

GLOSSARY

- ABCC** – Atomic Bomb Casualty Commission, an American organization established under the auspices of the National Academy of Sciences to investigate the late effects of the atomic bombs dropped on Japan in 1945. Succeeded by the Radiation Effects Research Foundation ([RERF](#)) in 1975.
- Absolute risk** is an excess risk from radiation exposure that is expressed as the arithmetic difference between the observed risk and the underlying natural or baseline risk.
- Absorbed dose** is the mean energy per unit mass imparted by [ionizing radiation](#) to an irradiated medium. Units: [gray](#) (Gy), formerly [rad](#). (see [Units](#)).
- Activity** is the mean number of decays per unit time of a [radioactive](#) nuclide. Units: [becquerel](#) (Bq), formerly [curie](#) (Ci). (see [Units](#)).
- Additive (absolute risk) model** is a model in which excess risk is expressed as a term to be added to the underlying natural or baseline risk. (Compare with the [multiplicative model](#).)
- Additive transfer** is a transfer in which the excess absolute risk ([EAR](#)) is assumed to be transferable between populations.
- Alpha particle** is two [neutrons](#) and two [protons](#) bound as a single charged particle (a helium nucleus) that is emitted from the nucleus of certain [radioactive isotopes](#) in the process of disintegration.
- AMAD** is the activity median aerodynamic diameter of particles in a [radioactive](#) aerosol (see discussion on [page 3-5](#) for a more complete description).
- AMTD** is the activity median thermodynamic diameter of particles in a [radioactive](#) aerosol (see discussion on [page 3-5](#) for a more complete description).
- Ankylosing spondylitis** is arthritis of the spine.
- Ataxia telangiectasia (AT)** is an inherited disorder associated with an increased risk of cancer, lymphoma in particular, and characterized by immunologic, chromosomal, and [DNA](#) defects.
- Background radiation** is the amount of radiation to which a member of the population is exposed from natural sources. These include terrestrial radiation due to naturally occurring [radionuclides](#) in the soil, cosmic radiation originating in outer space, and naturally occurring radionuclides deposited in the human body, including the daughters of [radon](#).
- Baseline (cancer) rate** is the cancer experience observed in a population in the absence of the specific agent being studied; the baseline rate might, however, include cancers from a number of other causes, such as smoking, background radiation, etc.
- Becquerel (Bq)** is an SI unit of activity. Equal to 1 disintegration per second. (see [Units](#)).
- BEIR** – Biological Effects of Ionizing Radiation. Name of the Committees of the U.S. National Academy of Sciences assessing the biological effects of [ionizing radiation](#). BEIR I 1972, BEIR II 1977, BEIR III 1980, BEIR IV 1988, BEIR V 1990, BEIR VI 1994, 1998.
- Beta particle** is a charged particle emitted from the nucleus of certain unstable atomic nuclei ([radioactive isotopes](#)), having the charge and mass of an electron.
- Biokinetic model** is a mathematical model describing the time course of a substance, such as plutonium, in the body.
- Cancer** is a malignant tumor of potentially unlimited growth, capable of invading surrounding tissue or spreading to other parts of the body by metastasis.

Carcinogen – an agent that may cause cancer. Ionizing radiations are physical carcinogens; there are also chemical and biologic carcinogens. Most carcinogens are also mutagens (see [below](#)). Biologic carcinogens may be external (e.g., viruses) or internal (genetic defects).

Carcinoma is a malignant tumor (cancer) of epithelial origin. Compare with [sarcoma](#).

Cascade impactor - equipment used to estimate particle size.

Case-control study is an [epidemiological](#) study in which people with disease and a similarly composed group of people without disease are compared in terms of exposures to a putative causative agent.

CDPHE – Colorado Department of Public Health and Environment.

Cell culture – the growing of cells [in vitro](#) (in a glass container) in such a manner that the cells are no longer organized into tissues.

Coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100 to express the result as a percentage. It is a measure of the spread in a parameter.

Cohort study or follow-up study; is an [epidemiological](#) study in which groups or cohorts of people are identified with respect to the presence of exposure to a disease-causing agent and compared with a similar unexposed control group with respect to disease outcome.

