

ICRP Recommendations on the Lens of the Eye

Canadian Nuclear Safety Commission & Canadian Radiation Protection Association

Webinar on Recommended Dose Limits for Lens of the Eye

March 21, 2018

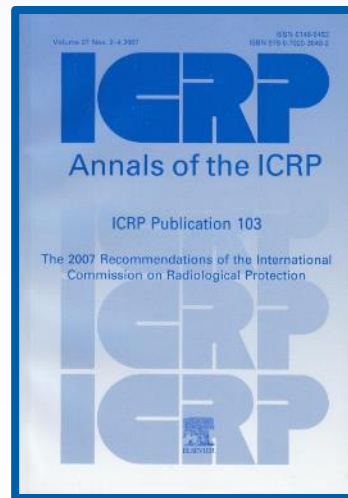
Christopher Clement

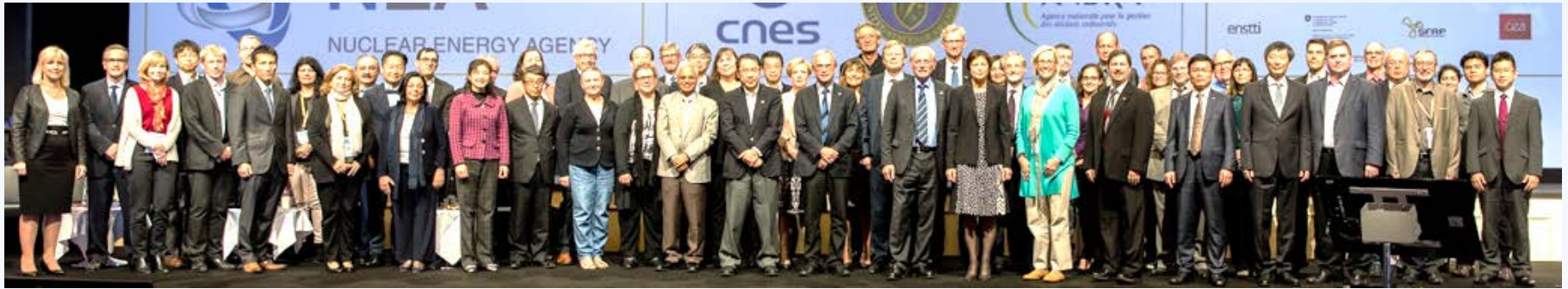
ICRP Scientific Secretary

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ICRP Mission

Advance for the public benefit the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation





