

Recommendations on the lens of eye dose limit: importance and implementation

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**System of Radiological Protection
Human Health Objectives**

Manage and control exposures so that:

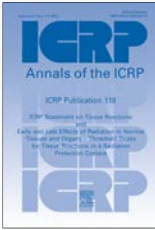
- Harmful **tissue reactions** (deterministic effects) are prevented
- The risks of **stochastic effects** (cancer or heritable effects) are reduced to the extent reasonably achievable


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Tissue Reactions

ICRP Publication 118

**ICRP Statement on Tissue Reactions
&
Early and Late Effects of Radiation in
Normal Tissues and Organs –
Threshold Doses for Tissue Reactions
in a Radiation Protection Context**



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Tissues and Organs Considered

- Haematopoietic and immune systems
- Digestive system
- Reproductive system
- Skin
- **Cardiovascular and cerebrovascular system**
- **Eye**
- Respiratory system
- Urinary tract
- Musculoskeletal system
- Endocrine system
- Nervous system

Some Thresholds

- Circulatory disease: 0.5 Gy (acute or protracted)
- Cataract induction: 0.5 Gy (acute or protracted)
- Skin effects:
 - Early transient erythema: 2 Gy
 - Permanent epilation: 7 Gy
 - Ischaemic dermal necrosis: 18 Gy
- Mortality:
 - 1 Gy (without care), 2-3 Gy (with good care), acute
 - 4-8 Gy per week, or 10-14 Gy over 1-3 months likely tolerated

Cataract Induction: Conclusions

- **Threshold for acute exposure: ~0.5 Gy with 95% CI including zero**
- **Threshold for protracted exposure: ~0.5 Gy**
 - Evidence mainly on opacities rather than cataracts because follow-up times were generally shorter
 - Newer study* from RERF:
 - At 1 Gy, 20-30% excess of cataract surgery
 - Threshold of 0 to 0.8 Gy, if one exists

* Nerishi K, Nakashima E, Minamoto A, Fujiwara S, Akahoshi M, Mishima HK, Kitaoka T, Shore R: Postoperative cataract cases among atomic bomb survivors: Radiation dose response and threshold. Radiation Research 2007; 168:404-8

New Dose Limit for Lens of the Eye: Principles of Protection

Radiogenic cataracts continue to be treated as tissue reactions

- No change to the principles or concepts of the system of radiological protection
- Therefore, **the human health objective is to prevent radiogenic cataracts**

Numerical change is in response to clear evidence of a significantly lower threshold

New Dose Limit for Lens of the Eye: Role of Optimisation

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
- Considering optimisation, this limit should keep doses below the 0.5 Sv threshold
- 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 of protection

Although many options were considered, a change is not justified based on improvements to protection

Statement on Tissue Reactions

*(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.***

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.***



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