Competing risks are other causes of death which affect the magnitude of the risk being studied. Persons dying from other causes are not at risk of dying from the factor in question.

Confidence interval is a measure of the reliability of a parameter of a distribution, such as the mean, standard deviation, median etc. A 90% confidence interval around a median means that 9 times out of 10 the estimated median would be within the specified interval.

Curie (Ci) is a unit of [radioactivity](#) equal to 3.7×10^{10} disintegrations per second. (see [Units](#)).

DDREF – Dose and dose rate effectiveness factor. The factor by which the slope of a pure [linear model](#) fitted to the data should be divided to give the low-dose slope, i.e., the linear term in a [linear-quadratic dose-response model](#).

Deterministic describes effects whose severity increases with dose above a [threshold dose](#). Below the threshold dose the effect is not evident, although subtle minor effects may occur. Deterministic effects most often follow acute, high-dose exposure in days to weeks. Examples are skin damage (erythema i.e. reddening), hair loss (epilation), hematological damage (loss of bone marrow function), impairment of fertility (i.e. reduction of sperm count). Longer term effects may also occur and include cataract induction, fibrosis of tissue etc. After high doses of [alpha particles](#) from internal emitters such as plutonium, pulmonary fibrosis, pneumonitis and lymphopenia may occur. Thresholds for deterministic effects (except for the embryo-fetus) are not lower than 0.5 Gy and many, especially after chronic exposure are much higher (NCRP 1991; NRPB 1996).

Distributions (see [Annex to the Glossary](#)).

DNA – Deoxyribonucleic acid; the genetic material of cells.

Dominant mutation or gene disorder – the mutation or gene disorder is dominant if it produces its effect in the presence of an equivalent normal gene from the other parent.

Dose see [absorbed dose](#); [equivalent dose](#); [effective dose](#).

Dose-distribution factor – a factor which accounts for modification of the dose effectiveness in cases in which the [radionuclide](#) distribution and the resultant dose are nonuniform.

Dose effect (dose-response model) a mathematical formulation of the way the effect (or biological response) depends on dose.

Dose rate is dose delivered per unit time.

Dosimetry System 1986 (DS86) is used to estimate individual radiation doses received by the atomic bomb survivors. It replaced the [T65D](#) dosimetry system and was developed following criticism of the precision of the T65D dosimetry system.

Doubling dose is the amount of radiation needed to double the natural [incidence](#) of a genetic or somatic anomaly.

Edema – an accumulation of an excessive amount of watery fluid in cells, tissues, or serous cavities.

Effective dose is a quantity obtained by multiplying the [equivalent dose](#) in various specific tissues and organs by a tissue weighting factor appropriate to each and summing the products. Unit: [sievert](#) (Sv), (see [Units](#)).

Electron volt (eV) is a unit of energy = 1.6×10^{-12} ergs or 1.6×10^{-19} J (joule); 1 eV is equivalent to the energy gained by an electron in passing through a potential difference of 1 V; 1 keV = 1,000 eV; 1 MeV = 1,000,000 eV.

Elutriator - equipment used to estimate particle size.

Endosteal cells - a layer of cells lining the inner surface of bone in the central medullary cavity (marrow).

Epidemiology is the study of the determinants of the frequency of disease in man. The two main types of [epidemiological](#) studies of chronic disease are cohort (usually follow-up) studies and case control (often retrospective) studies.

Equivalent dose is a quantity obtained by multiplying the average [absorbed dose](#) in a tissue or organ by a [radiation weighting factor](#) to allow for the different effectiveness of the various [ionizing radiations](#) in causing harm to tissue. Unit: [sievert](#) (Sv), (see [Units](#)).

Etiology is the science or description of cause(s) of disease.

Excess absolute risk (EAR) is the absolute difference between the instantaneous [incidence](#) or [mortality](#) rates between two groups of people, e.g., those exposed to radiation at a given level and those unexposed.

Excess lifetime risk (ELR) is the excess risk from induced cancer due to exposure when the effects over an entire lifetime are accounted for. Individuals who would have died of cancer anyway but die early because of exposure are not included.