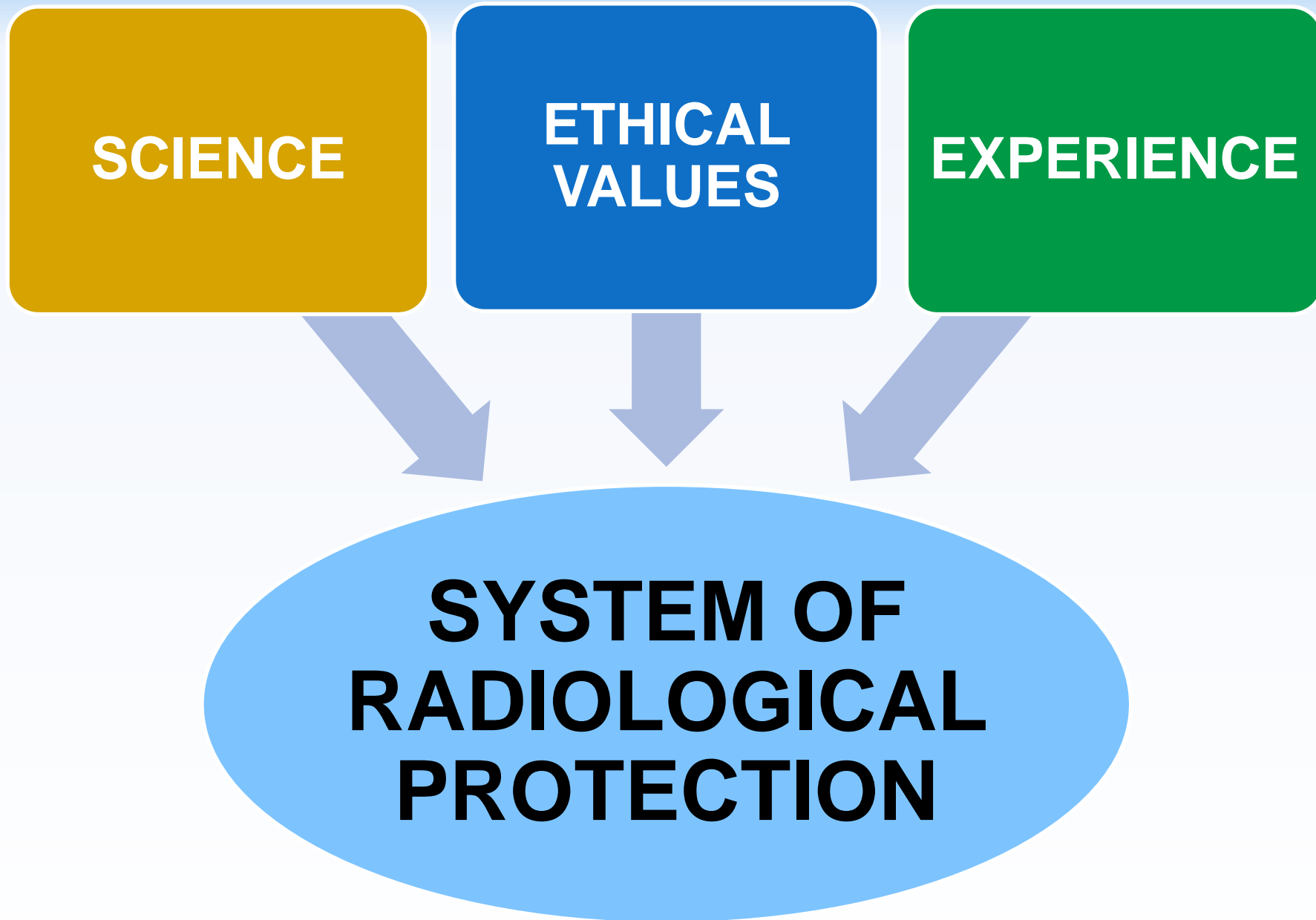
>250 members from 35 countries,
experts who volunteer their time

Independent

Non-governmental

Non-profit





Primary Aim

Contribute to an **appropriate level of protection for people and the environment** against the detrimental effects of radiation exposure without unduly limiting the desirable human actions that may be associated with such exposure



Protection Goal for Human Health

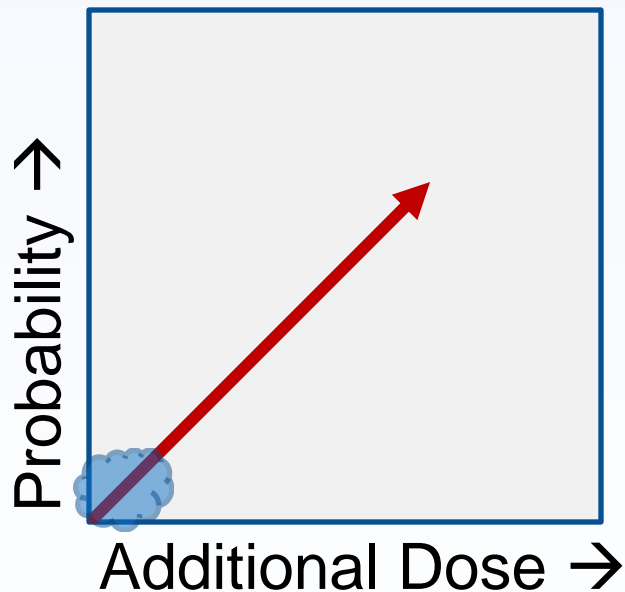
Manage and control exposures so that:

