

**International Radiation
Protection Association
EYE DOSE GUIDANCE**

(and EPRI Workshop)

-- SPRING 2016 --



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COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

IRPA

2015 IRPA survey of professionals on the new dose limit to the lens of the eye and wider issues associated with tissue reactions

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A questionnaire sent to all the IRPA ASs

on April 23rd, 2015

Topic 1 Implications for Dosimetry

Q1 – Q8 - implications for monitoring and assessing dose to the lens of the eye and the interpretation of the results.

Topic 2 Implications for Methods of Protection

Q9 – Q12 - implications for methods (e.g., procedures or the design phase of equipment, facilities, and protective equipment) used to reduce dose to the eye, in the context of optimization of protection.

Topic 3 Wider Implications of Implementing the Revised Limit

Q13 – Q18 - long term impact on working activities; - changes in Health surveillance; - more claims for compensation

Topic 4 Legislative and other general aspects

Q19 – Q22 - guidelines addressing monitoring related to new limit; -consultation for legislation; -wider issue of tissue reactions, also circulatory disease



Conclusions from the survey

Direct implication in dosimetry and protection

- ▶ **ASs devoted most attention to the medical area**, non uniform exposure (interventional radiology and cardiology)
 - **A dosimeter measuring Hp(3) close to the eye** is
 - considered the ideal method and used in pilot studies;
Because of the limited availability of Hp(3) dosimeters,
 - **Hp(0.07) and Hp(10) are predominantly used**;
 - When use a dosimeter close to the eye → *it should be on a head band¹*, **suggestions on the position**: the side of the head, the eyebrow ridge, on the forehead, or attached into the protective glasses;
 - ¹ **Not seen as practical by medical HPs attending the IRPA eye presentation.**



Conclusions from the survey

Direct implication in dosimetry and protection

- The dosimeter is **worn at the collar** outside the lead apron, but no correction factor is applied;
 - **Protective systems are not always available** and used at different levels, hospital to hospital, even within the same country;
-
- ▶ **In nuclear installations**, shielding masks, glove-boxes and remote systems were in use before the introduction of the new dose limit, and no major changes are foreseen
 - ▶ **Regardless of the area of use**, issues emerge, beside the economic ones, about the discomfort associated with using lead glasses, since they are heavy and not being suitably fitted for individuals.

Related Activities

**Radiation Induced Cataracts:
Science, Policy, and Impacts
Radiation Protection Workshop**
Wednesday, 1 June 2015

**EPRI Update:
Lens of the Eye Projects**



IAEA

International Atomic Energy Agency

TECDOC No. 1731

**Implications for Occupational
Radiation Protection of the
New Dose Limit for the
Lens of the Eye**

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INTERNATIONAL RADIATION PROTECTION ASSOCIATION

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 - > Public Understanding
 - > Stakeholder Engagement

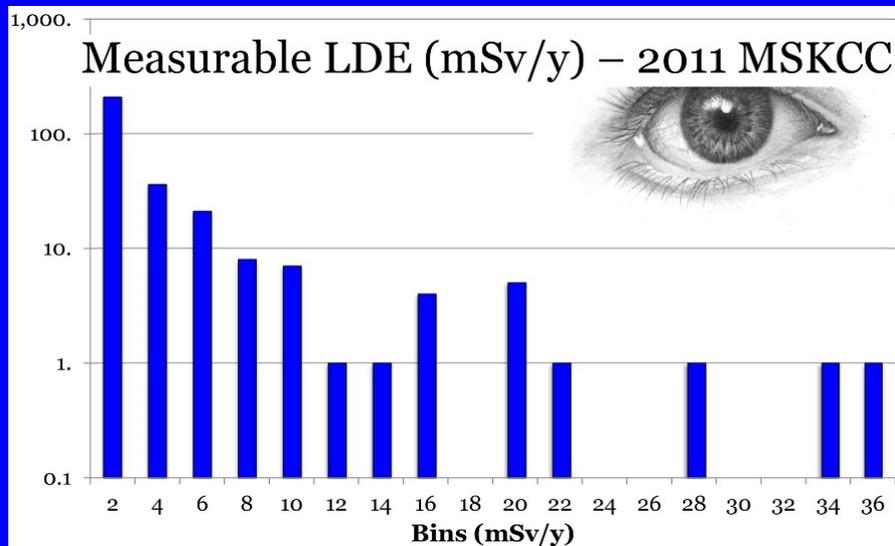
The primary purpose of IRPA is to provide a medium whereby those engaged in radiation protection activities in all countries may communicate more readily with each other and through this process advance radiation protection in many parts of the world. This includes relevant aspects of such branches of knowledge as science, medicine, engineering, technology and law, to provide for the protection of man and his environment from the hazards caused by radiation, and thereby to facilitate the safe use of medical, scientific, and industrial radiological practices for the benefit of mankind.