Excess relative risk (ERR) is the [relative risk](#) minus one, $RR-1$. Also = $\frac{O}{E} - 1 = \frac{O-E}{E}$ where O

is the number of cancers observed in a population and E is the number expected.

Excess risk (ER) $O-E$, is the difference between the number of cancers observed (O) and the numbers expected (E).

Fallout is [radioactive](#) debris from a nuclear detonation or other source, usually deposited from airborne particles.

Fibrosis – formation of fibrous tissue as a reparative or reactive process, as opposed to formation of fibrous tissue as a normal constituent of an organ or tissue.

Fluoroscopy is a method of directly visualizing internal structures by directing [x-rays](#) through an object (e.g., part of the body) onto a fluorescent screen.

Fractionation is the delivery of a given total dose of radiation as several smaller doses, separated by intervals of time.

Gamma radiation, also gamma rays; short wavelength electromagnetic radiation (photon) originating from the nucleus of a [radionuclide](#), similar to [x-rays](#) but usually of higher energy than about 100 keV.

Geometric mean (GM) – the geometric mean of a set of positive numbers is the exponential of the arithmetic mean of their logarithms. The geometric mean of a lognormal distribution is given in the [Annex to the Glossary](#).

Geometric standard deviation (GSD) – the geometric standard deviation of a lognormal distribution is the exponential of the standard deviation of the associated normal distribution. (see [Annex to the Glossary](#)).

Gray (Gy) is the SI unit of [absorbed dose](#) (see [Units](#)).

Half-life, biologic is the time required for the body to eliminate half of an administered dose of any substance by regular processes of elimination; it is approximately the same for both stable and [radioactive isotopes](#) of a particular element.

Half-life, radioactive is the time required for a [radioactive](#) substance to lose 50% of its [radioactivity](#) by decay.

Hodgkin's disease is a neoplastic disease that is characterized by progressive enlargement of lymph glands, spleen and liver, and by progressive anemia.

Hormesis or hormetic response are terms used to describe stimulatory or beneficial effects resulting from an agent usually considered to cause detrimental effects.

IARC – International Agency for Research on Cancer. Among other things, IARC conducts some international [epidemiological](#) studies.

ICDA – The International Classification of Diseases Adapted for use in the U.S. The ICD is periodically revised by the World Health Organization; the 9th ICDA is adapted from the 9th ICD which was issued in 1978.

ICRP – International Commission on Radiological Protection. Setup in 1928 as a professional body to consider radiation effects and recommendations about radiation protection practices and limits of exposure for workers and the public.

ICRU – International Commission on Radiation Units and Measurements. Setup in 1928 to recommend suitable quantities, units and measurement procedures for radiation applications and protection.

Incidence or incidence rate – the rate of occurrence of a disease within a specified period of time, often expressed as number of cases per 100,000 individuals per year.

Intake – that which is taken in per unit time.

Intrinsic merit of a method is an arbitrary measure of the inherent characteristics of the method which includes its directness among other, perhaps less tangible, things. Reliance on fewer factors will generally mean a higher intrinsic merit. Included also in the intrinsic merit is some appreciation of the actual characteristics of the method in the individual cases considered (ie. the uncertainties). In this report the intrinsic merit is scored by assigning an integer from 0 to 10.

Intubation – insertion of a tubular device into a canal, hollow organ, or cavity; specifically, passage of an orotracheal tube into the bronchi of animals to administer [radioactive](#) aerosols.

In utero – in the womb, i.e., during gestation before birth.

Inverse dose rate effect – with [low-LET](#) radiation high dose rates are virtually always more effective than low dose rates for the same total dose (see [DDREF](#)). In some [high-LET](#) circumstances the opposite effect, i.e., lower dose rate is more effective, is observed. This is called inverse dose rate effect.

In vitro (literally, in glass), refers to events occurring in a cell culture vessel or in the test-tube (as opposed to in vivo, in the living individual.)

Ionizing radiation is radiation sufficiently energetic to dislodge electrons from an atom and thus leave the atom positively charged or “ionized”. [Ionizing radiation](#) includes [x](#) and [gamma](#) radiation, electrons ([beta radiation](#)), [alpha particles](#) (helium nuclei), and heavier charged atomic nuclei. [Neutrons](#) ionize indirectly by colliding with atomic nuclei.