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



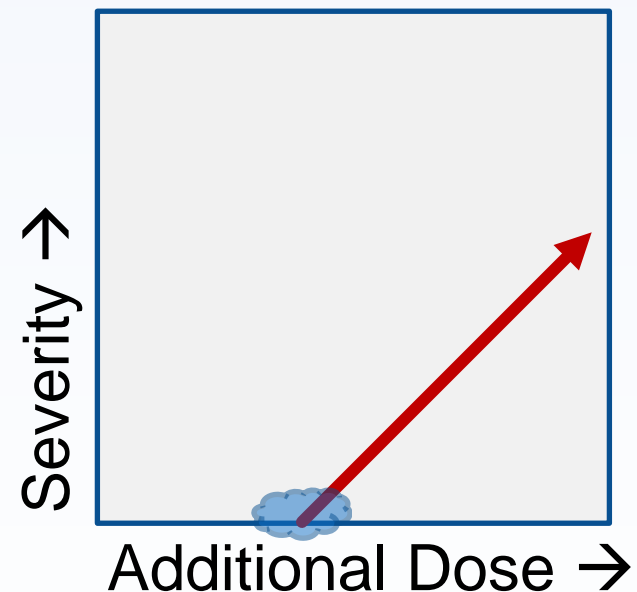
Cancer & Heritable Effects

(Stochastic Effects)



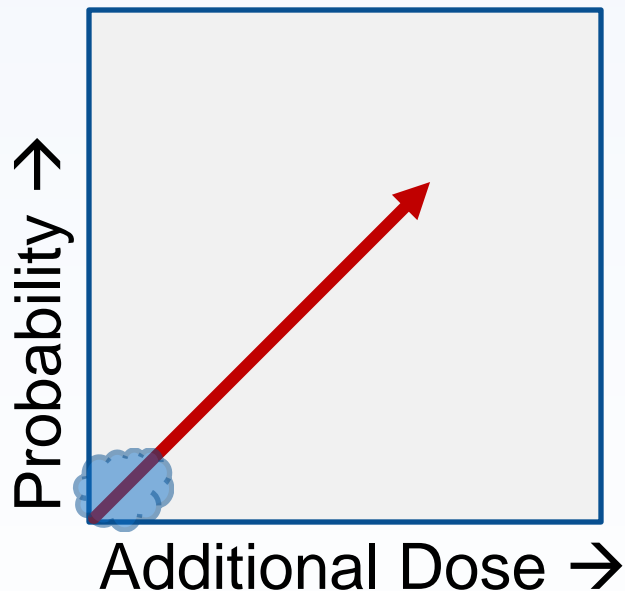
Harmful Tissue Reactions

(Deterministic Effects)



Cancer & Heritable Effects

(Stochastic Effects)



