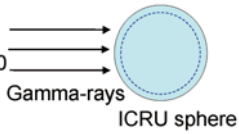
Units of Radiation — Dose Equivalents: Measurable Operational Quantities for Deriving Effective Doses

Dose equivalent = Absorbed dose at a reference point that meets certain requirements × Quality factor

To substitute for "effective doses" that cannot be actually measured, "operational quantities" that can be measured as conservative values or as nearly the same values as effective doses, such as an ambient dose equivalent and personal dose equivalent, are defined under certain conditions.

Ambient dose equivalent (1cm dose equivalent)

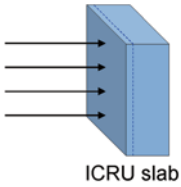
Dose equivalent is a dose that would be produced at a depth of 1 cm from the surface of an ICRU sphere, which is 30 cm in diameter and simulates human tissue, placed in a field where radiation is coming from one direction; Ambient dose equivalent is used in measurements of ambient doses using survey meters, etc.



Personal dose equivalent (1 cm dose equivalent)

Dose equivalent at a depth of 1 cm at a designated point on the human body; Since measurement is conducted using an instrument worn on the body, exposure from all directions is evaluated while a self - shielding effect is always at work.

⇒ **Personal dose equivalents are always smaller than survey meter readings!**



Operational quantities for approximating effective doses that cannot be actually measured (p.40 of Vol. 1, “Concepts of Doses: Physical Quantities, Protection Quantities and Operational Quantities”) are defined, such as the ambient dose equivalent H*(d) (d is depth) for evaluating ambient doses in a work environment, etc., the personal dose equivalent $H_p(d)$ for evaluating personal exposure, and the directional dose equivalent H’ (d,α) (α is the angle of incidence) as a quantity for use when there is a need to evaluate the depth and directions of incidence as well, as in the case of exposure of the lens of the eye to β-particles or soft X-rays.

Generally, both the ambient dose equivalent and the personal dose equivalent are also called 1 cm dose equivalents because a depth of 1 cm is used in the case of exposure to γ-rays.

However, while the ambient dose equivalent is measured using measuring instruments that are less affected by directivity, such as a stationary ionization chamber and a survey meter, the personal dose equivalent is measured using a small personal dosimeter worn on the trunk of the body, so incidence from the back is evaluated while a self-shielding effect is always at work. Therefore, in the case of exposures only from the front direction, such as exposures in laboratories, the ambient dose equivalent and the personal dose equivalent are equal, but in the case of exposures from all directions, personal dose equivalents are always smaller than the values measured with a survey meter, etc. Calculation of an effective dose for incidence from all directions is made under the condition of “rotational irradiation” in which the human body is rotated, and the calculated value will be exactly the same as the personal dose equivalent. In other words, the calculated value will generally be larger than the effective dose.

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