Latest News

- New Lens of Eye Area on the IRPA Website**
2016-07-13 IRPA EC
- Update on the June 2016 IAEA Radiation Safety Standards Committee Meeting**
2016-07-08 IRPA President Roger Coates
- Just Released: IRPA Bulletin No 10 - Special IRPA14 Issue**
2016-07-04 IRPA CoP
- FS-IRPA Workshop on RP Culture in Waste Management, 14-16 Nov 2016, St Ursanne Switzerland**
2016-07-04
- IRPA President Roger Coates awarded Officer of the Order of the British Empire (OBE)**
2016-06-14 IRPA EC
- ICRU Invites Nominations for the Gray Medal**
2016-06-03
- Check out IRPA's New YouTube Channel**
2016-05-26 IRPA EC

IRPA Guidance is based on 20 mSv/y

- ICRP recommendation is 20 mSv/y
- NCRP may be 50 mSv/y



Dauer: EPRI 2016

Measurable LDE (mSv/y) - 2011

Exposed Medical Staff	Avg	Min	25%	50%	75%	95%	99%	Max
IR/FGI MD no Pb glasses	11.1	0.1	0.5	7.0	19.3	32.5	35.7	36.5
Radiopharmacist	4.7	0.1	4.3	5.0	6.4	8.0	8.5	8.6
IR/ FGI Tech-Nurse no Pb	2.5	0.1	0.4	1.1	1.9	12.0	19.1	19.3
NM Tech-Nurse	2.4	0.1	0.3	0.9	2.8	9.8	15.5	19.0
Hospital Average **	2.1	0.1	0.2	0.5	2.0	8.5	19.6	36.5
NM MD	1.9	0.1	0.5	1.4	2.6	6.2	7.2	7.6
Research Radiochem	1.9	0.1	0.1	0.6	3.3	6.3	7.8	8.2
Commercial Radiopharm	1.6	0.1	0.1	0.3	1.3	7.1	23.5	70.2
Radiation Safety	1.1	0.1	0.5	1.0	1.9	2.2	2.3	2.3
Inpatient Nurse	0.4	0.1	0.2	0.3	0.4	0.9	1.8	2.2

Dauer: EPRI 2016



Guideline protocol for eye protection and eye dose monitoring of workers

IRPA guideline protocol for eye protection and eye dose monitoring of workers

INTRODUCTION

In April 2011, the International Commission on Radiological Protection revised its eye dose threshold for cataract induction. The Commission specified a limit of 0.5 Gy, compared with the previous threshold doses for visual-impairing cataracts of 5 Gy for acute exposures and > 8Gy for highly fractionated ones. Further, ICRP recommended a reduction in the dose limit for occupational exposure in planned exposure situations (in terms of equivalent dose) for the lens of the eye from 150 mSv to 20 mSv in a year, averaged over defined periods of 5 years, with no dose in a single year to exceed 50 mSv ⁽¹⁾. This revised dose limit is incorporated into IAEA International Basic Safety Standards ⁽²⁾, and into the Council Directive Euratom ⁽³⁾ which must be implemented by the Member States by February 2018.