Isotopes of an element are nuclides that have the same number of [protons](#) in their nuclei, and hence the same atomic number, but that differ in the number of [neutrons](#), and therefore in the mass number; chemical properties of isotopes of a particular element are identical.

Kerma – **K**inetic **E**nergy **R**elaxed per unit **M**ass of material. A unit of energy released, expressed in [gray](#) (or [rad](#)), that represents the kinetic energy transferred to charged particles per unit mass of irradiated medium when indirectly ionizing (uncharged) particles, such as photons or [neutrons](#), traverse the medium. If all of the kinetic energy is absorbed “locally” the kerma is equal to the [absorbed dose](#).

Latent period or latency is the period of time between exposure to a causative agent and expression of a disease. After exposure to a dose of radiation, there is a delay of several years (the minimum latent period) before any cancers are seen.

LET see [linear energy transfer](#).

Lethality fraction is the fraction of incident cases of cancer in a given organ or tissue that result in death.

Life-span study (LSS) – Life-span Study of the Japanese atomic bomb survivors; the sample consists of 93,741 persons (in city) of whom 86,572 survivors have a defined dose assigned to them (Pierce et al. 1996a).

Life-table is a table of a population showing the number of persons who, of a given number born or living at a specified age, live to attain successive higher ages, together with the numbers who die in each age interval.

Lifetime risk is the [excess absolute risk](#) (of cancer) due to an agent like radiation expressed throughout the lifetime of the exposed individuals.

Lineal energy (y) is a measure of the energy lost by a particle in a small spherical volume. If ϵ is the energy imparted to a volume of mean chord diameter l , $y = \frac{\epsilon}{l}$

Linear energy transfer (LET) is the average amount of energy lost per unit track length during the passage of a charged particle through matter.

Low LET. Radiation characteristic of light charged particles such as electrons produced by [x rays](#) and [gamma rays](#) where the distance between ionizing events is large on the scale of a cellular nucleus (microns). Usually the LET is less than 10 keV μm^{-1} .

High LET. Radiation characteristic of heavy charged particles such as [protons](#) or [alpha particles](#) where the distance between ionizing events is small on the scale of a cellular nucleus (microns). Usually the LET will be above 50 keV μm^{-1} .

Linear (L) model also, linear dose-effect relationship – expresses the effect (e.g., mutation or cancer) as a direct (linear or proportional) function of dose.

Linear-quadratic (LQ) model also, linear-quadratic dose-effect relationship – expresses the effect (e.g., mutation or cancer) as partly directly proportional to the dose (linear term) and partly proportional to the square of the dose (quadratic term). The linear term will predominate at lower doses, the quadratic term at higher doses.

Log-normal distribution see [Annex to the Glossary](#).

Loss of life expectancy (LLE) in a population due to radiation exposure. (years).

Low dose is an expression used in this document to refer to [absorbed doses](#) in the range of 0 – 0.2 Gy.

Low dose rate is an expression used in this document to refer to dose rates of below 0.1 Gy per day for all radiations.

LSS see [Life-span Study](#).

Lymphosarcoma is a sarcoma of the lymphoid tissue. This does not include [Hodgkin's disease](#).

Monte Carlo calculation is the evaluation of a probability distribution by means of random sampling.

Morbidity (rate) is the proportion of people with a particular disease during a given year per given unit of population.

Mortality (rate) is the rate by which people die from a disease, e.g., a specific type of cancer, often expressed as number of deaths per 100,000 persons per year.

Multiplicative (relative risk) model is based on the assumption that the [relative risk](#) resulting from the exposure to two risk factors is the product of the relative risks from the two factors taken separately.

Multiplicative transfer is a transfer in which the excess relative risk ([ERR](#)) is assumed to be transferable between populations. The ERR from the exposed population is applied to the baseline rate for that cancer in the new population.

Mutagen – an agent that may cause a genetic change in a cell resulting in a variety of possible biological effects, including cancer (carcinogen). Many mutagens are also carcinogens.

