Justification, optimisation and dose limitation following nuclear accidents

An ICRP Perspective

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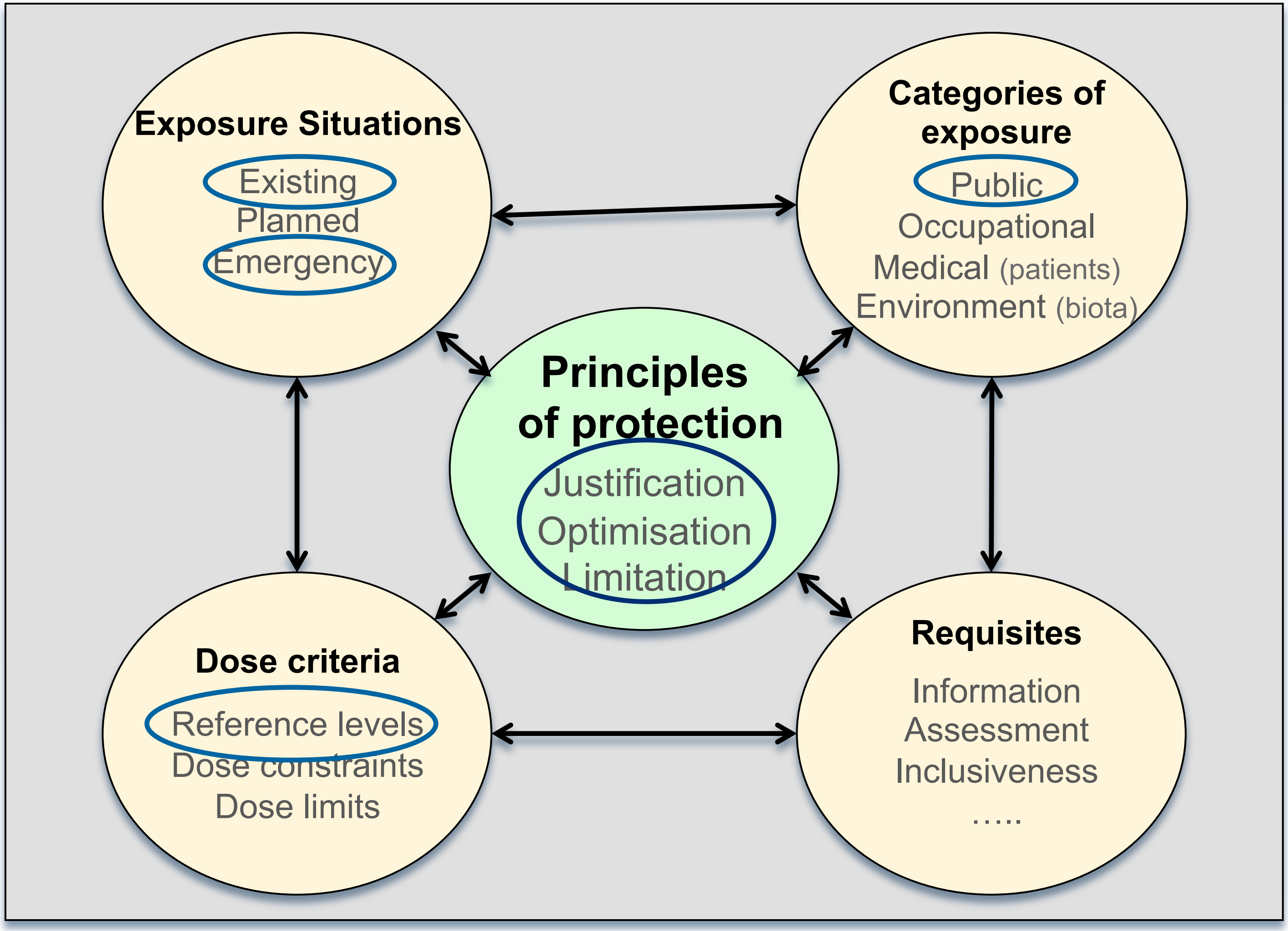
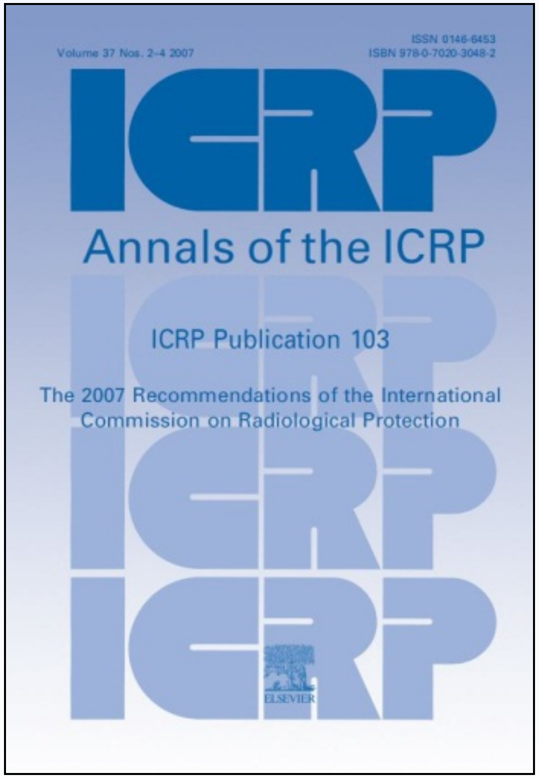
ICRP Committee 4
ICRP TG93