The reduction of the limit for occupational exposure for the lens of the eye has significant implication in view of the application to planned exposure situations for the different areas of occupational exposure ^(4,5) and needs adequate approaches for eye protection and eye dose monitoring.

IRPA initiated a process in 2012 to survey the views of the Associate Societies worldwide and to provide a medium for discussion on the implications of implementation of the new limits for the lens of the eye in occupational exposure ⁽⁶⁻⁹⁾.

Within the IRPA key scope of supporting the RP professionals; the purpose of this guideline is to provide practical recommendations about when and how eye lens dose should be monitored in the framework of the implementation of the new ICRP dose limit for the lens of the eye, as well as guidance on use of protective devices depending on the exposure levels.

WORKERS FOR WHOM LENS OF THE EYES MONITORING MIGHT BE NEEDED

Risk assessments should be carried out to identify workers for whom exposure of the lens of the eyes might be important. These will require the use of information available on the tasks undertaken and the level of involvement in the procedures.

1. Workers exposed to a relatively uniform whole-body radiation field, shall not need any specific eye lens monitoring. The whole body dosimeter will provide a good estimate of the eye-lens dose. This is the most frequent situation, and thus in most cases no special monitoring or procedures shall be required.

A guideline protocol has been drafted, to provide practical recommendations about **when** and **how eye lens dose should be monitored** in the framework of the implementation of the new dose limit for the lens of the eye, as well as guidance on **use of protective devices** depending on the exposure levels.



Guideline protocol for eye protection and eye dose monitoring of workers

- **Workers for whom lens of the eyes monitoring might be needed**
- **Proposed dose levels for implementation of dose monitoring**
- **Eye lens monitoring procedures**
- **Guidance on use of eye protective devices**



Guideline protocol for eye protection and eye dose monitoring of workers

Table 1 Proposed dose levels for implementation of dose monitoring ⁽¹²⁾

Tissue	Dosimeter position	Dose quantity*	Annual dose (mSv)	Monthly dose (mSv)	Protection / Dose monitoring recommendations
Eyes	Collar or headband	Hp(3)	1–6	0.2–0.5	Initial monitoring with collar or head dosimeter to establish dose levels. Regular monitoring recommended
Eyes	Collar or headband	Hp(3)	> 6 (15)**	> 0.5	Regular monitoring with collar or head dosimeter is required.

This guidance is based on the ICRP dose limit of 20 mSv/y

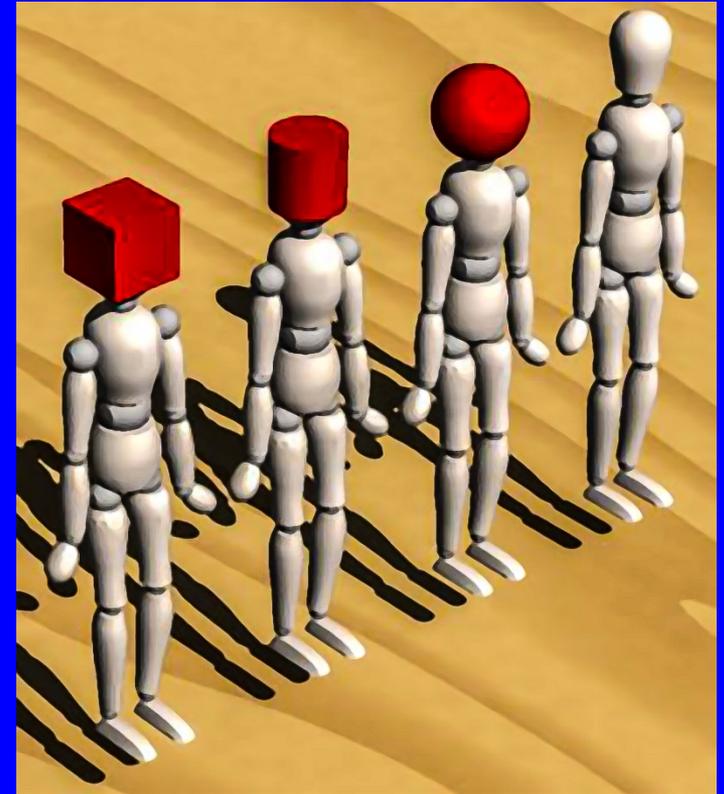
Hp(10) may be a reasonable substitute for imaging X-ray photons (including scatter).

