

ICRP 60 DOSIMETRY SYSTEM

Learning Objectives

- Identify differences between the ICRP-60 system and current USNRC regulations
- Explain the science supporting these changes

ICRP 60 DOSIMETRY SYSTEM

- 1990 Recommendations of the ICRP
- Already adopted in Europe and by IAEA
- Similar dose limits published in NCRP 116 (1993)
- NRC in process of deciding how to update 10CFR20 to reflect new guidance

Changes in ICRP60

Five major changes recommended in ICRP60:

1. Nomenclature
2. Annual maximum dose limit
3. Annual average dose limit over an identified 5-year period
4. Revised radiation and tissue weighting factors
5. Revised dose limits remove non-stochastic organ dose limit

Changes in Nomenclature

- “Quality factor” renamed “radiation weighting factor”, w_R
- “Dose equivalent” renamed “equivalent dose”
= absorbed dose x radiation weighting factor
and summed over all radiations:

$$H_T = \sum_R w_R D_{T,R}$$

- “Effective dose equivalent” renamed “effective dose”
= equivalent dose x tissue weighting factor
and summed over all tissues:

$$E = \sum_T w_T H_T$$

- “Non-stochastic” renamed “deterministic”
- “Genetic” renamed “hereditary”
- Committed (always assumed) and collective remain same

Annual Maximum Dose Limit

- Effective dose should not exceed 50 mSv (5 rem) in any one year
- This is the sum of external penetrating deep dose equivalent (DDE) and committed effective dose from all intakes in a year
- Note there is no longer a separate limit for organ dose

Annual Average Dose Limit

Effective dose should not exceed 20 mSv (2 rem) per year, averaged over a designated 5 year period.

Thus, effective dose should not exceed 100 mSv (10 rem) in the 5-year period

Separate limits for lens of eye: 150 mSv (15 rem) and for skin and extremities: 500 mSv (50 rem)

Changes in w_R

Photons, all energies		1
Electrons & muons		1
Neutrons	< 10 keV	5
	10 -- 100 keV	10
	0.1 -- 2 MeV	20
	2 -- 20 MeV	10
	> 20 MeV	5
Protons (non recoil) > 2 MeV		5
Alphas, fission fragments, heavy nuclei		20

Changes in w_T

Organ	ICRP 26	ICRP60
gonads	0.25	0.20
breast	0.15	0.05
Thyroid	0.03	0.05
bone surface	0.03	0.01
Remainder	0.06 ea. (x5)	0.025 ea. (x2)

New W_T factors in ICRP 60

Organ	W_T
colon	0.12
stomach	0.12
bladder	0.05
liver	0.05
esophagus	0.05
skin	0.01

Risk Factors for Stochastic Effects, 10^{-2} Sv^{-1}

	Fatal cancer	Non-fatal cancer	Hereditary effects	Total
Adult workers	4.0	0.8	0.8	5.6
Entire population	5.0	1.0	1.3	7.3

Why the changes?

Change in A-bomb survivor risk factors

- more cancer as population ages
- lower neutron dose at Hiroshima

Optimization (ALARA) philosophy

NCRP 116 recommendations:

Annual maximum of 50 mSv (5 rem)

Lifetime limit of age x 10 mSv (1 rem)

So for working age 18 to age 65,

limit = 65 rem = 1.4 rem/yr