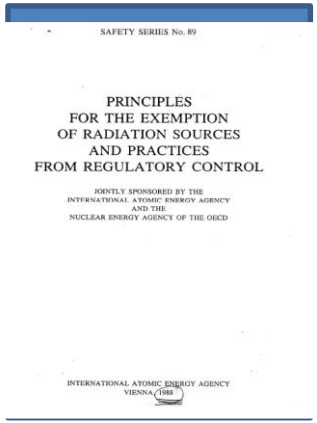
or

Like exclusion and exemption, it is aiming to focus the regulatory system onto issues of significance, not trivia.

Clearance criteria

What is a trivial dose?

- what is likely to be acceptable to individuals?
- context of natural background exposure


SAFETY SERIES No. 89

PRINCIPLES
FOR THE EXEMPTION
OF RADIATION SOURCES
AND PRACTICES
FROM REGULATORY CONTROL

JOINTLY SPONSORED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY
AND THE
NUCLEAR ENERGY AGENCY OF THE OECD

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA 1988

Conclusion: '**Some tens of µSv per year**'

IAEA Safety Series 89, 1988

Based on LNT and other prudent judgements

- eg 'a few percent of natural background'

So how to put clearance into practice?

From philosophy to the practical application of clearance:

a) Application to a specific situation
b) Conversion to Activity Concentration
   [µSv/y to Bq/g]
c) Practical measurement margin – confidence in the outcome because it is legal compliance
d) Sum of fractions – combination of several nuclides
e) Activity distribution in cleared material

Conservatisms in the system

	Description	Factor of Conservatism
a)	Application to a specific practice	3
b)	Conversion to Activity Concentration	3 - 15
c)	Practical measurement margin	1.5 – 2.5
d)	Sum of fractions	1.2 - 2
e)	Activity distribution in the cleared stream	2 - 5
Cumulative Impact (Range)		33 - 1125
Typical Cumulative Impact		**100 - 1000**

Clearance outcome and implications

'*Some tens of μSv/y*' was set as a (very) prudent level.

In practice, clearance gives actual doses a factor of at least 100 lower - not more than around **0.1 μSv/y**

Implications: Managing waste as radioactive material is much more expensive than 'free release'.

> Eg. UK experience: to reduce from 1 Bq/g to 0.1 Bq/g for Cs137 costs several £ Billion over lifetime.

Is this money well spent??

Prudence for RP - artist's licence!

At a few tens of mSv

Prudence for RP - artist's licence!

At a few tens of mSv

At a few µSv

Prudence - wider implications

Prudence must be balanced with other ethical values:

Eg **Beneficence** – doing the best that can be done with society's resources

Society has limited resources: if used on inappropriate prudence/conservatism, this is an opportunity cost which does not give best value for society

How do we save the most lives?

We have drifted into accepting conservatisms in our day to day work, without consciously assessing its impact or what is really appropriate.

Indeed, we don't really know how much conservatism we have – its usually well hidden.

Optimisation, ALARA and Reasonableness

It is universally accepted that the **optimisation principle** is

- the **central pillar for the practical implementation of radiation protection**
- the **dominant factor controlling exposures in any well-developed system of protection**.

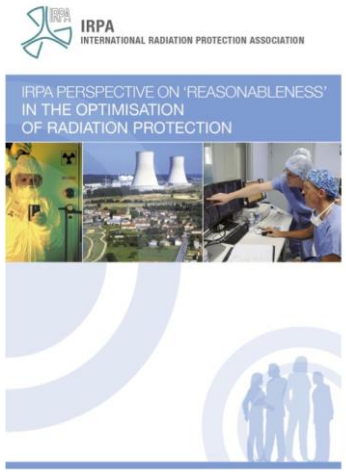
As such it is a much-discussed topic:

- ICRP
- IAEA
- NEA
- IRPA etc

What are the concerns from the IRPA consultation?