Mechanism

Mutation of individual cells

Model for Protection

Probability of effect
increases with dose
without threshold

Protection Aim

Reduce risk to the extent
reasonably achievable

→ **Keep doses As Low As Reasonably Achievable**

Mechanism

Injury to populations of cells

Model for Protection

Severity of effect
increases with dose
above a threshold

Protection Aim

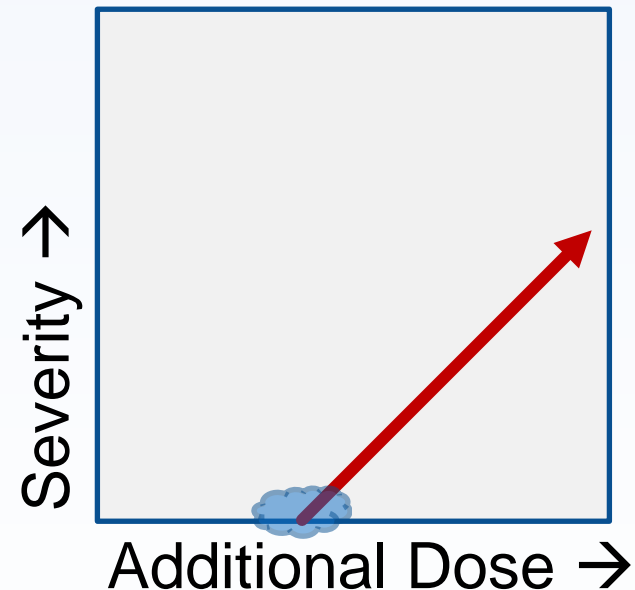
Prevent harmful reactions

→ *Keep doses below
threshold*

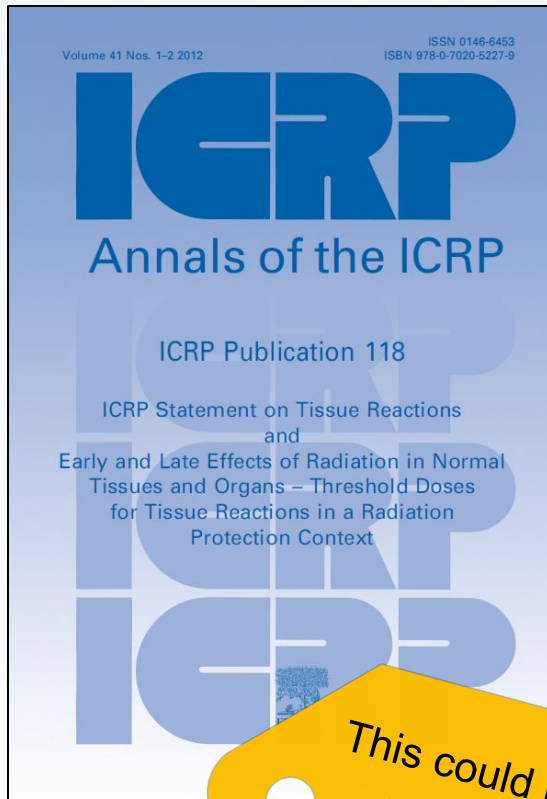
Harmful Tissue Reactions

(Deterministic Effects)

