Views from the Japan Health Physics Society on the implementation of the 2007 recommendations

Focusing on the optimization process using dose constraints

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  - Understanding of additional risk due to radiation below 1mSv/y

- **Conclusion**
Addressing issues #1

- Who determine the dose constraint (DC)?
  - For occupational exposure,
    - Experience gained in managing workers exposed to radiation will inform the choice of a value for a constraint for occupational exposure. [Pub.103 para. 257]
    - For this reason, large established organizations, having a comprehensive radiological protection infrastructure, will often set their own constraints for occupational exposure. [Pub.103 para. 257]

  Operators can set DC based on their experiences.

- For public exposure,
  - Constraints for members of the public in planned exposure situations would typically be set by the national regulatory authorities. [Pub.103 para. 259]
  - The Commission wishes to emphasise that dose constraints are not to be used or understood as prescriptive regulatory limits. [Pub.103 para. 233]

  How do we set DC for new site with no experiences?
Addressing issues #2

- Relation to dose limit (DL)? (DL > DC or DL ≥ DC?)
  - Dose limit > Dose constraint
    - Dose constraints for planned situations represent a basic level of protection and will always be lower than the pertinent dose limit. [ICRP Pub.103 para. 230]
  - Dose limit ≥ Dose constraint
    - Bands of dose constraint and reference level [Pub.103 Table 5]
    - [Public exposure] The first band, 1 mSv or less, applies to exposure situations where individuals receive exposures – usually planned – that may be of no direct benefit to them but the exposure situation may be of benefit to society. [Pub.103 para. 239]

1 mSv/y can be used as a DC for public exposure.
Table 5. Framework for source-related dose constraints and reference levels with examples of constraints for workers and the public from single dominant sources for all exposure situations that can be controlled.

<table>
<thead>
<tr>
<th>Bands of constraints and reference levels* (mSv)</th>
<th>Characteristics of the exposure situation</th>
<th>Radiological protection requirements</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 20 to 100** (a)</td>
<td>Individuals exposed by sources that are not controllable, or where actions to reduce doses would be disproportionately disruptive. Exposures are usually controlled by action on the exposure pathways.</td>
<td>Consideration should be given to reducing doses. Increasing efforts should be made to reduce doses as they approach 100 mSv. Individuals should receive information on radiation risk and on the actions to reduce doses. Assessment of individual doses should be undertaken.</td>
<td>Reference level set for the highest planned residual dose from a radiological emergency.</td>
</tr>
<tr>
<td>Greater than 1 to 20</td>
<td>Individuals will usually receive benefit from the exposure situation but not necessarily from the exposure itself. Exposures may be controlled at source or, alternatively, by action in the exposure pathways.</td>
<td>Where possible, general information should be made available to enable individuals to reduce their doses. For planned situations, individual assessment of exposure and training should take place.</td>
<td>Constraints set for occupational exposure in planned situations.</td>
</tr>
<tr>
<td>1 or less</td>
<td>Individuals are exposed to a source that gives them little or no individual benefit but benefits to society in general. Exposures are usually controlled by action taken directly on the source for which radiological protection requirements can be planned in advance.</td>
<td>General information on the level of exposure should be made available. Periodic checks should be made on the exposure pathways as to the level of exposure.</td>
<td>Constraints set for public exposure in planned situations.</td>
</tr>
</tbody>
</table>

* Acute or annual dose.

** In exceptional situations, informed volunteer workers may receive doses above this band to save lives, prevent severe radiation-induced health effects, or prevent the development of catastrophic conditions.

* Situations in which the dose threshold for deterministic effects in relevant organs or tissues could be exceeded should always require action.
Views on DC for occupational #1

- Dose constraint is a target value *set by operators* per a source

<table>
<thead>
<tr>
<th>Dose Limits</th>
<th>Constraints and Reference Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect individual workers from occupational exposure and the Representative Person from public exposure</td>
<td></td>
</tr>
<tr>
<td>From all regulated sources in planned exposure situations</td>
<td>From a source in all exposure situations</td>
</tr>
</tbody>
</table>

How do we set a source for the dose constraint?
Views on DC for occupational #2

- Practical dose criteria similar to DC in Japan?
  - Target dose for individual at the stage of design of facilities
    - e.g. individual dose for boundary of controlled area
    - Source intensity, Occupancy time, Shield thickness etc.
    - Self-determined target dose by plant makers or operators

  It may be possible to regard individual target dose at the design stage of facilities as a DC in occupational exposure based on source-related approach.

- Target dose (on assumption) for individual in actual workplaces
  - 15 mSv/y for complying with 20mSv/y
  - 5 mSv/3months for complying with 20mSv/y
  - 0.1 mSv/work for complying with 20mSv/y
  - DC is based on source-related approach, but in workplaces, individual dose is always controlled by personal dosimeter with individual-related approach

  It is impossible to apply optimization using DC based on source-related approach to occupational exposure controlled by individual-related approach.
Views on DC for public #1

- DC is a target value **set by regulatory authority**
  - Not a regulatory limits, but just a target value.

- Practical dose criteria similar to DC in Japan?
  - **Dose Target** in “Regulatory Guide for the Annual Dose Target for the Public in the Vicinity of Light Water Nuclear Power Reactor Facilities” Specified by the Nuclear Safety Commission
    - Gaseous and liquid radioactive wastes: 0.05mSv/y / one site
    - Sky-shine dose: 0.05mSv/y / one site
  - **How to count on site** ➔ **Unbalanced regulation by site**
    - 1 reactor in one site: 0.05mSv/y / one reactor
    - 6 reactors in one site: 0.05mSv/y / 6 reactors

 Guidance on how to compare with the dose constraint is necessary in addition to methodology of dose assessment.
Views on DC for public #2

- Two approaches dependent on conservativeness of dose assessment

  - **Accurate approach**
    - To comply with dose constraint using *detailed* dose assessment (e.g. probabilistic analysis with small conservativeness) assigning the dose constraint to one facility taking into consideration effects of multiple facilities.

    - Probabilistic dose assessment is complex calculation.
    - Heavy burden to verify it for both operator & regulator.

  - **Rough approach**
    - To comply with dose limit, 1 mSv/y using *conservative* dose assessment (e.g. deterministic analysis with large conservativeness) and taking no account of effects of multiple facilities.

    - Deterministic dose assessment is simple calculation.
    - Light burden to verify the conservativeness.
Views on DC for public #3

- Understanding of additional risk due to radiation below 1mSv/y

**Comparison with total BG cancer risk (detriment)**

![Graph showing risk comparison](image)

- Mean: $1.4 \times 10^{-3}$, Normal distribution
- $\sigma$: $8.7 \times 10^{-5}$

Conclusions

- There may be both cases where it is possible and impossible to apply dose constraint for occupational exposure practically.
  - Individual target dose in the facility design could be regarded as a DC.
  - In the actual workplaces, it is difficult to specify a source in the occupational exposure.
  - Target dose which can be set by individual-related personal dosimeter is suitable for practical tool to comply with dose limit based on individual-related approach.

- Significant requirements to apply dose constraint for public practically are as follows:
  - To give comprehensive guidance on comparison between target value (dose constraint) and the dose assessment results in addition to methodology of assessment, when regulatory authority determines dose constraint.
  - To give options for conservativeness of dose assessment and determine a dose constraint according to the conservativeness (e.g. to allow to use 1 mSv/y as a dose constraint in case of large conservativeness in the assessment).