NAS/NRC – The National Academy of Sciences (NAS) is a private non-profit professional society created by the U.S. Congress in 1863 to offer assistance to government agencies and other international bodies regarding scientific matters. The National Research Council (NRC) was organized by the NAS in 1913 to associate the broad community of science and technology with the Academy purpose.

NCRP – National Council on Radiation Protection and Measurements is a private, not-for-profit professional organization chartered by the U.S. Congress in 1964 to “collect, analyze, develop and disseminate in the public interest information and recommendations about radiation protection, measurements, quantities and units.” The NCRP produces reports on all aspects of radiation protection. It is located at 7910 Woodmont Avenue Suite 800 in Bethesda, Maryland 20814.

Neoplasms are abnormal growths, such as a tumor; neoplastic disease refers to any disease that forms tumors, whether malignant or benign.

Neutron is an uncharged subatomic particle capable of producing ionization in matter by collision with charged particles. Approximately the same mass as a [proton](#) it is a constituent of the nuclei of all atoms except hydrogen. The nucleus of deuterium (heavy hydrogen) has one [proton](#) and one neutron.

NIH transfer (model) – the excess absolute risk ([EAR](#)) is assumed to apply both in the exposed population and the proposed transfer population, i.e., the same number of cancers per unit population and unit dose will be produced in each. (It is called NIH because the National Institutes of Health NIH (1985) used it in preparing the radioepidemiological tables).

Normal distribution see [Annex to the Glossary](#).

NRPB – National Radiological Protection Board in the United Kingdom.

Nuclide is a species of atom characterized by the constitution of its nucleus, which is specified by its atomic mass and atomic number (Z), or by its number of [protons](#) (Z), number of [neutrons](#) (N), and energy content.

Odds ratio – If P_1 is the probability of getting cancer after an exposure (to radiation) and P_2 is the probability of getting the cancer without the exposure, the odds of getting cancer after this exposure are $O_1 = P_1/(1-P_1)$. The odds of getting cancer without the exposure are $O_2 = P_2/(1-P_2)$. Thus the odds ratio

$$\frac{O_1}{O_2} = \frac{P_1 (1-P_2)}{P_2 (1-P_1)} \approx \frac{P_1}{P_2}$$

when P_1 and P_2 are small.

Oncogenes are genes which carry the potential for initiating cancer.

Person-gray is a unit of collective dose obtained by summing individual [absorbed dose](#) values for all people in the exposed population. Thus, the number of person-grays contributed by 1 person exposed to 1 Gy is equal to that contributed by 100,000 people each exposed to 10 mGy.

Person-years (PY) is the number of persons exposed times the number of years after exposure, sometimes minus some lag period during which the dose is assumed to be unexpressed (minimum [latent period](#)).

Prevalence is the number of cases of a disease in existence at a given time per unit population, usually 100,000 persons.

Probability of causation is a number (or percentage) that expresses the probability that a given cancer, in a specific tissue, has been caused by an exposure to a carcinogenic agent, such as radiation.

Progeny are the decay products resulting after a series of [radioactive](#) decays. Progeny can also be radioactive, and then the chain continues until a stable nuclide is formed.

Projection model is a mathematical model that describes the excess cancer risk at different levels of dose, time after exposure, or baseline level of risk, in terms of a parametric function of that factor. It becomes a projection model when data in a particular range of observations is used to assign values to the parameters in order to estimate (or project) excess risk for factor values outside the range, e.g., from the observation period to lifetime.

Promoter is an agent which is not by itself carcinogenic, but which can amplify the effect of a true carcinogen by increasing the probability of late-stage cellular changes needed to complete the carcinogenic process.

Proton is a positively charged subatomic particle. Protons make up the nuclei of all atoms including hydrogen, which has one proton only.

Protraction is the spreading out of a radiation dose over time by continuous delivery at a lower dose rate.

Quadratic-dose model is a model which assumes that the excess risk is proportional to the square of the dose.

Quality factor (Q) is an LET dependent factor by which [absorbed doses](#) are multiplied to obtain (for radiation-protection purposes) a quantity which corresponds more closely to the degree of biological effect produced by x or low-energy [gamma rays](#).

