Occupational Radiation Protection: Stability and challenges in the view of the IAEA Basic Safety Standards.

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International Basic Safety Standards

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IAEA Safety Standards
for protecting people and the environment

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

General Safety Requirements Part 3
No. GSR Part 3

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IAEA International Atomic Energy Agency
TOWARDS ENSURING APPROPRIATE LEVEL OF RADIATION PROTECTION AND SAFETY
Para 1.17: For planned exposure situations, exposures and risks are subject to control to ensure that the specified dose limits for occupational exposure are not exceeded, and optimization is applied to attain the desired level of protection and safety.

Para 1.22: Dose constraints are applied to occupational exposure and to public exposure in planned exposure situations.

Para 3.25: For occupational exposure and public exposure, registrants and licensees shall ensure, as appropriate, that relevant constraints are used in the optimization of protection and safety for any particular source within a practice.
If compared with 1996 BSS and 2014 BSS: What is the same (STABILITY) and What is principally different (CHALLENGES)?

**Same:**
three fundamental principles of radiation protection (ICRP26, 1971)
- **justification** (all exposure situations)
- **optimization** of protection (all exposure situations)
- **dose limitation** (planned exposure situations, except for patients)

**Different:**
from: subdivision of RP system into Practices and Intervention
to: holistic approach (i.e. to cover ANY exposure situation)

- Planned exposure situations  Constraints, Limits
- Emergency exposure situations  Reference levels
- Existing exposure situations  Reference levels
Occupational exposure as in BSS Chapter 3: Planned Exposure Situations

Requirements for **occupational exposure**

- Responsibilities of regulatory body
- Monitoring and recording of exposures
- Responsibilities of employers and licensees
- Compliance by workers
- Classification of (work) areas: controlled and supervised
- Local rules and personal protective equipment
- Assessment of occupational exposure
- Information, instruction and training
- Special arrangements – pregnant and breast-feeding women, persons under 18 years of age
STABILITY
Development of dose limits

- Public dose limits: Dose constraints ≤ 1 mSv; set by regulator
- Occupational dose limits: Dose constraints ≤ 20 mSv; set or approved by regulator

ICRP and BSS markers on the graph represent the development of dose limits over time from 1955 to 2015.
<table>
<thead>
<tr>
<th>DOSE LIMITS</th>
<th>Occupational exposure</th>
<th>Public exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>over 18 years of age</td>
<td>16 to 18 years of age</td>
</tr>
<tr>
<td>Whole body</td>
<td>20 mSv averaged over 5 years, max 50 mSv in a single year</td>
<td>6 mSv</td>
</tr>
<tr>
<td>Lens of the eyes</td>
<td>20 mSv</td>
<td>20 mSv</td>
</tr>
<tr>
<td>Skin, extremities</td>
<td>500 mSv</td>
<td>150 mSv</td>
</tr>
</tbody>
</table>
CHALLENGES:

Selected Issue I: Responsibility
Responsibility for protection and safety

To establish and maintain a legal, regulatory and organizational framework

- Government

To establish or adopt regulations and guidelines

- Regulatory body

**Prime responsibility**

- Person or organization responsible for facilities and activities
- Principal parties

**Specified responsibility**

- Other parties
Selected Issue II: OPTIMIZATION
1. Optimization – as being formulated in the BSS

- **SP5 of the IAEA Safety Fundamentals:** Protection must be optimized to provide the highest level of safety that can reasonably be achieved.

- **Optimization linked to ALARA:** The optimization of protection and safety, when applied to the exposure of workers, members of the public and comforters and caretakers of patients undergoing radiological procedures, is a process for ensuring that the magnitudes and likelihood of exposures and the numbers of individuals exposed are as low as reasonably achievable, taking social and economic factors into account… (1.15)
2. Optimization – is it “process” or “end point”?

- …Optimization is a forward-looking iterative process requiring both qualitative and quantitative judgments… (ICRP Publ.103)

- In the optimization process, the intended outcome would be that ALL exposures reach levels that are as low as reasonably achievable, social and economic factors being taken into account…

  Optimization must satisfy both:
  to be processed, and (this process) to be finished (i.e. reach levels) by leading to the expected conditions (e.g. ALARA) however …
there is the legal issue too

- obligation “to be processed (i.e. subject of optimization process)” is ALREADY MET by starting the process
- however, obligation “to be optimized” is met ONLY IF the process ends with an optimized status

And then requirement(s) for optimization must read as:

In all exposure situations, each party with responsibilities for protection and safety shall ensure that protection and safety is optimized. (and NOT - “is subject to optimization process”)

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Exposure to individual **BEFORE**
optimization of protection and safety

**PROCESS** of optimization of protection and safety (ICRP Publ.101), *inter alia* to ensure equity of distribution of exposure by
- Shielding
- Distance from source
- Layout of facility
- Time of work with the source
- Number of workers, etc.

**WAY how to meet**
LEGAL OBLIGATION

Exposure to individual **AFTER**
optimization of protection and safety
i.e. status when **P&S is optimized**
3. Optimization – who is in charge?

**Top to down approach:**

- The **government or regulatory body** shall establish and **enforce requirements** for optimization of protection and safety. (Req. 11)

  \[ \downarrow \]

- **Registrants and licensees** shall **ensure** that protection and safety is **optimized**. (para 3.23)  
  \[ \downarrow \]  
  *i.e. PRINCIPAL PARTY*

- (Employers, registrants and licensees shall..) involve **workers**, through their representatives if appropriate, in **optimization** of protection and safety  
  (para 3.77(a))
Selected Issue III:
DOSE CONSTRAINT
Few thoughts on “dose constraints”

• **What is dose constraint?**
  It is prospective and source related value of individual dose… that is used in for the optimization of protection and safety… and serves as a **boundary** in defining the range of options **in optimization**.

