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**ICRP Statement on Tissue
Reactions April 2011**
New dose limits

(personal views for discussion)

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New dose limits for lens of the eye

ICRP Statement

- Review of detriment from non-cancer/ deterministic effects (now called tissue reactions)
- ICRP consultation 2010/11 – documents and responses online at: www.icrp.org
- Epidemiological evidence - lens of the eye threshold dose now 0.5 Gy
- Recommended new dose limit of 20 mSv/yr averaged over 5 years (with no year exceeding 50 mSv)

New dose limits for lens of the eye

Draft report: Early and late effects of radiation in normal tissues and organs: threshold doses for tissue reactions and other non-cancer effects of radiation in a radiation protection context

- Update of estimates of threshold doses for tissue injury defined at 1% incidence.
- Higher incidences than expected of eye cataracts than expected after lower doses. Particularly < 1 Gy.
- Rate of dose accrual does not modify incidence.
- Implication that cause if single-hit type events.
- Therefore, 0.5 Gy threshold proposed irrespective of rate of dose delivery.

New dose limits for lens of the eye

Current lens of eye dose limits:



EC BSS Directive 96/29/EURATOM

- Article 9: Exposed workers = 150 mSv/yr
- Article 11: Apprentices & students 16-18 yrs = 50 mSv/yr
- Article 14: Public = 15 mSv/yr

EC Draft BSS Feb 2010

- Eye dose limits yet to be specified

IAEA draft BSS (submitted to CSS in May 2011 for endorsement then IAEA Board of Governors for approval for publication)

- As BSS Directive 96/29/EURATOM

New dose limits for lens of the eye

Most affected sectors:

- Medical interventional radiologists, cardiologists, neuro-radiologists, vascular radiologists, etc
- Radiopharmacy workers & PET?
- Nuclear glove box work/maintenance
- Nuclear decommissioning workers (eg. High energy Sr-90 beta fields)



New dose limits for lens of the eye

Dosimetry issues: PHOTONS

- ICRP 103 says as $H_p(3)$ is rarely monitored and $H_p(0.07)$ can be used for the same purpose for photons.
[$H_p(0.07)$ over-estimates $H_p(3)$ by less than 5% at energies above 150keV and no worse than 7% down to 50keV.]
- Dosimetry services use results from standard whole body doseimeters to infer eye doses using $H_p(0.07)/H_p(10)$ averaging algorithms (making radiation field assumptions).
- Some dosimetry services in the UK measure $H_p(3)$.
- For directional gamma radiation fields, the dosemeter must be worn on the front of the head.

New dose limits for lens of the eye

Issues to consider: BETA

The use of $H_p(0.07)$ to infer equivalent dose to the eye in beta radiation fields leads to significant over-estimates of dose which, in the light of the proposed change in limit, will no longer be a viable: in these situations, $H_p(3)$ dosimetry will be required. Given that most eye dosimetry is typically conducted using $H_p(0.07)$ dosimeters, a move to $H_p(3)$ may well mean that compliance with the new dose limit would not be as challenging as many commentators think.

New dose limits for lens of the eye

Practical issues:

- Wear goggles at least 7mm [tissue equivalent] thick to normalise eye exposure so that $H_p(10)$ can be used to infer $H_p(3)$.
- If threshold for protracted exposure is around 0.5 Gy, what about someone with a cumulative exposure to date of 0.4 Gy or 0.6 Gy (ignoring background and medical exposures)? The epidemiological evidence is that life-time exposures are important.
[Historically, extremity dose histories will be adequate for the purpose of identifying those at risk, provided that there is confidence that radiation field directionality did not cause greater exposure of the head compared to the location of the extremity dosimeters in question.]

New dose limits for lens of the eye

Practical issues:

- Authorities will need to be satisfied that the under-pinning science that ICRP cites is robust, authoritative and applicable to the occupational exposure setting.

Eg. Applicability of:

epidemiological studies that involve people who've been acutely or semi-acutely exposed to radiation, to the protracted life-long exposure situation of workers.

studies such as Chernobyl 'clean-up' workers, A-bomb victim follow-up and head exposure for ring-worm treatment involve exposure regimes different to workplace exposure scenarios.

Also issues of dose characterisation and associated accuracy in these studies.

New dose limits for lens of the eye

Practical issues for authorities to consider:

Most authorities currently awaiting publication of BSS.

However..

- Authorities will need to raise awareness amongst duty holders of the scale of the likely dose limit reduction for the eye so that they, in turn, can discuss their dosimetry needs with their dosimetry services.
- Authorities will need to commence discussions with dosimetry services since few services offer $H_p(3)$ dosimeters to their clients. This is fine for photon fields because a $H_p(0.07)$ only leads to a 5-7% overestimate of dose. But for beta fields, $H_p(0.07)$ is inappropriate for eye dose assessment under the proposed new limit and will lead to very large overestimates.

New dose limits for lens of the eye

Practical issues for authorities to consider:

Categorisation of workers

- Do we still need to specify Cat A workers at $> 3/10^{\text{th}}$ of any dose limit (ie. 6mSv for the eye) and Cat B at > 1 mSv when the limit is based on threshold effects?
- Vast majority of medical sector are Cat B workers and 1-2000 in the UK would now be Cat A workers. Costs = initial & annual medical reviews, eye dosimetry, dose record keeping = €M? + €? ALARA measures and investigations. Benefits = dose reductions?

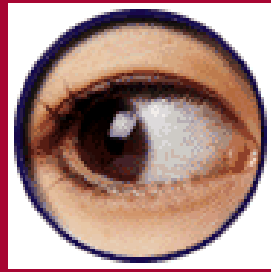
New dose limits for lens of the eye

Practical issues for authorities to consider:

ALARP

- “Experience shows that increased use of remote handling techniques to reduce beta exposures in the past has increased extremity and whole body doses in some cases.”
- “If current doses generally < 20 mSv then work won't change but significant extra monitoring and categorisation of workers will be required, diverting safety finances to legislation compliance demonstration purposes only.”

New dose limits for lens of the eye



Summary of issues:

- Applicability of the science behind new limit
- Sectors most affected by 20 mSv dose limit
- Dosimetry – dosimeters & geometry
- Historical doses and life-time doses
- Benefits and resources associated with increased numbers of Cat A workers

