Entwicklungen im Strahlenschutz

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- International Commission on Radiological Protection  
  What ICRP does and why

- Waste disposal and potential exposure  
  Concept developments since Publication 46 (1986)

- The ethical basis of ICRP Recommendations  
  Justification (political) – optimisation – limits & constraints

- The 2007 Recommendations = Publication 103  
  Focus on the exposure situation, not on the process  
  Protection of the environment
About ICRP
ICRP In The Cosmic Scheme

- Basic Scientific Studies
- Scientific Evaluations (UNSCEAR, BEIR etc.)
- ICRP Recommendations
  - Regional (PAHO, EC, NEA) & Topical (ILO, WHO, FAO) Stand’s
  - International Safety Standards: BSS (IAEA)
  - Industry Stand’s (ISO, IEC)
- National Regulations
- Demonstration of Compliance
Waste disposal and potential exposure

Defines principles; notes probabilistic nature – describes potential exposures [not the term!]; discusses truncated collective doses
Waste Disposal

  
  Clarifies policy; collective dose – don’t ignore, but disaggregate & discuss uncertainty; constraint: 0.3 mSv
Collective Dose: Logical, But Is It Right?

Equates
many small doses to
few large doses...

Are 500 road traffic
casualties just as bad as
500 plane crash victims?
Waste Disposal


  Dilute & disperse / Concentrate & retain; optimisation by qualitative judgement; consider natural processes & human intrusion
Strategies for Waste Disposal

INDUSTRIAL / MEDICAL OPERATIONS

WASTE

- Dilute / Disperse

CONCENTRATE / RETAIN

DISPOSAL
- LLW/ILW surface
- HLW underground

ENVIRONMENT

INSTANT / EARLY RELEASES
- Atmospheric
- Liquid

DELAYED RELEASES

DILUT- / DISPERSION
Methodological Options

Constrained optimisation
Potential exposure

Formal techniques
Judgmental process

Natural processes

Aggregated approach: Risk constraint
Disaggregated approach: Dose, probability evaluation

Likely / Less likely

Dose / Risk constraint appropriate

Probability?

Barriers bypassed

Dose / Risk constraint inappropriate

Assess consequences

Generic Intervention Levels

If necessary, reduce possibility of human intrusion

Human intrusion
Potential Exposures

- Workplace accidents
  - Number of people affected: small
  - Detriment = health risk to those directly exposed
- Large disasters
  - Number of people affected: large
  - Detriment: also contaminated land, food restrictions, etc
- Exposures in the far future, e.g. from waste repositories
  - Considerable uncertainties
  - Dose calculations: to compare protection options; not to project detriment
Assessment of Potential Exposures

- Publication 76 (1997): Protection from Potential Exposures: Application to Selected Radiation Sources

- Risk constraints to guide optimisation of protection against workplace accidents
  \[ \text{Prob (accident)} \times \text{Prob (death | accident dose)} \]
  This Expectation Value not appropriate for long-lived waste – cf. definition of Risk, Chapter 3 of BMU draft

- Recommended generic risk constraints:
  - Potential exposure of workers: \(2 \times 10^{-4}\) per year
  - Potential exposure of the public: \(1 \times 10^{-5}\) per year
Publication 81 Conclusion

- If the appropriate constraint is satisfied for natural processes;

- If reasonable measures have been taken to reduce the probability of inadvertent human intrusion;

- If sound engineering and managerial principles have been followed;

- Then radiological protection requirements can be considered satisfied.
The ethical basis of ICRP Recommendations
The Principles of Protection

Source-related, in all exposure situations:

- Justification
  More benefit than detriment

- Optimisation of protection
  Dose and risk constraints to
  (a) increase equity,
  (b) consider multiple sources

Individual-related, in planned exposure situations

- Application of dose limits
  Except medical exposure of patients
<table>
<thead>
<tr>
<th>Utilitarian ethics</th>
<th>Deontological ethics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judge actions by the consequences</td>
<td>Some duties are imperative</td>
</tr>
<tr>
<td><strong>Justification</strong></td>
<td><strong>Limitation</strong></td>
</tr>
<tr>
<td>Do more good than harm</td>
<td>No individual unduly harmed</td>
</tr>
<tr>
<td><strong>Optimisation</strong></td>
<td><strong>Dose constraints</strong></td>
</tr>
<tr>
<td>Maximise good &gt; harm</td>
<td>Increased equity = emphasise the individual</td>
</tr>
</tbody>
</table>
## Limits, Levels – Constraints & Multiple Sources

<table>
<thead>
<tr>
<th>DOSE LIMITS</th>
<th>DOSE CONSTRAINTS / REFERENCE LEVELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect individuals from <strong>PUBLIC</strong> and <strong>OCCUPATIONAL</strong> exposure…</td>
<td></td>
</tr>
<tr>
<td>from ALL regulated sources, in <strong>PLANNED</strong> exposure situations</td>
<td>from a source, in <strong>ALL</strong> exposure situations</td>
</tr>
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</table>

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**ICRP**

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION
The 2007 ICRP Recommendations
ICRP Consulted Widely on the 2007 Recommendations
## Nominal Probability Coefficients (% Sv$^{-1}$)

<table>
<thead>
<tr>
<th>Exposed population</th>
<th>Cancer</th>
<th>Heritable effects</th>
<th>Total detriment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Publ 60</td>
<td>2007</td>
<td>Publ 60</td>
</tr>
<tr>
<td>Whole</td>
<td>6.0</td>
<td>5.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Adult</td>
<td>4.8</td>
<td>4.1</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Nominal Probability Coefficients (% Sv\(^{-1}\))

For practical protection purposes,
the overall risk coefficient of ~5%
is still appropriate

BMU draft para. 8.3.2 uses 5.7% to get 1.8 mSv;
5% would yield 2 mSv
A Reminder:

1 = 2
Stakeholders Are Engaged in Optimisation

LET'S HURRY HOME
SO MUMMY CAN GET INVOLVED IN STAKEHOLDER OPTIMISATION
**In 1990, a Process-Based Approach**

<table>
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<th>Practice</th>
<th>Intervention</th>
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<tr>
<td><em>increases exposure or risk</em></td>
<td><em>reduces exposure or risk</em></td>
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</table>

- Optimise protection = reduce collective dose;
- restrictions on individual dose constrain the optimisation
In 1990, a Process-Based Approach

Practice

increases exposure or risk

Dose limit

Dose constraint

Protection optimised

Intervention

reduces exposure or risk

Optimisation…

Intervention level

…but what happens here?
2007, Exposure Situation: Planned / Emergency / Existing

- reject planned options –
  even if collective dose is lower

- acceptable planning options
  desirable final result

Inappropriate to plan to allow higher exposures
Regulatory Philosophy

RULES, RULES, RULES - HAVEN'T YOU HEARD OF MODERN PEDAGOGICS?
**Why Protect Other Species?**

- *NOT* driven by concerns of existing radiation hazards

- Fills a conceptual gap
  
  *Science to show that other species are adequately protected if individual humans are protected (cf. Chapter 5.2, BMU draft)*

  - and methods to improve protection if required

- Further guidance will be provided
To Summarise, ICRP is...

- Retaining the fundamental principles of protection
- Clarifying how they apply to sources and the individual
- Changing focus from process (practice/intervention) to exposure situation (planned/emergency/existing)
- Extending the concept of source-related constraints to all situations
- Updating weighting factors and detriment
- Maintaining the current dose limits
The 2007 ICRP Recommendations

GEE, THESE ARE INTERESTING RECOMMENDATIONS!