• **Is it dose limit?**
  No.
  Limit is the value that **must not be exceeded**, and it is **a priori set legally binding** value.
When were dose constraints introduced?

**Occupational**: 150 (internal organs other than) 5(N-18) (gonads, …)

- **1959**: limit: 50
- **1962**: upper limit (from a practice) limit: 20
- **1971**: constraint: ≤ 20
- **1991**: constraint: ≤ 20; established by employer, registrant and licensee

**Public**: limit: 50

- **1962**: ALARA 3 RP principles
- **1971**: optimization
- **1991**: optimization linked to dose constraint

<table>
<thead>
<tr>
<th>Year</th>
<th>Constraint</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>1962</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>1971</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>1972</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>1991</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>1996</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>2007</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
<tr>
<td>2011</td>
<td>ICRP</td>
<td>BSS</td>
</tr>
</tbody>
</table>
(1) Constraint *versus* limit – only a linguistic problem?
(2) Dose constraints in prospective evaluations and as one means of *initiating investigations* of actual operations
(3) Risk of dose constraint being interpreted as an “additional” *limit* or as a new “standard of care” for workers
(4) Dose constraint as only one of many factors in total *risk management*
(5) Dose constraint in the process of *optimisation*
(6) Need for *education and training* specifically addressing dose constraint?
Use and “not-use” of dose constraints

• Dose constraint serves as:
  1. In planning stage: **tool for optimization** defining the range of options in **optimization** in the operation of any controlled source
  2. In exposure stage: **benchmark** assessing the suitability of the **optimized protection strategy** (1.23)

• Dose constraints are **NOT dose limits** and exceeding a dose constraint should **NOT** represent a regulatory **infraction**, but could result in the implementation of follow-up actions (1.22)

• Dose constraints are **NOT applicable** to the exposure of patients to radiation for diagnosis or treatment. (1. 30)
SETTING OF DOSE CONSTRAINTS:
CROSSCUTTING ISSUES BETWEEN RESPONSIBILITY FOR RADIATION SAFETY AND OPERATIONAL EFFECTIVENESS
The regulatory body shall establish requirements for optimization of protection and safety, ... and establish or approve constraints, as appropriate, for dose and risk, or the process for establishing constraints, ... 

**Occupational:**
Employers, registrants and licensees ... shall ensure ... that protection and safety is optimized ....

↓

i.e. government or regulatory body is NOT necessarily establishing constraints; AND it is ensuring protection and safety is optimized instead (e.g. by reg. and licensees)
Dose Constraints in Optimisation – National Regulations (few examples)

Countries of European Union:
- Relatively harmonized approach on adoption of the concept of dose constraints as it is recommended by the ICRP.

Northern America:
- Instrument of action level is used → level that trigger certain actions if it is reached.
- Optimization below action level is not required.
- Dose constraint is not directly linked to the optimisation (USA) and reaching pre-set dose level (dose constraint) may trigger an action.

Japan:
- Uniform introduction of dose constraints into regulatory system based on dose limits seems to be not necessary.
- Current system provides satisfactory operating flexibility.
Selected Issue IV:
SPECIFIC CASE – OCCUPATIONAL EXPOSURE IN EMERGENCY
Exposure of emergency workers

• **Basic principle:**
  ...(even in an emergency) relevant requirements for occupational exposure in planned explore situation shall apply…
  
  ➔ ILO: an emergency worker is a worker
  i.e. 20 mSv/year averaged over 5 years
  ➔ maximum dose = 50 mSv/year

**Exceptions:**
  o Life saving (<500 mSv)
  o Prevent severe deterministic effects (<500 mSv)
  o Avert large collective dose (<100 mSv)

• **Principle of voluntarily taken action:**
  The value of 500 mSv may be exceeded under special circumstances…and the worker volunteers to take the action and understands the health risk.

[in line with Gsr Part 3: Radiation Protection And Safety Of Radiation Sources: International Basic Safety Standards . Schedule IV, Table IV. 2]
... example of raising of maxim value for doses to workers undertaking interventions (Japan 2011)

Legal status (in 2011):

- **IAEA BSS ed.1996**: ... under specific circumstances (life saving, averting large collective dose and avoiding catastrophic conditions) the value can exceed 2x single year dose limit, but should not exceed it 10x, i.e. $10 \times 50 = 500 \text{ mSv}$ ...
- **Japanese legislation**: ... should not exceed **100 mSv** (2x single year dose limit, i.e. **no exception allowed**)

On the order of the Prime Minister (15 March 2011, 23:48 JST):

\[
100 \text{ mSv/y} \rightarrow 250 \text{ mSv/y}
\]

*(still half of max 500 of the BSS)*

**Justification:**

“Because at Fukushima 1, the level of radiation is **400 millisieverts per hour**. The previous limit of 100 millisieverts means that workers can work for only 15 minutes; the new limit of 250 millisieverts means that they can work for 30 minutes.”

The ministry (i.e METI-NISA) explained that "this is an emergency measure, taken in response to the Prime Minister's request, to prevent this nuclear disaster from escalating."

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MOVING FORWARD TO THE IMPLEMENTATION
Development of Safety Standards: SG on Occupational Radiation Protection (in preparation)

- Following the revised BSS, jointly developed with ILO
- Combining the current five existing SGs on ORP
- DPP approved by CSS during in 2011
- Two CS held in 2012, overall review in the early of 2013
- Presented in the RASSC meeting in November 2013
- Sent to Member States for comments early of 2014
- Resolution of MSs comments in September 2014
- Approved at RASSC/WASSC/NUSSC in November 2014 for submission to CSS
Thank you for your attention