

The United Nations Scientific Committee on the Effects of Atomic Radiation

- Occupational Exposure of Lens of the Eye-



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“Regulatory implementation of equivalent dose limit for the lens of the eye for occupational exposure”



UNSCEAR

United Nations Scientific Committee
on the Effects of Atomic Radiation

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environment

General overview 2000-2021

- The eye is considered a relatively radiosensitive organ mainly because of the frequent development of posterior subcapsular cataracts
- There have been “dramatic improvements” in the understanding of acute effects long-term local radiation injuries due to irradiation
- It was thought that single acute doses of low-LET radiation of 2 Gy or more and for fractioned exposure, vision-impairing damage to the retina and the optic nerve may require a cumulative dose of the order of 50–60 Gy.
- Majority of opacities after radiation do not impair vision, however above 7 Gy severe visual impairment
- In 2008 it was suggested that the lens of the eye may be more radiosensitive than previously considered
- For occupational exposure and accidents a few observations have been made for different medical procedures and after accidents



Planned exposure activities

Workers	Procedures	Equivalent dose (mSv)
3 vascular surgeons*	47 consecutive endovascular aortoiliac aneurysm (over 1 year)	7.8 (primary surgeon) 5.7 (first assistant) 2 (second assistant)
10 specialists	83	
interventional radiologists	a) Vascular intervention radiology	0.04 - 2.1 (per procedure)
	b) Interventional cardiology	
	- With and without lead screen	0.04 – 1 (per procedure)
	- With lead screen	0.05 - 0.5 (per procedure)
	- Without lead screen	0.03 – 1 (per procedure)

*Other procedures are also presented in UNSCEAR 2008, Annex B report



Accidents

Country	Year	Type	Main cause	Persons	Eye exposure (Gy)	Effects
USSR	1966	X ray equipment	Poor maintenance	1	20	1 Death after 7 years and loss of left eye*
Peru	1977	¹⁹² Ir source	Untrained personnel; not registered equipment	3	0.9	No eye effects reported**
USSR	1978	<i>Siberian Chemical Complex</i>	<i>Pu deficient glovebox</i>	1 7	2.5 (whole body) 0.05 and 0.6	Eyesight impairment occurred some time later*
Argentina	1982	X therapy facility	Operator's failure	1	5.8	Cataracts on both eyes**
USSR	1980	⁶⁰ Co irradiation facility		1	50	No eye effects reported**

*2008 Report

** 2000 Report, Annex E



Chernobyl accident

- Ukrainian–American Chernobyl Ocular Study
 - Two ophthalmological examinations 12 and 14 years after the accident - 8,607 workers in six cities located in five Ukrainian oblasts
 - Modelling revealed data not compatible with a dose–effect threshold **of more than 700 mGy**, and that the lower boundary of the estimated dose threshold was close to 150 mSv with uncertainties
- ARS workers (15 years of clinical observation of 77 workers)
 - 11 cases of clinically significant cataracts were observed
 - among persons who survived doses from 2.6 to 8.7 Gy
 - latent period varied from 1.5 years (for the most exposed person) to 12 years (for the least exposed person)
- Ukrainian studies of cataracts among the ARS survivors and the recovery operation workers were underway since 2008.



Fukushima accident

2013 Report

- No direct information on beta-radiation fields at FDNPS was available to the Committee.
- Priorities for research identified included estimation of doses to the lens of the eye for workers involved in the on-site mitigation strategies.

2020/2021 Report

- TEPCO determined the personal dose equivalent (March 2011-March 2012)
 - 77 workers more than 100 mSv; 10 of these were estimated to have received more than 150 mSv
- Discernible risk of cataracts is uncertain; some estimates of dose to the lens of the eye have become available.
- Remains to be established whether full-face masks
- The worker epidemiology study includes plans, but no results are published.



Further research areas and next steps

- **Planned exposure**

- **The Committee notes that data on the equivalent doses to the lens of the eye reported until 2019 is limited.** It is expected that for the Committee's next evaluation of occupational exposure, more countries will be in the position to provide reliable data on this topic

- **Accidents**

- Critical analysis to better understand of existing knowledge from the **Chernobyl accident**. Need to better evaluate latency and cataract progression, and to better characterize the risk to the lens of the eye from exposure to low-to-moderate radiation doses.
- Beta dose to the lens of the eye of workers was identified as a research need in the UNSCEAR 2013 Report (**Fukushima**) but an assessment of these doses had not been reported/published until 2019.

UNSCEAR new evaluation planned for 2023

- Welcome feedback and cooperation on this topic for the new evaluation

Further information

- **Printed version can be ordered from**
<https://unp.un.org>
- **Electronic version for free download**
www.unscear.org



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