- Optimisation/ALARA is the controlling influence in practical decision-making
- In many cases we have drifted into a regime of ‘ever lower doses’ – effectively an approach of minimization, not optimization. This is perhaps a reflection of our inherent over-conservatism, particularly amongst the regulatory community
- We have lost a sense of proportionality in the way we consider very low exposures

The IRPA Perspective on Reasonableness



Underpinning Factors

a. RP Principles

b. LNT/Threshold

c. Ethical Values

d. Natural background context

Guiding Principles

1. Judgement call

2. Proportionality

3. Stakeholder engagement

4. All Hazards Approach

5. Avoid over-conservatism

6. Value for Society

7. De Minimis

8. Safety culture

9. Audit trail

https://www.irpa.net/docs/IRPA%20Perspective.pdf (2021)

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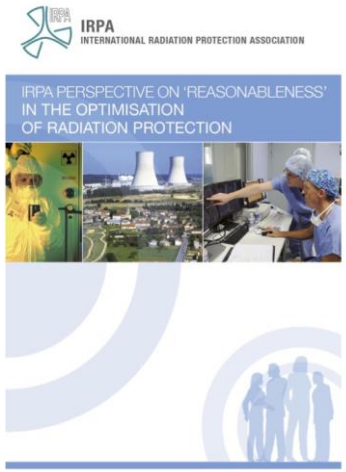

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Decision-making at Low Dose

The Key Issue

Why do we allocate significant societal resources to reduce some relatively low exposure levels to even lower levels?

We must look again at how to take decisions at very low doses

- around ‘a few mSv’ and lower
- ie within the range of natural background variability

The key issue - context

How to take decisions at very low doses

- around ‘a few mSv’ and lower
- ie within the range of natural background variability

Characteristics:

- the science is uncertain and contentious
- risk perception has a very strong influence in many situations

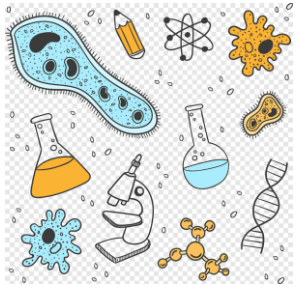
So what scientific steps should we take?

Continue studies on low-dose health effects

- but don't hold your breath for a breakthrough!

Don't expect a clear answer over the next decade

- Threshold advocates will remain strong (especially in the US!)
- LNT advocates will remain strong



And when/if an answer comes ……

So what next - cultural steps ?

To make progress over the next decade, focus on cultural and procedural steps:

- the basis for decision-making at low doses (‘a few mSv’ or less).

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  - if there is a risk, then its very small (and well within the range of risk commonly accepted in society)
- These doses are well within the variability of natural background (including impacts due to individual decision-making)
- But in some situations perception of risk is a powerful driver

Low-dose Decisions: Is there an imbalance?

An Illustrative example - Compare and contrast two types of exposure:

Exposure from the clearance system

versus

Exposure from a holiday

The classic example

Clearance – the 10 µSv/a criterion

Actually its nearer 0.1µSv/a because of conservatisms!

Doses to a very few individuals!

- up from 2mSv/a to 2.0001mSv/a

It costs many tens/hundreds £M

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Cornwall holiday in the UK

Hundreds of thousands of holidaymakers each year

Each person gets several tenths mSv additional dose

No-one is remotely concerned or interested

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No-one is remotely concerned or interested

Is this giving value for money (best use of resources) to society?

Does it align with Common Sense?

Common Sense

Definitions:

- The basic level of practical knowledge and judgment that we all need to help us live in a reasonable and safe way.
- Practical judgment that is independent of specialized knowledge, training, or the like.
- The natural ability to make good judgements and behave sensibly.
- Sound and prudent judgment based on a simple perception of the situation or facts.