Measured Hp(3) may be needed for other irradiations.

Validity of collar measurements is irradiation geometry dependent.

Work still has to be done

- **Calibration method for $H_p(3)$**
 - Test geometry is critical.
- **Standards for defining the clinical protection factor for PPE**
 - Irradiation geometry
 - Clinical task





Guideline protocol for eye protection and eye dose monitoring of workers

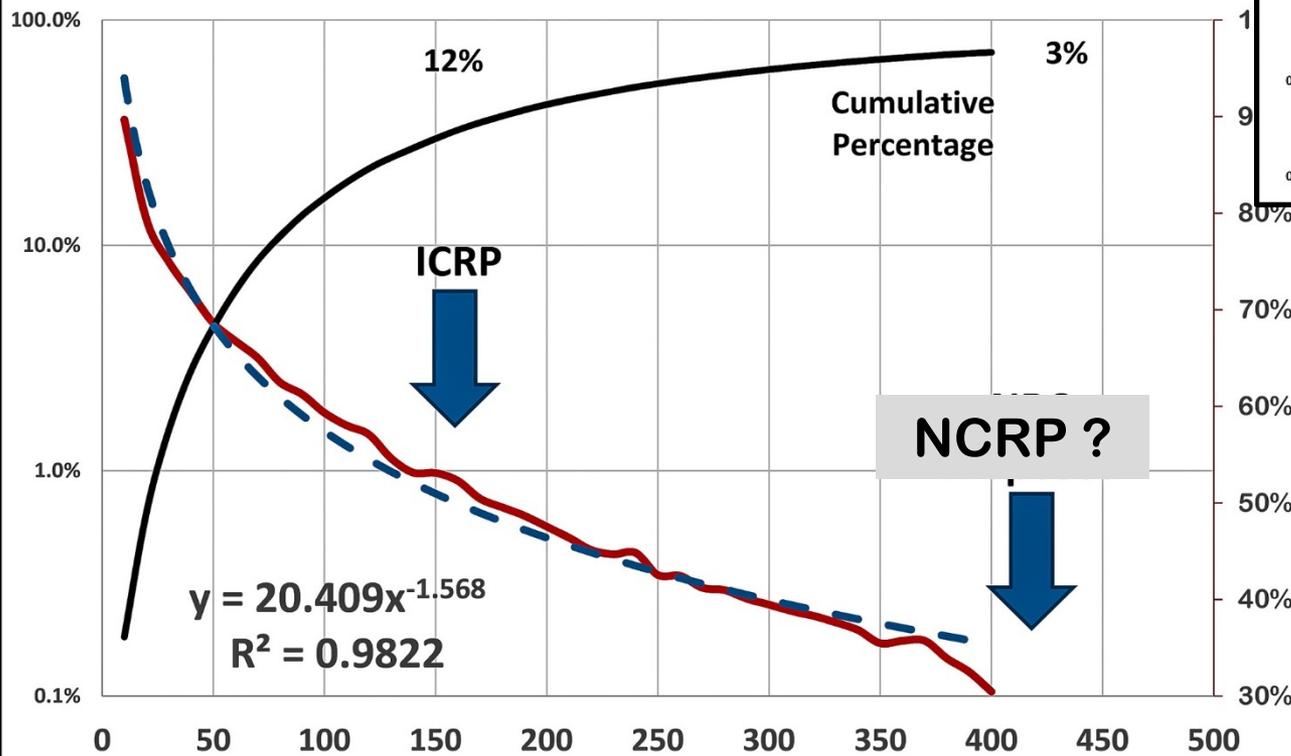
Table 2 Proposed dose levels for guidance on use of protective devices ⁽¹²⁾