System of Protection



Relevant ICRP publications



Publication 103

Fundamental Recommendations

Publication 109

Emergency Situations

Publication 111

Post-Accident Recovery

The impact of Fukushima Daiichi NPP accident on ICRP guidance

The impact of Fukushima Daiichi NPP accident on ICRP guidance

- The dose criteria for planned exposure situations introduced by ICRP in Publication 60 and retained in ICRP Publication 103, i.e. dose limits for the public (1 mSv per year) and for occupationally exposed workers (20 mSv per year) are now **well accepted worldwide**

- In contrast, the dose criteria introduced in Publication 103 for selecting reference levels in emergency and existing exposure situations (20 -100 mSv and 1- 20 mSv, per year respectively) **are still often misunderstood and even disputed**

- How to harmonize and coherently apply RP System to all exposure situations?

ICRP TG93 to update of Publications 109 & 111

Full members

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In collaboration with:

Fukushima dialogue with stakeholders
ICRP members: Jacques Lochard (MC), Ohtsura Niwa (MC), Chris Clement (Scientific Secretary), Nobuhiko Ban (C1), Jean-François Lecomte (C4)

TG93 and related meetings

TG93 meetings

1st	2013 – November	Fukushima
2nd	2014 – May	Fukushima
3rd	2014 – November	Paris
4th	2015 – April	Paris
5th	2015 – July	Tokyo
6th	2016 – July	Tokyo
7th	2017 – February	Paris
8th	2017 – July	Tokyo

ICRP dialogue meetings

13 meetings during 2011 – 2017	Fukushima pref.

Stakeholder meetings

2015 & 2017	Fukushima dialogue	Tokyo/Fukushima
2016	NERIS	Paris

Application of the Commission's Recommendations for the Protection of People in the Event of a Nuclear Accident - Update of Publications 109 and 111

Draft report: structure

Editorial
Abstract
Preface
Main points
Executive summary
Glossary

1. Introduction
2. **General considerations**
3. **Emergency response**
4. **Recovery**
5. Emergency and recovery preparedness
6. Conclusions
7. Annexes