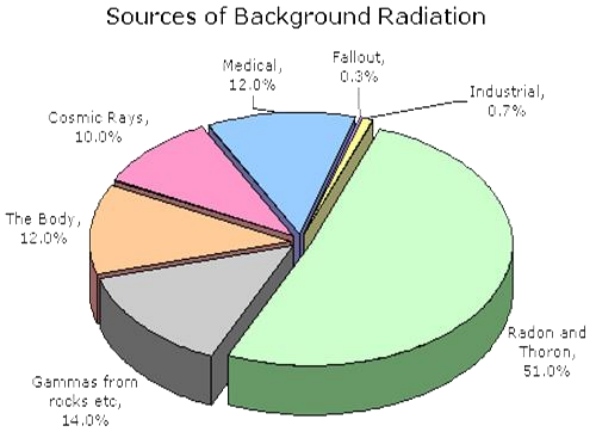
A VALUE that is perhaps missing from our system?

The context of natural background exposure

- Every person receives at least 2mSv/a :
  - This is the basic minimum (and many receive significantly higher doses)
  - Everything else is an addition to this

- Personal lifestyle decisions add a ‘Delta’ to this:
  - Whether to change house
  - Where to holiday
  - Whether to fly
  - What to eat (….. etc)

This Delta could easily be ± 0.5 mSv or more



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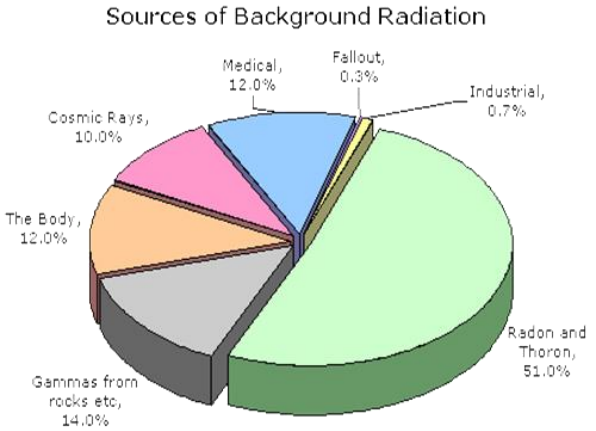
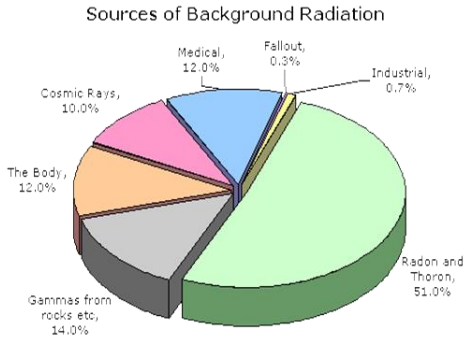


- Such decisions are made daily, with no concern or interest (and usually no knowledge) of radiation risk.

  Rightly so, but ……

The context of natural background exposure

- Natural background exposure at the basic level is classed as ‘existing exposure’ and usually regarded as uncontrollable
- But these ‘Delta’ exposures of individual choice are ***in principle*** controllable:
  - Property safety laws: [move house, or holiday accommodation]
  - Risk information laws: [warning on airline tickets]
  - Food safety laws: [restrict higher dose foods]



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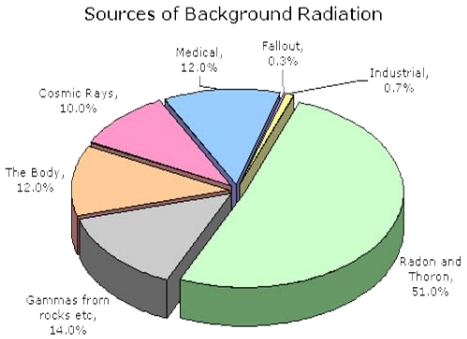
- But these ‘Delta’ exposures of individual choice are ***in principle*** controllable:
  - Property safety laws
  - Risk information laws
  - Food safety laws
- OK – most of us would agree that it would be disproportionate to control these exposures at these low levels, but …… they are controllable!
- Our system of protection has decided to allow them – they are ‘deemed acceptable’.

