IMPLICATIONS OF THE NEW DOSE LIMIT FOR LENS OF THE EYE

SOUTH AFRICA, National Nuclear Regulator

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Recent studies have suggested that the lens of the eye may be more radiosensitive than previously considered.

In particular, among both A-bomb survivors (Minamoto et al., 2004) and a group of children treated for skin haemangioma (Hall et al., 1999), there is evidence of excesses of both cortical and posterior subcapsular cataract at doses somewhat lower than expected. In the assignment of a dose threshold for cataract, uncertainties are recognised on the mechanisms of cataract development, and also on the relationship between the detection of lens opacity and the expression of visual impairment. The recent data and mechanistic uncertainties noted above highlight the need for a detailed reappraisal of the radiosensitivity of the lens of the eye and a newly formed Task Group of ICRP Committee 1 will address this issue.
1. SUMMARY FOR SCIENTIFIC BASIS

- There are three predominant forms of cataract: **cortical**, involving the outer, more recently formed lens fibre cells; **nuclear**, developing first in the inner embryological and foetal lens fibre cells; and **posterior subcapsular** (PSC), developing from the dysplasia of transitional zone epithelial cells and resulting in an opacity at the posterior pole.

- Cataracts develop “naturally” with increasing age. Lifetime risk of occurrence of a cataract requiring surgical intervention is about 0.32, typically occurring in normal individuals aged 60 or over.

- Lens replacement is a well established surgical procedure.
2. OLD DOSE LIMITS FOR THE LENS OF THE EYE

ICRP Publication 103

<table>
<thead>
<tr>
<th>Type of limit</th>
<th>Occupational</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective dose</td>
<td>20 mSv per year, averaged over defined periods of 5 years\textsuperscript{e}</td>
<td>1 mSv in a year\textsuperscript{f}</td>
</tr>
<tr>
<td>Annual equivalent dose in:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lens of the eye\textsuperscript{b}</td>
<td>150 mSv</td>
<td>15 mSv</td>
</tr>
<tr>
<td>Skin\textsuperscript{c,d}</td>
<td>500 mSv</td>
<td>50 mSv</td>
</tr>
<tr>
<td>Hands and feet</td>
<td>500 mSv</td>
<td>--</td>
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</tbody>
</table>
BSS: Schedule III, Recommended Dose Limits for planned exposure situations

- **Dose limit for workers**: an equivalent dose to the *lens of eye* of 20 mSv per year averaged over 5 consecutive years, and of 50 mSv in any single year,

- **Dose limit for apprentices**: an equivalent dose to the lens of eye of 20 mSv in a year,
2. NEW DOSE LIMITS FOR THE LENS OF THE EYE

Public Dose Limit for Lens of the eye

No change is recommended to the public dose limit for the lens of the eye (15 mSv/a). The existing limit remains adequately protective considering:
- the effective dose limit of 1 mSv/a
- 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.
• Requirement 12: Dose Limits

The Regulatory Body shall establish Dose Limits for Occupational Exposure & Public Exposure, the registrants & Licensees shall apply these limits.
Requirement 13: Safety Assessments

The Regulatory Body shall establish & enforce Requirements for safety assessments and the organisation responsible for a facility or activity that gives rise to radiation risks shall conduct an appropriate safety assessment of this facility.
IMPLICATIONS

1. National Nuclear Regulator is in the process of updating its Regulations, so the change to be updated in the new Regulations, for compliance by the Licensees.

2. Licensees be required to conduct safety assessments.
   – to determine the expected magnitudes and likelihood of exposures in normal operation, and
   – to the extent reasonable, make an assessment of potential exposures.
   – to assess the adequacy of the provisions for protection and safety.
   – Categories of workers at risk of elevated doses to the lens of the eye.
Licensees required to establish Local Rules.
Establish in writing local rules and procedures that are necessary for protection and safety for workers specifically those with potential of exposure to lens of the eye.
Include in the local rules and procedures any relevant investigation level or authorized level, and the procedures to be followed in the event that any such level is exceeded;
Make the local rules and procedures and the measures for protection and safety known to workers affected;
Employers, in cooperation with licensees, are required to provide all workers with:

- Adequate information on health risks due to their occupational exposure in normal operation, anticipated operational occurrences and accident conditions,
- Adequate instruction and training and periodic retraining in protection and safety
- Adequate information on the significance of their actions for protection and safety
IMPLICATIONS: SPECIFIC TRAINING OF WORKERS

BSS REQUIREMENTS

Parties to receive training on new dose limit
- Radiation protection Experts (RPO’s and RPS’s)
- Occupationally Exposed Workers
- Dosimetry service providers
- NNR Staff

Training to cover
- Biological effects of radiation
- Shielding, personal protective equipment
- Specific task related issues
- Use of active dosimeters
5.3 Dose limits for occupational exposure

For occupational exposure of workers over the age of 18 years, the dose limits shall be:

(a) An effective dose of 20 mSv per year averaged over five consecutive years (100 mSv in 5 years), and a maximum of 50 mSv in any single year;
(b) An equivalent dose to the lens of the eye of 20 mSv per year averaged over 5 consecutive years (100 mSv in 5 years) and of 50 mSv in any single year;
(c) An equivalent dose to the extremities (hands and feet) or the skin of 500 mSv in a year.

Guidance Document to be developed at a later stage.
DOSIMETERS SUITABLE FOR THE LENS OF THE EYE

- MPA-TKD-01, MPA Dortmund
- LPS TLD-TK 03, LPS Berlin
- LPS TLD-TK 07, LPS Berlin
- LPS TLD-TK 08, LPS Berlin
- GSF-TL-TD-60, HZM München
- GSF-TL-TD-70, HZM München
- BE-TLD-TD-PHOTONEN 01, Senatsverwaltung Berlin
- BE-TLD-TD-Brille, Senatsverwaltung Berlin
CONCLUSIONS & RECOMMENDATIONS

• The establishment of the reduced dose limit for the lens of the eyes has Regulatory Implications.

• TECDOC or Guidance Document on Implementation of the new dose limits to the lens of the eye to be published 2013

• Availability of suitable dosimeters and proper training becomes an important aspect, even in the compilation of new safety assessments by the Licensees.

• Guidance on workers to be mostly affected or working areas and the Protective equipment to be used.