Rad is a unit of [absorbed dose](#). Replaced by the [gray](#) in SI units (see [Units](#)).

Radiation weighting factor, w_R , is a factor representing the different effectiveness of different radiations in inducing [stochastic](#) (cancer and hereditary) effects. Range is from 1 to 20, see NCRP Report 116, Table 4.3 page 20 (NCRP 1993a).

Radioactivity is the property of some nuclides of spontaneously emitting particles or [gamma radiation](#), emitting [x radiation](#) after orbital electron capture, or undergoing spontaneous fission. Artificial radioactivity is man-made radioactivity produced by fission, fusion, particle bombardment, or electromagnetic irradiation. Natural radioactivity refers to the radioactivity exhibited by more than 50 naturally occurring radionuclides.

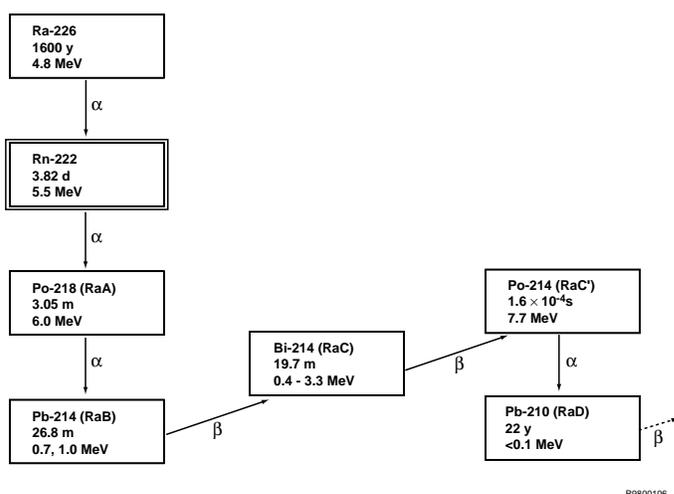
Radiogenic – caused by radiation or susceptible to being caused by radiation.

Radioisotopes are radioactive atomic species of an element with the same atomic number and usually identical chemical properties.

Radionuclide is a radioactive atomic species of an atom characterized by the constitution of its nucleus.

Radiosensitivity – relative susceptibility of individuals, cells, tissues, organs, and organisms to the injurious action of radiation; radiosensitivity and its antonym, radioresistance, are used in a comparative sense rather than an absolute one.

Radon. Element no.86, an odorless, colorless inert gas. ^{222}Rn . Its decay products are shown in the diagram on the following page.



Radium-226 decay scheme showing the principal decay products of **radon** (NCRP 1984).

RBE_M – the maximum value of the RBE between [high-LET](#) and [low-LET](#) radiations at very low doses. (see [Relative biological effectiveness](#) (RBE))

Recessive gene disorder – this requires that a pair of genes, one from each parent, be present in order for the disease to be manifest. An example is cystic fibrosis.

REID – risk of exposure induced death (for a lifetime), e.g., due to cancer. Individuals who would have died of cancer anyway but die early because of exposure are included.

Relative biological effectiveness (RBE) is the biological potency of one radiation as compared with another. It is numerically equal to the inverse of the ratio of [absorbed doses](#) of the two radiations required to produce the same type and level of biological effect in the same organism or tissue. The reference radiation is often [gamma rays](#) of cobalt-60 or of radium, or 200 kV [x-rays](#).

Relative risk is an expression of the excess risk relative to the underlying ([baseline](#)) risk; if the excess equals the baseline risk the relative risk is 2. Alternatively, it is the ratio of observed to expected values O/E.

Rem is a unit of [equivalent dose](#). The equivalent dose in “rem” is numerically equal to the [absorbed dose](#) in “rad” multiplied by the [radiation weighting factor](#) (or quality factor). Replaced by [sievert](#) = 100 rem.

RERF, Radiation Effects Research Foundation is a bi-nationally funded and managed foundation in Japan chartered under an agreement between the U.S.A. and Japan in 1975. The RERF is the successor to the [ABCC](#) (Atomic Bomb Casualty Commission).

Risk is a probability that harm, such as a fatal cancer, will occur.

