New Dose Limit for Lens of the Eye

TM on the New Dose Limits for the Lens of the Eye: Implications and Implementation

Vienna
October 2-4, 2012

Christopher Clement
ICRP Scientific Secretary
Chronology

- Initial plan to review tissue reactions
- ICRP Task Group 63 formed
- TG63 report in development
- Consultation on TG63 report
- Initial discussions at MC meeting
- Extensive discussions at MC meeting
- Active drafting of the statement
- Statement issued
- TG 63 report approved
- Publication 118
Tissue Reactions

ICRP Publication 118

ICRP Statement on Tissue Reactions and Early and Late Effects of Radiation in Normal Tissues and Organs – Threshold Doses for Tissue Reactions in a Radiation Protection Context
Cataract Induction: Conclusions

- Threshold for acute exposure: \(~0.5\) Gy with 95\% CI including zero

- Threshold for protracted exposure: \(~0.5\) Gy
  - evidence pertains mainly to opacities rather than cataracts, although follow-up times were generally shorter
Tissue Reactions
General Conclusions

- Acute doses up to around 100 mGy produce no functional impairment of tissues
  - Including lens of the eye (but the use of a threshold model remains uncertain)

- For most situations the principal risk remains cancer
- At higher doses tissue reactions become increasingly important
  - particularly in accidents and medical exposures
Statement on Tissue Reactions
Issued April 21, 2011

1. Background

2. Evidence of lower thresholds

3. Revised dose limit for lens of the eye

4. Cautionary statement for medical practitioners

5. Optimisation of protection for exposures to tissues
(2) The Commission has now reviewed recent epidemiological evidence suggesting that there are some tissue reaction effects, particularly those with very late manifestation, where threshold doses are or might be lower than previously considered. **For the lens of the eye, the threshold in absorbed dose is now considered to be 0.5 Gy.**
(3) For occupational exposure in planned exposure situations the Commission now recommends an equivalent dose limit for the lens of the eye of 20 mSv in a year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv.

- Given the substantially lower threshold, a higher limit would not be adequately protective
- Alignment with the effective dose limit facilitates implementation
Statement on Tissue Reactions

(5) The Commission continues to recommend that optimisation of protection be applied in all exposure situations and for all categories of exposure. With the recent evidence, the Commission further emphasises that protection should be optimised not only for whole body exposures, but also for exposures to specific tissues, particularly the lens of the eye, and to the heart and the cerebrovascular system.
Considerations in developing the new limit for the lens of the eye
The System of Radiological Protection: Protection of Human Health

Manage and control exposures so that:

- Deterministic effects (harmful tissue reactions) are prevented
- The risks of stochastic effects (cancer or heritable effects) are reduced to the extent reasonably achievable
Deterministic, Stochastic, and....

**Deterministic effect**
Characterised by a threshold dose and an increase in the severity of the reaction as the dose is increased further

**Stochastic effect**
The probability of an effect occurring, but not its severity, is regarded as a function of dose without threshold

<table>
<thead>
<tr>
<th></th>
<th>↑ dose → ↑ severity</th>
<th>↑ dose → ↑ risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>Deterministic</td>
<td>(Deterministic?)</td>
</tr>
<tr>
<td>No Threshold</td>
<td>???</td>
<td>Stochastic</td>
</tr>
</tbody>
</table>

The divide between deterministic and stochastic effects is a simplification used to build a practical system of protection
P60 (169) The **dose limit forms only a part of the system of protection** aimed at achieving levels of dose that are as low as reasonably achievable, economic and social factors being taken into account.

P60 (160) ... a judgment about a level of dose that would reasonably be regarded as being **only just short of unacceptable**
The System of Radiological Protection: Optimisation

P60 (162) … dose limit should be set [considering that the] … system of radiological protection should be such that this figure would only rarely be approached

P103 (211) …optimisation of protection, with restriction on … individual dose … is central to the system of protection and applies to all three exposure situations…

P103 (214) Optimisation is always aimed at achieving the best level of protection under the prevailing circumstances…
Radiogenic cataracts continue to be treated as tissue reactions
  i.e. no a change to the principles or concepts of the system of radiological protection

Numerical change in response to clear evidence of a significantly lower threshold
Explicit recommendation to optimise protection for exposures to specific tissues (e.g. lens of the eye) to:

- reflect uncertainty in setting a nominal threshold for the entire population
- keep lifetime doses below the nominal threshold as the annual limits alone do not guarantee this
- account for the possibility of the lack of a threshold
New Dose Limit for Lens of the Eye: Occupational Exposures

20 mSv in a year, averaged over defined periods of 5 years, with no single year exceeding 50 mSv

- Given the substantially lower threshold, a higher limit would not be adequately protective

- Alignment with the effective dose limit facilitates implementation
New Dose Limit for Lens of the Eye: Public Exposures

No change is recommended to the public dose limit for the lens of the eye (15 mSv/y)

- Existing limit remains adequately protective considering:
  - the effective dose limit of 1 mSv/year
  - low likelihood of protracted preferential exposure of the lens
  - optimisation for exposures to the lens

- Although many options were considered, a change is not justified based on improvements to protection
New Dose Limit for Lens of the Eye: Limits & Nominal Threshold

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational</strong></td>
<td><strong>Public</strong></td>
</tr>
<tr>
<td>20 mSv per year x 50 years</td>
<td>15 mSv per year x 70 years</td>
</tr>
<tr>
<td>= 1000 mSv</td>
<td>= 1050 mSv</td>
</tr>
</tbody>
</table>

Optimisation of protection

Low likelihood of protracted preferential exposure of the lens

1 mSv/y effective dose limit

Nominal threshold 500 mGy