Tissue	Annual unprotected dose (mSv)	Protection recommendations
Eyes	3–6	Ceiling suspended screens should be used where available. Protective eyewear may be considered where there is no other protective device.
Eyes	6–10	Training in use of ceiling-suspended screens recommended. Protective eyewear should be considered, particularly where no other protective devices are available.
Eyes	> 10	Protection essential. Both ceiling suspended shield and protective eyewear should be considered and at least one form used.

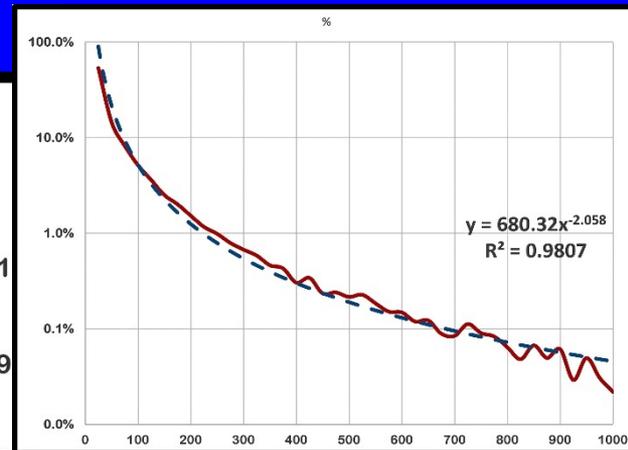
- These values are prudent for either 20 or 50 mSv/y
- Individual monitoring results will demonstrate the (im)proper use of external devices such as ceiling-suspended screens.
- Even with proper use of external devices, the collar reading can exceed 10 mSv/y. Protective eyewear is also needed for these individuals

Percent of 68,740 monthly (non 'M') 2014 collar badge readings on medical workers.

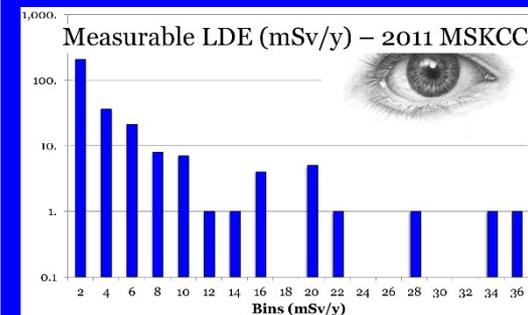
% of Collar Badges with monthly DDE reading (mrem)



Annualized Hp(10) mrem



Annualized Hp(10) mrem



Dauer: EPRI 2016

PPE for Eyes



Strategy	Reduction Factor
Leaded glasses	3-10
Shielded drape	25
Leaded glasses + drape	140
Ceiling shield	130
Rolling shield	1000