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2. GENERAL CONSIDERATIONS

- 2.1. Accident timeline
- 2.2. Effects of nuclear accidents
  - 2.2.1 Radiological health effects
    - 2.2.1.1 Deterministic effects (harmful tissue reactions)
    - 2.2.1.2. Stochastic effects
  - 2.2.2. Societal and economic effects
    - 2.2.2.1 Societal effects
    - 2.2.2.2. Psychological effects
    - 2.2.2.3. Economic impacts
  - 2.2.3 Environmental effects
- 2.3. Protection of people and the environment
  - 2.3.1. Radiological protection considerations
  - 2.3.2. Justification
  - 2.3.3 Optimisation
    - 2.3.3.1. Optimisation in early and intermediate phases
    - 2.3.3.2 Optimisation in the long-term phase
    - 2.3.3.3. Reference levels

Accident timeline

In the new publication the Commission is proposing to adopt the following sequential time phases to characterise the timeline of the accident

	Early phase	Intermediate phase	Long-term phase
Preparedness	Emergency response		Recovery
	Emergency exposure situation		**Existing exposure situation**

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3. EMERGENCY RESPONSE

3.1 Characteristics of the early and intermediate phase

3.2 Protection strategies

3.2.1. Early phase

3.2.2. Intermediate phase

3.3 Protection of the public

3.3.1. Radiological characterisation

3.3.1.1. Monitoring of the environment

3.3.1.2. Monitoring of individuals

3.3.2. Protective actions

3.3.2.1. Evacuation and relocation

3.3.2.2. Sheltering

3.3.2.3. Iodine thyroid blocking

3.3.2.4. Foodstuff management

3.3.2.5. Decontamination of people

3.3.3. Termination of emergency protective actions

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3. EMERGENCY RESPONSE (cont.)

3.4 Protection of emergency responders

- 3.4.1. Protection of emergency responders during the early phase
  - 3.4.1.1 On-site
  - 3.4.1.2 Off-site
- 3.4.2. Protection of emergency responders during the intermediate phase
  - 3.4.2.1 On-site
  - 3.4.2.2 Off-site
- 3.4.3. Cumulative lifetime exposure

3.5 Preparing for the long-term phase

- 3.5.1 Permanent relocation
- 3.5.2 Criteria for moving from the intermediate phase to the long-term phase

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4. LONG-TERM PHASE/RECOVERY

- 4.1. Characteristics of the long-term phase
  - 4.1.1. Living in contaminated area
  - 4.1.2. Characteristics of exposure
  - 4.1.3. Exposure pathways
- 4.2. Protection of the population
  - 4.2.1. Protection actions implemented by authorities
  - 4.2.2. Self-help protective actions
  - 4.2.3. Radiation monitoring and health surveillance
    - 4.2.3.1 Radiation monitoring
    - 4.2.3.2 Health surveillance
  - 4.2.4. Foodstuff management
- 4.3. Protection of recovery responders
- 4.4. Protection of the environment
- 4.5. Waste management
- 4.6. Evolution and termination of recovery actions

Radiological protection considerations

Justification (1)

The principle of justification ensures that any decision that alters a radiation exposure should do more good than harm.

- The principle of justification should be applied at different levels/ scales and over different time-frames: situations evolve and prevailing circumstances change
- Overall benefit and harm of a set of protective actions must be assessed when justifying the protection strategy
  - Consider short and long term impacts of individual protective actions, not only in terms of dose reduction but also in terms of effects on the health and well being of various groups of people

Justification (2)

Emergency exposure situations:

- Justification of the initial decision to intervene to reduce doses
- Justification of the protection strategy subsequently selected
  - Lessons learned from Fukushima experience of evacuation
    - Requires adequate planning

Existing exposure situations:

- Justification of the decision taken by the authorities at the end of the emergency exposure situation, to allow people to live permanently in the long term contaminated areas
- Justification of the protection strategies to improve the radiological situation at the local level
  - Lessons learned from Fukushima experience of decontamination
    - Requires establishment of realistic dose criteria

Optimisation (1)

