

Glossary of Terms Related to Radioactivity, Radiation Dose, and Exposure

absorbed dose – The energy absorbed by matter from ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

becquerel (Bq) – A unit of radioactivity equal to 1 disintegration per second. See also curie.

collective dose – The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert).

committed dose equivalent – The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

committed effective dose equivalent – The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

curie (Ci) – A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity. See also becquerel.

dose (radiological) – A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary.

dose equivalent – The product of absorbed dose in rad (or gray) in tissue, a quality factor, and other modifying factors. Dose equivalent is expressed in units of rem (or sievert).

effective dose equivalent – The summation of the products of the dose equivalent received by specified tissues of the body and the appropriate weighting factor. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem (or sievert).

external dose or exposure – That portion of the dose equivalent received from radiation sources outside the body (i.e., “external sources”).

half-life (radiological) – The time in which one-half of the atoms of a specific radionuclide decay into another nuclear form or energy state. Half-lives for different radionuclides range from fractions of a second to billions of years.

1 **gray** – The SI (International System of Units) unit of absorbed dose. One gray (Gy) is equal to an
 2 absorbed dose of 1 joule/kg (1 Gy = 100 rads). (The joule in the SI unit of energy, abbreviated as J.)
 3 (See also rad.)
 4

5 **internal dose or exposure** – That portion of the dose equivalent received from radioactive material taken
 6 into the body (i.e., “internal sources”).
 7

8 **millirem (mrem)** – A subunit of a rem. One mrem equals 1/1000th (0.001) of a rem. See also sievert.
 9

10 **person-rem** – Unit of collective total effective dose equivalent.
 11

12 **quality factor** – The principal modifying factor used to calculate the dose equivalent from the absorbed
 13 dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate quality factor. The
 14 quality factors to be used for determining dose equivalent in rem are shown in the following table:

15
 16 Quality Factors ^(a)
 17 -----
 18 Radiation type Quality
 19 factor
 20 -----
 21 X-rays, gamma rays, positrons, electrons (including tritium
 22 beta particles)..... 1
 23 Neutrons, < 10 keV..... 3
 24 Neutrons, > 10 keV..... 10
 25 Protons and singly-charged particles of unknown energy with
 26 rest mass greater than one atomic mass unit..... 10
 27 Alpha particles and multiple-charged particles (and
 28 particles of unknown charge) of unknown energy..... 20
 29 -----
 30 When spectral data are insufficient to identify the energy of the
 31 neutrons, a quality factor of 10 shall be used.
 32

33 (ii) When spectral data are sufficient to identify the energy of the
 34 neutrons, the following mean quality factor values may be used:
 35

Quality Factors for Neutrons
 [Mean quality factors, Q (maximum value in a 30-cm dosimetry phantom), and values of neutron flux density that deliver in 40 hours, a maximum dose equivalent of 100 mrem (0.001 sievert).]

Neutron energy (MeV)	Mean quality factor	Neutron flux density (cm ² s ⁻¹)
2.5 x 10 ⁻⁸ thermal.....	2	680
1 x 10 ⁻⁷	2	680
1 x 10 ⁻⁶	2	560
1 x 10 ⁻⁵	2	560
1 x 10 ⁻⁴	2	580
1 x 10 ⁻³	2	680
1 x 10 ⁻²	2.5	700
1 x 10 ⁻¹	7.5	115
5 x 10 ⁻¹	11	27
1.....	11	19
2.5.....	9	20
5.....	8	16
7.....	7	17
10.....	6.5	17
14.....	7.5	12
20.....	8	11
40.....	7	10
60.....	5.5	11
1 x 10 ²	4	14
2 x 10 ²	3.5	13
3 x 10 ²	3.5	11
4 x 10 ²	3.5	10

(a) Source: 10 CFR 835.

rad – A unit of radiation absorbed dose (such as, in body tissue). One rad is equal to an absorbed dose of 0.01 joule/kg (1 rad = 0.01 gray). See also gray.

radiation – Ionizing radiation such as alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions.

radioactive decay – The decrease in the amount of any radioactive material with the passage of time, due to spontaneous nuclear disintegration (i.e., emission from atomic nuclei of charged particles, photons, or both).

radioactivity – The property or characteristic of radioactive material to spontaneously “disintegrate” or “decay” with the emission of energy in the form of radiation. The unit of radioactivity is the curie (or becquerel).

rem – The special unit of radiation effective dose equivalent (1 rem = 0.01 Sievert). See also sievert.

roentgen (R) – The special unit of X- or gamma- radiation exposure. One roentgen equals 2.58 x 10⁻⁴ coulombs per kilogram of air.

sievert (Sv) – The SI (International System of Units) unit of radiation effective dose equivalent (1 Sv = 100 rem). See also **rem**.

1 **total effective dose equivalent (TEDE)** – The sum of the effective dose equivalent (for external
 2 exposures) and the committed effective dose equivalent (for internal exposures). Total effective dose
 3 equivalent is expressed in units of rem (or sievert).
 4

5 **weighting factor** – The fraction of the overall health risk, resulting from uniform, whole body irradiation,
 6 attributable to a specific tissue. The dose equivalent to each tissue is multiplied by the appropriate
 7 weighting factor to obtain the effective dose equivalent contribution from that tissue. The weighting
 8 factors are as follows:
 9

10 Weighting Factors For Various Tissues^(a)

Organs or tissues	Weighting factor
Gonads.....	0.25
Breasts.....	0.15
Red bone marrow.....	0.12
Lungs.....	0.12
Thyroid.....	0.03
Bone surfaces.....	0.03
Remainder ^(b)	0.30
Whole body ^(c)	1.00

23
 24 (a) Source: 10 CFR 835.

25 (b) "Remainder" means the five other organs or tissues with the highest
 26 dose (for example, liver, kidney, spleen, thymus, adrenal, pancreas,
 27 stomach, small intestine, and upper large intestine). The weighting
 28 factor for each remaining organ or tissue is 0.06.

29 (c) For the case of uniform external irradiation of the whole body, a
 30 weighting factor equal to 1 may be used in determination of the
 31 effective dose equivalent.
 32