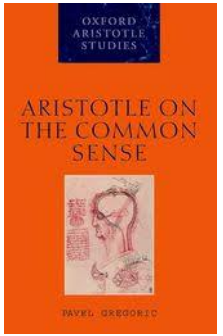


Common sense again

……. Why is it acceptable to allow widespread controllable exposures at levels of significant fractions of a mSv?

……. Whilst requiring some exposures to a very few persons to be reduced to µSv levels and lower?

- It is almost impossible to explain to peers
- This places unnecessary burdens on society
- It has the potential to call our profession into disrepute



Decisions at low dose

- **How to take decisions at ‘a few mSv/a and lower’**
  - when we don’t really know the risk, other than ‘if there is a risk, its very small’.
- LNT in principle provides a prudent basis for the system of protection,
  - but it needs a sense of proportionality in applying this prudence at these very low doses.
  - It must not be the only input to decision-making.
- We need to develop a more pragmatic framework:
  - which acknowledges the uncertainties,
  - recognises the wider framework of our radiation world,
  - and takes account of ‘common sense’
  - which is proportionate to the level of risk

How to address ‘Public Concern’

We should make use of the context of natural background, and its variability, in our public interactions

But we should beware reacting to ‘perceived public concern’ by imposing very low dose decisions:

- Does driving to low doses really ease public concern?
- Or does it make them think: ‘if it needs to be that low, this man-made radiation must be really dangerous’
- Hence it actually feeds ‘radiation phobia’

And remember that someone has to pay. Usually its all of us!

The System of Protection itself, and how we implement it, should not try to anticipate any perceived public concern by reinforcing low dose expectations

Implications (1) - Regulators

Regulators and authorities

- should not require/expect formal ALARA assessments when doses are a small fraction of the limit or reference level
- should not seek to anticipate ‘perceived public concern’ by imposing unnecessarily small exposures
  - which only serve to fuel radiation phobia

Implications (2) – Operators (etc)

But those owning the exposure situation should be prepared to consider local, helpful, proportionate, ‘good value’ actions to meet good practice:

- For example based on safety culture considerations
- Or improving wider stakeholder well-being in a proportionate way

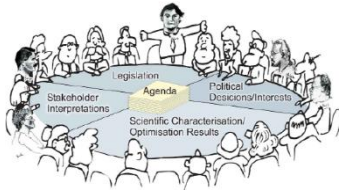
Implications (2) – Operators (etc)

But those owning the exposure situation should be prepared to consider local, helpful, proportionate, 'good value' actions to meet good practice:

- For example based on safety culture considerations
- Or improving wider stakeholder well-being in a proportionate way

Stakeholder engagement is a central tenet of effective optimisation:

- It should be timely, proportionate, empathetic, and educative for all parties



Implications (3) – RP Experts

RP experts should:

- Never ever say that 'the risk from radiation is 5% per Sv'
  - at the levels of importance we just don't have that information!

- Always be prepared to discuss 'Is it safe?'
  - Yes, it's a subjective concept!
  - But in normal usage, 'safe' does not imply 'totally free from risk'
  - See IRPA Guidance on Communicating Radiation and Risk

    https://www.irpa.net/members/IRPA%20Guidance%20Public%20Engagement.pdf

Conclusions and Recommendations

How to build a better, stronger and more relatable approach to optimisation and low-dose decision-making:

- We need to accept the limitations of the current science, and focus on how we take decisions at the low doses of real relevance to society
- Give greater emphasis to natural background exposure and its variability, both in general decision-making and in public interactions
- Relax a little from our natural ‘over-conservatism’ at these very low doses
- Broaden the basis for assessing tolerability of risk based purely on LNT, taking account of wider inputs such as:
  - the context of natural background and its variability
  - public perception and the avoidance of radiation phobia
  - the need for proportionality and to ensure value in the use of society’s resources.
- Continue to prioritise public engagement on radiation risk, but avoid an ‘auto-response’ of seeking ‘ever lower doses’

And recognize the value of Common Sense