The principle of optimisation of protection ensures that all exposures are kept as low as reasonably achievable (ALARA) with restrictions on individual exposures to limit inequity between individuals

- The principle of optimisation should be applied to those situations for which protection strategies have been justified
- Optimisation of the protection strategy ensures: the likelihood of incurring exposures; the numbers of people exposed; and the magnitude of their individual doses are ALARA
  - The level of protection is the best under prevailing circumstances
  - To avoid inequitable outcomes, there should be restrictions on individual doses from a particular source, through application of reference levels

Optimisation (2)

Emergency exposure situations:

- Prevailing circumstances should drive optimisation of protection strategy (maintain flexibility). Consider:
  - Radiological aspects (e.g. source term, ambient dose rates …)
  - Non-radiological aspects (e.g. time of day, weather, children …)

Existing exposure situations:

- Optimisation can be implemented step-by-step. Consider:
  - Where , when and how people are exposed
  - Selection of appropriate actions under the prevailing circumstances
    - Protect people with the highest exposure, and in parallel reduce all exposures ALARA
  - Implementation of protection strategy (including self help actions)
  - Evaluation, through monitoring of people and the environment

Reference levels

- Indicators of the level of exposure considered tolerable, given the prevailing circumstances
- Tools to support the practical implementation of the optimisation principle in existing and emergency exposure situations by:
  - identifying exposures requiring more attention
  - reviewing exposure scenario to further improve protection
- Values to inform decisions on protection strategies
- Can be specified in measurable quantities to facilitate their application in specific circumstances but these derived quantities must be realistic
- Depending on the circumstances (i.e. presence of long-lived radionuclides), it may be appropriate to use time-varying reference levels to improve the situation progressively

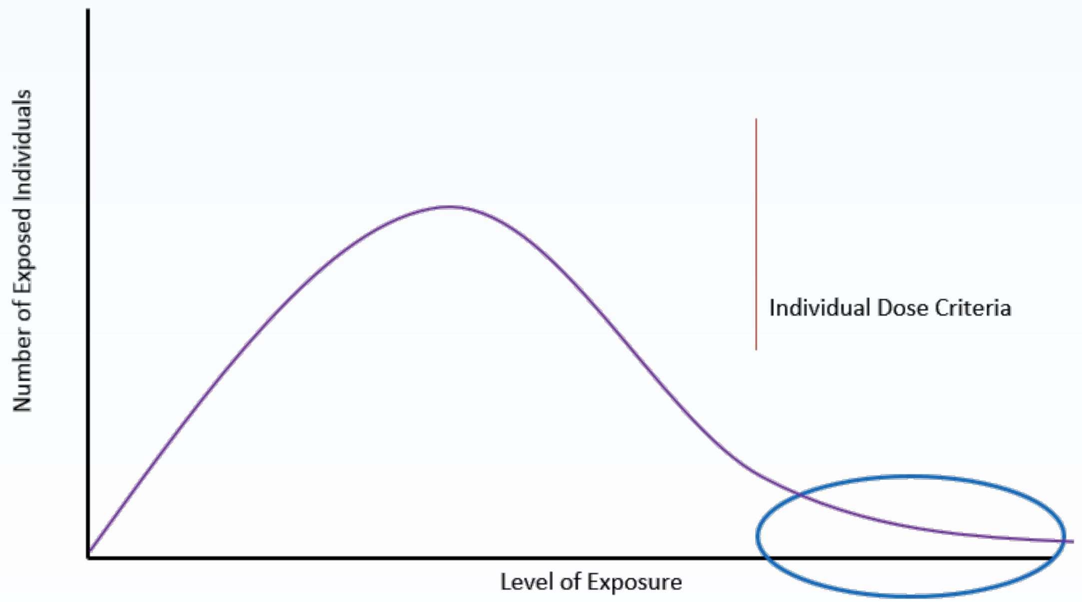
Proposed* reference levels for optimising protection for members of the public in case of nuclear accidents