*e.g. necrosis, cataract induction,
circulatory disease*



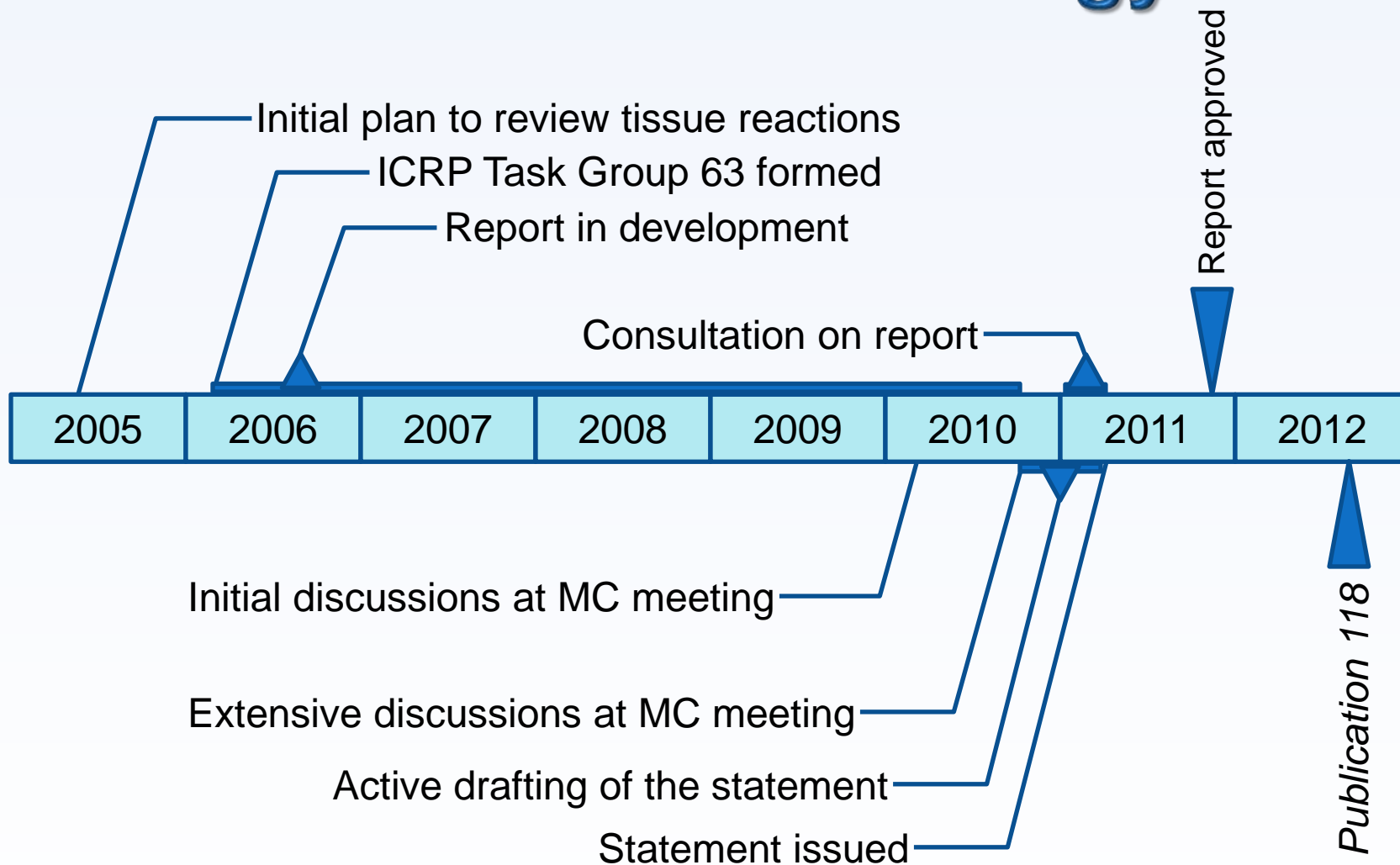
ICRP *Publication 118*



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



Publication 118 Chronology



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

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
 - Later study* from RERF:
 - At 1 Gy, 20-30% excess of cataract surgery
 - Threshold of 0 to 0.8 Gy, if one exists

* Neriishi 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

?

Cancer & Heritable Effect

(Stochastic Effect)

Mutation of individual cells

No threshold

→ Keep doses As Low As Reasonably Achievable

Harmful Tissue Reaction

(Deterministic Effect)

Injury to populations of cells

Threshold

→ Keep doses below threshold

Why?

Previously considered
tissue reaction

Protection based on
assumption of a threshold
still the best principle of
protection for cataracts

Therefore, **aim to keep
doses below threshold**



Harmful Tissue Reaction

(Deterministic Effect)

Injury to populations of cells

Threshold

→ ***Keep doses below
threshold***

Keeping Doses Below a Threshold

Dose Limits

+

Optimisation of Protection

Dose Limit for Lens of the Eye: Occupational Exposures

“(3) For occupational exposure in planned exposure situations ... 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.”

– Publication 118 Statement on Tissue Reactions

- Given the threshold, a higher limit would not be adequately protective
- Alignment with the effective dose limit facilitates implementation

Optimisation

“(5) ... protection should be optimised not only for whole body exposures, but also for exposures to specific tissues, particularly the lens of the eye ...”

– Publication 118 Statement on Tissue Reactions

- Helps keep lifetime doses below threshold (annual limits alone do not guarantee this)
- Reflects uncertainty in setting threshold
- Accounts for the possibility of the lack of threshold

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 per year)

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

Summary

No change to principles or concepts in the system of radiological protection

- Numerical change to the dose limit in response to clear evidence of a significantly lower threshold

Explicit recommendation to optimise protection for exposures to the lens of the eye:

- Helps keep lifetime doses below threshold
- Reflects uncertainty in setting threshold
- Accounts for the possibility of the lack of threshold





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