Risk coefficient is the increase in the (annual) [incidence](#) or [mortality](#) rate per unit dose: (1) absolute risk coefficient is the observed (O) minus the expected (E) number of cases per person year at risk for a unit dose (i.e., O-E per unit dose); (2) the relative-risk coefficient is the fractional increase in the baseline incidence or mortality rate for a unit dose, i.e., O/E per unit dose.

Risk estimate is the number of cases (or deaths) that are projected to occur in a specified exposed population per unit dose for a specified exposure regime and expression period (including lifetime): number of cases per [person-gray](#) or, for [radon](#), the number of cases per person cumulative [working-level month](#).

RNA – ribonucleic acid.

Sarcoma is a malignant growth arising in tissue of mesodermal origin (connective tissue, bone, cartilage or striated muscle). Compare with [carcinoma](#).

Sex-linked mutation (or X-linked) is a mutation associated with the X chromosome. It will usually only manifest its effect in males (who have only a single X chromosome).

Shielded kerma is kinetic energy released per unit mass of material after the incident radiation has passed through intervening shielding material. It is approximately equal to the dose at the skin.

SI units are the International System of Units as defined by the General Conference of Weights and Measures in 1960. These units are generally based on the meter/kilogram/ second units, with special quantities for radiation including the [becquerel](#), [gray](#) and [sievert](#).

Sievert is the SI unit of [equivalent dose](#) and [effective dose](#). It is equal to dose in grays times a [radiation weighting factor](#). (see [Units](#)).

Somatic means relating to the body (as distinguished from the germ plasm or the psyche).

Specific activity is the total activity of a given nuclide per gram of a compound, element, or [radioactive](#) nuclide.

Specific energy is the actual energy per unit mass deposited per unit volume in a given event. This is a [stochastic](#) quantity as opposed to the average value over a large number of events (i.e., the [absorbed dose](#)).

Spline is a curve of predetermined shape; a spline with 1 knot has a single inflection point and thus two different segments.

Standard deviation is the square root of the variance. (see [Annex to Glossary](#))

Standard(-ized) incidence ratio (SIR) is the ratio of the disease [incidence](#) rate in a certain specific population compared with that in a standard population. The ratio is based on 100 for the standard so that an SIR of 200 means that the test population has twice the incidence of the disease under study.

Standard(-ized) mortality ratio (SMR) is the ratio of the disease or accident mortality rate in a certain specific population compared with that in a standard population. The ratio is based

on 100 for the standard so that an SMR of 200 means that the test population has twice the mortality from that particular cause of death.

Stochastic effects – effects whose probability of occurrence in an exposed population (rather than severity in an affected individual) is a direct function of dose; these effects are commonly regarded as having no threshold; hereditary effects are regarded as being stochastic; some somatic effects, especially carcinogenesis, are regarded as being stochastic. At low doses stochastic effects are of low probability.

Target theory (hit theory) is a theory explaining some biological effects of radiation on the basis that ionization, which occurs in a discrete volume (the target) within the cell, directly causes a lesion that later results in a physiological response to the damage at that location; one, two, or more hits (ionizing events within the target) may be necessary to elicit the response.

Tentative 1965 Dose (T65D) is a dosimetry system used to estimate individual radiation doses received by the atomic bomb survivors. This system was formulated on the basis of data obtained at atomic bomb tests in Nevada, the BREN experiment, and large-scale shielding experiments.

Thorium. Element no. 90 is a metallic, primordial element of high density widely distributed in the environment. It is the parent of a [radioactive](#) decay chain shown in the [figure](#) on the following page.

Thorotrast is a 25% colloidal solution of thorium dioxide used as a radiographic contrast medium. Contains about 5 grams thorium (20 kBq ^{232}Th) plus decay products.

Threshold hypothesis is the assumption that no radiation injury occurs below a specified dose, the threshold dose.

Time-since-exposure (TSE) model is a model in which the risk is not constant but varies with the time after exposure.

Tissue weighting factor, w_T , is a factor for a particular tissue representing the fraction of the detriment (cancer plus hereditary effects) attributed to that tissue when the whole body is irradiated uniformly.