Emergency exposure situation	Existing exposure situation
100 mSv or lower [a]	10 mSv/y or lower [b,c]
[a] Either in a short period or over a year [b] The long term goal is to reduce exposures to the range of 1 mSv/y or less [c] This clarifies the previous recommendation of the Commission to select RL for the optimization of protection of people living in contaminated areas in the lower part of the 1-20 mSv/y band	

ICRP: future perspective

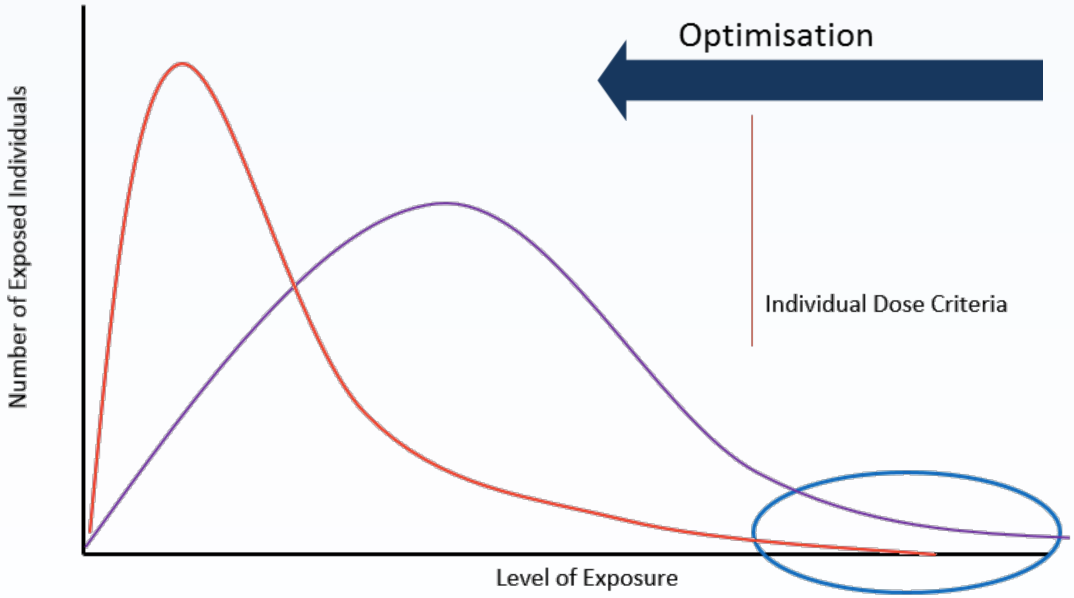
Towards a unified protection approach

- Characterize exposures
- Justify taking actions
- Identify exposures which warrant specific attention to reduce their magnitude