Thornton, Dauer et al 2010, JVIR

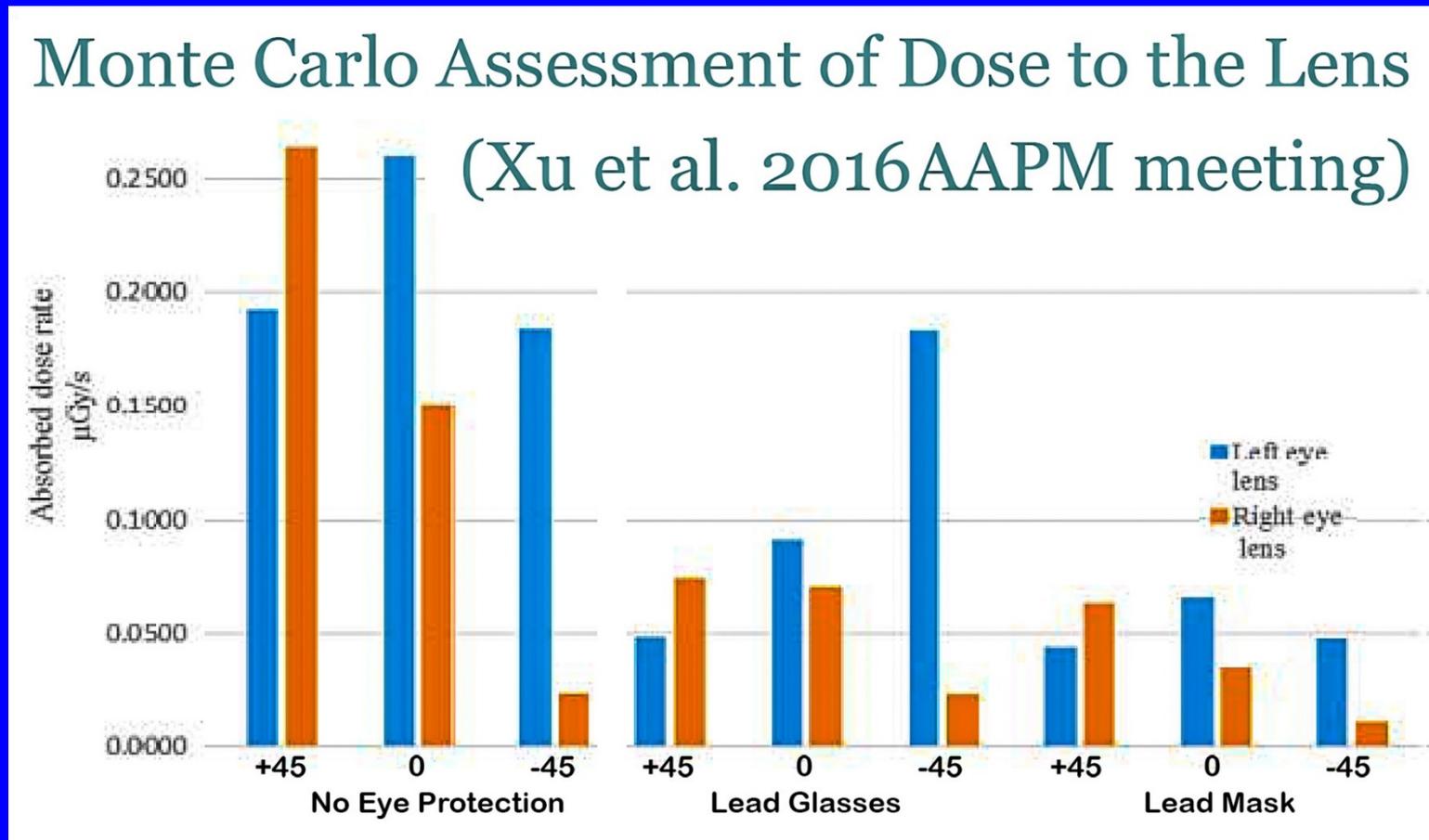
Dauer: EPRI 2016



Operator orientation matters



Orientation relative to the beam



Dauer: EPRI 2016

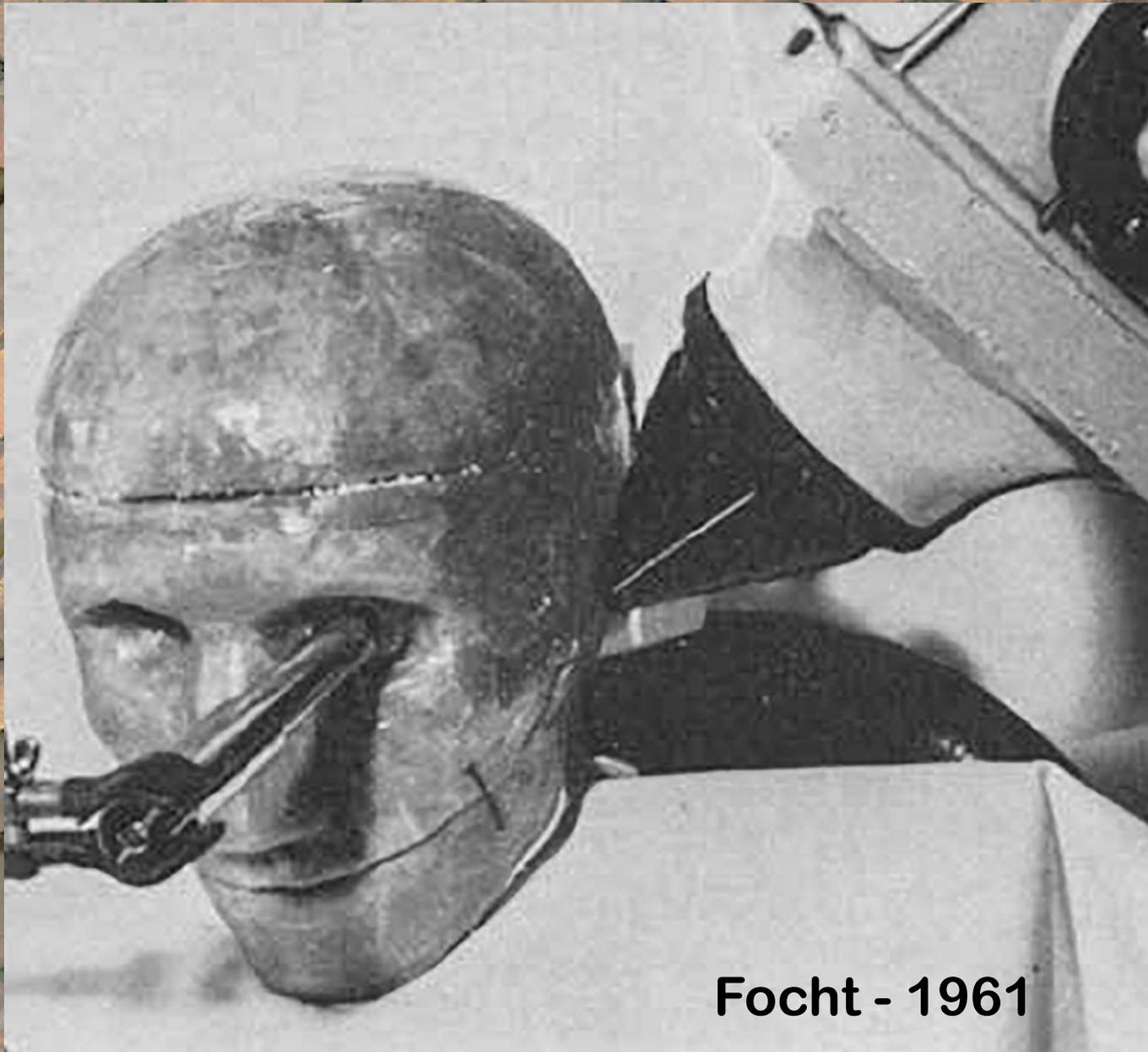
Protection factor for fluoro glasses?



- A minimum attenuation factor of three (3) for each eye is desirable.
- Dependent on device construction, geometry, operator's height, operator's motion, etc.
- Operational evaluation in a facility is possible.
- No available standard that accounts for known major variations in the orientation of the individual's head in the scatter field.

IRPA (EPRI) Conclusions

- Lens of eye dose limits of 20 – 50 mSv/y.
- Open question: Should all observable opacities be treated as cataracts?
- For the USA (assuming eye 50mSv/y) protective glasses with a minimum factor of 3 are consistent with the allowance for protective aprons.
- Adjustment for eye PPE should be as routine as adjustment for body PPE.



Focht - 1961