Transformed cells are tissue culture cells changed [in vitro](#) from growing in an orderly pattern and exhibiting contact inhibition to growing in a pattern more like that of cancer cells, due to the loss of contact inhibition. Transformed cells injected back into a host animal can give rise to cancer.

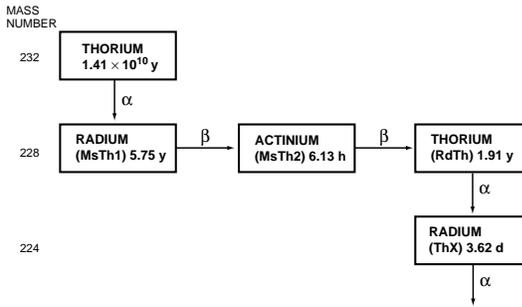
Translocation is a chromosome aberration resulting from chromosome breakage and subsequent structural rearrangement of the parts between the same or different chromosomes.

Units

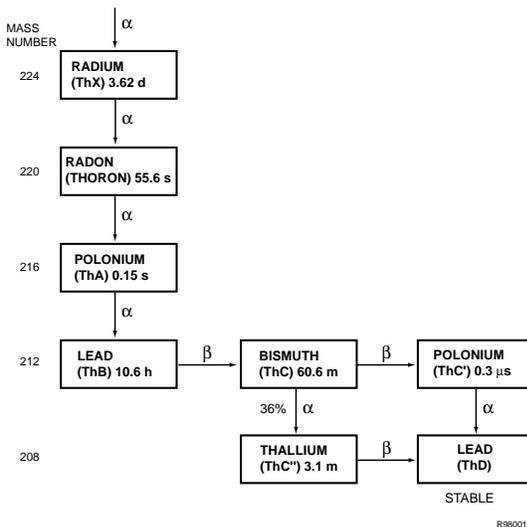
SI ^a	Historic	Conversion factors
becquerel (Bq)	curie (Ci)	1 Bq = 1 disintegration/s = 2.7×10^{-11} Ci 1 Ci = 3.7×10^{10} disintegration/s = 3.7×10^{10} Bq
gray (Gy)	rad	1 Gy = 1 J/kg ^b = 100 rad 1 rad = 100 erg/g = 0.01 Gy
sievert (Sv)	rem	1 Sv = 100 rem 1 rem = 0.01 Sv

^a International Units are designated as SI.

^b J = joule = 10^7 erg

THORIUM

DECAY OF RADIUM-224 AND DAUGHTERS



Decay products of $^{232}\text{thorium}$ (NAS/NRC 1988).

UNSCEAR – United Nations Scientific Committee on the Effects of Atomic Radiation, a committee involving a subset of the United Nations. It publishes periodic reports on sources and effects of [ionizing radiation](#).

Uptake – the absorption by a tissue of some substance, e.g., plutonium, and its permanent or temporary retention.

Variance. The variance of a set of measurements is the average value of the squares of the deviations of individual values from the mean value. (see [Annex to the Glossary](#))

Weighted dose is used in this report to represent approximate [equivalent doses](#) in the [Life-span Study](#) of the survivors of the atomic bombings, obtained by applying a value of [RBE](#) for [neutrons](#) of 10 to the neutron [absorbed dose](#) and adding it to the [gamma ray](#) absorbed dose.

Working level (WL) is any combination of short lived radon daughters in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha energy. This number was chosen because it is approximately the alpha energy released from the decay of daughters in equilibrium with 100 picocuries of ^{222}Rn . (see [Radon](#))

Working-level month (WLM) is exposure resulting from inhalation of air with a concentration of 1 working level of radon daughters for 170 working hours.

X radiation, also x rays; are penetrating electromagnetic radiation, usually produced by bombarding a metallic target with fast electrons in a high vacuum.

Xeroderma pigmentosum (XP) is an inherited disease in which skin cells are highly susceptible to sun-induced cancer; XP cells have a defect in [DNA](#) repair after ultraviolet irradiation which apparently accounts for the propensity for this neoplasm.

Years of life lost is the expected years of life for a nonexposed person minus the expected lifetime of an exposed person. (see [LLE](#)).