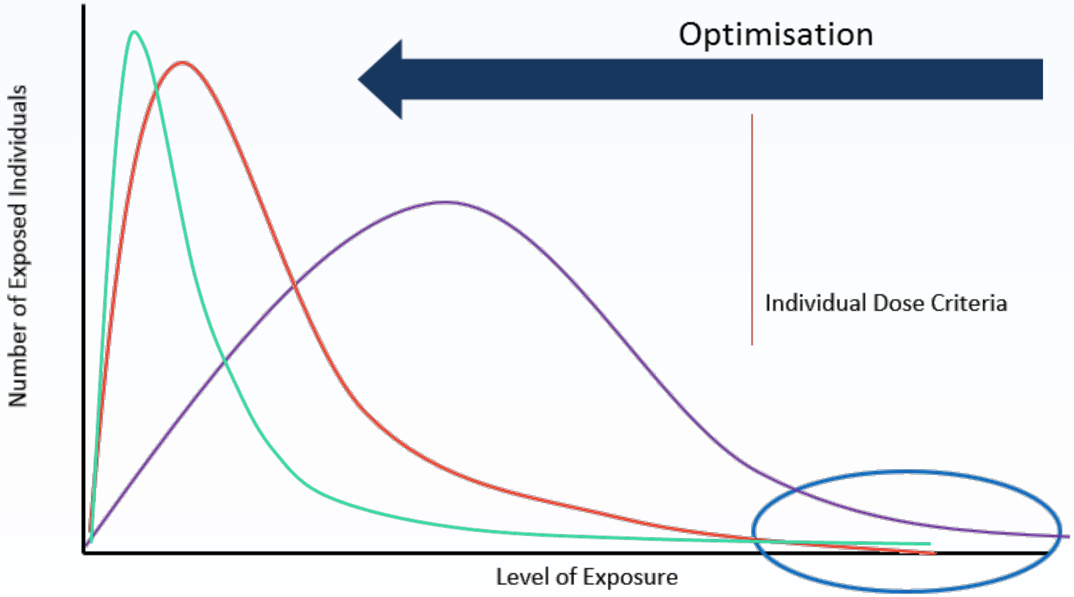
Apply optimisation

- Characterize exposures
- Justify taking actions
- Identify exposures which warrant specific attention to reduce their magnitude
- Influence the entire dose distribution and shift exposures towards lower values



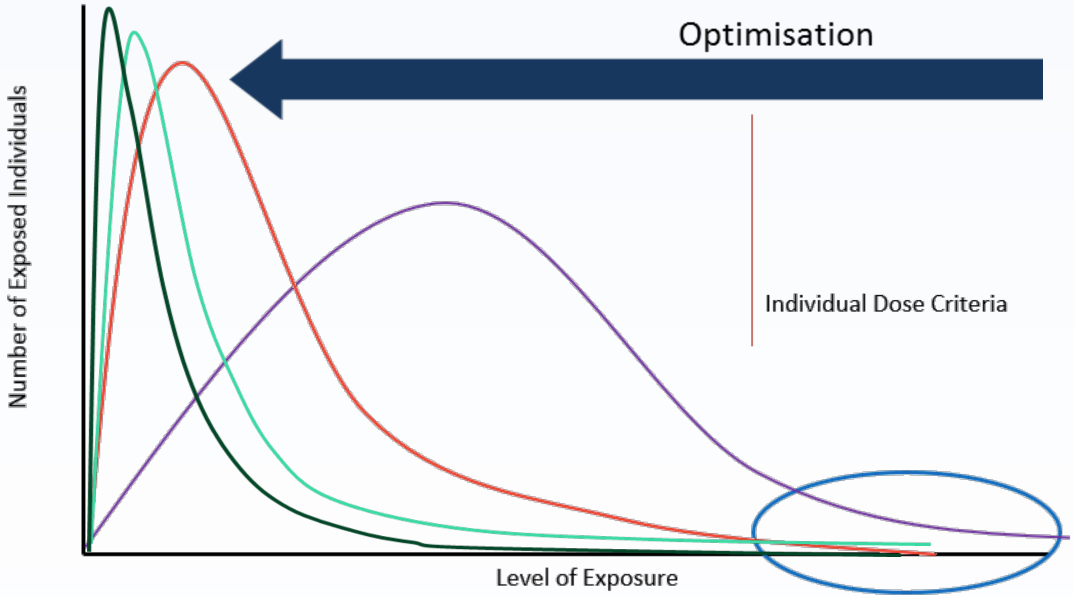
Iterative process

- Characterize exposures
- Justify taking actions
- Identify exposures which warrant specific attention to reduce their magnitude
- Influence the entire dose distribution and shift exposures towards lower values
- Reduce inequity



Build Culture of Protection

- Characterize exposures
- Justify taking actions
- Identify exposures which warrant specific attention to reduce their magnitude
- Influence the entire dose distribution and shift exposures towards lower values
- Reduce inequity
- Enable stakeholder engagement and action



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