

Nuclear term glossary

Activity: Refers to the radiating power of a radioactive substance; given in terms of atoms disintegrating per second such as becquerels (Bq) and curies (Ci).

Acute exposure: Short-term irradiation that may endanger health

AGR: Advanced Gas Cooled Reactor

ALARA: As low as reasonably achievable – the underlying principle of radiation usage, protection and safety by the nuclear industry.

Alpha particle: A specific type of radiation that has two neutrons and two protons. It has low penetrating power and short range. Alpha particles will not penetrate the skin introduced through the lungs or open wounds.

Atom: The smallest piece of an element that cannot be divided or broken up by chemical means.

Beta particle: A specific type of radiation caused by the decay process in a radioactive neutron. It has a moderate penetrating power and a range of up to a few metres in air. Beta particles can penetrate skin tissue and are also carcinogenic if inhaled, ingested or absorbed through open wounds

Bq: stands for Becquerel, a unit of activity – 1 disintegration per second.

BWR: Boiling Water Reactor

CANDU: Canadian Deuterium Uranium reactor. A Canadian designed heavy-water reactor that uses natural uranium as a fuel.

Chain reaction: Continuing process of nuclear fission in which the neutrons released from a fission trigger another nuclear fission and the process becomes self-sustaining otherwise known as criticality

Containment: The concrete and steel shell around a reactor to contain the materials inside the plant.

Contamination: The unwanted presence of radioactive material over an area, equipment or person, particularly where its presence can be harmful.

Control Rods: Rods made of neutron absorbing material that are dispersed throughout the reactor core to control the power of the reactor, shut it down etc.

Conversion: The process of generating uranium hexafluoride gas from yellow cake. The stage before enrichment.

Coolant: The liquid circulated through the reactor core to remove heat generated by the core. Can be a liquid (usually water or molten sodium) or a gas (usually carbon dioxide or helium).

Cooling Pond: Large tanks of water at all nuclear power plants into which spent fuel rods are stored before reprocessing or disposal.

Core: The central portion of a nuclear reactor where the fuel rods are contained, the chain reaction occurs and heat is produced to generate electricity.

Criticality: The state of a nuclear reactor when it reaches the stage of a self-sustaining chain reaction. This is why control rods are required – so that this process can be stopped.

Cs-137: One of the main radioactive materials discharged by nuclear power plant, Cesium-137 is a highly dangerous beta-emitter with a half-life of 30 years.

Daughter Product: The term used to describe a decay product of a radioactive substance for example plutonium-239 decays into americium-241.

Design Basis Accident or DBA: The worst hypothetical accident scenario used by the industry when designing nuclear plants. All plants should be able to withstand their DBA.

Dual-Capable: The term that refers to a weapon system such as military aircraft that can carry either conventional or non-conventional explosives or a combination of both.

Decommission: The process of closing down a facility followed by reducing residual radioactivity to a level that permits the release of the property for unrestricted use.

Decontamination: The reduction or removal of unwanted radioactive material from a structure, area, object, or person.

Dispersal: The spreading of radioactive material into the environment.

Dose: The amount of radiation absorbed by the body as a result of exposure to radioactive material measured in Sieverts (Sv), Grays (Gr) or Rem.

Enriched: Refers to the process whereby the proportion of fissile U-235 has been artificially increased above the 0.7% level in natural uranium.

Enrichment: The process of manufacturing enriched uranium by gaseous diffusion.

EURATOM: European Atomic Community

Excursion: Way of describing a nuclear reactor accident that leads to an uncontrollable increase in power inside the reactor e.g. Chernobyl.

Fall-out: Spread of radioactive particles from clouds of debris produced by a nuclear explosion or accidental release of nuclear materials to the environment. Prime cause of contamination in an accident or a nuclear explosion.

Fissile: Capable of undergoing fission by interaction with slow neutrons.

Fissile material: The three main fissile materials are uranium-233, uranium-235, plutonium-239,

Fission: Process of the splitting of the nucleus of an element into lighter nuclei with the release of substantial amounts of energy, such as in a fission-type nuclear weapon (atomic weapon).

Fusion: The fusion of the nuclei of two elements. For example fusion of isotopes of hydrogen combine to form a heavy atom with the release of substantial amounts of energy, such as a thermonuclear weapon (hydrogen weapon).

Fuel rod: A long, slender tube that holds fissionable material (fuel) for nuclear reactor use. Fuel rods are assembled into bundles called fuel elements or fuel assemblies, which are then loaded into the reactor core.

Gamma radiation: Electromagnetic radiation with very energetic photons (high-frequency radiation.) Gamma radiation is identical to X-rays of high energy. Gamma radiation is able to travel many meters in air and many centimeters in human tissue. It readily penetrates most materials and is sometimes called "penetrating radiation." Radioactive materials that emit gamma radiation and X-rays constitute both an external and internal hazard to humans.

GCR: Gas Cooled Reactor

Graphite: Compacted crystalline carbon used as a moderator in some types of reactor.

Gy or Gray: A way of measuring exposure to radiation and the absorbed dose – rarely used nowadays.

Half-life: The time in which half of a radioactive substance decays away. Measured half lives vary from millionths of a second to billions of years.

Heavy Water: Deuterium oxide or the heavy version of hydrogen, heavy because it contains the one proton of hydrogen with an additional neutron.

High-level waste: Highly radioactive waste material from the reprocessing of spent nuclear fuel that contains a combination of transuranic waste and fission products High-level nuclear waste remains radioactive for hundreds of thousands of years and emits large amounts of radiation,.

HWR: A heavy Water Reactor that uses heavy water as both the moderator and the coolant.

Helium: A light chemically inert gas used as the coolant in high temperature gas-cooled reactors.

HEU: High Enriched Uranium is uranium that has been enriched above 20% fissile uranium-235 content and is usually enriched to above 90% for use in nuclear weapons and submarine reactors.

HLW: see above High Level Waste

Horizontal Proliferation: An increase in the number of countries that possess nuclear weapons.

I-131: Iodine-131, another principal emission created by nuclear power plants. A hazardous fission product that easily accumulates in the thyroid gland with a half-life of 8 days.

ICRP: International Commission on Radiological Protection created in 1925 that makes recommendations on safe levels of exposure to radiation for use by all nations.

International Atomic Energy Agency (IAEA): Established in 1957 to promote peaceful uses of atomic energy and ensure that such uses do not further military purposes.

Irradiation: Exposure to penetrating or gamma radiation. Irradiation can occur when all or part of the body is exposed to radiation from an unshielded source and is also used in cancer treatment and food preservation.

Isotope: Any two or more forms of an element having identical or very closely related chemical properties and the same atomic number but different atomic weights or mass numbers.

Ionisation: The knocking out of one or more electrons from their orbit around the nucleus of an atom or from a group of atoms.

Ionising radiation: Radiation energetic enough to ionise atoms.

Kiloton: The energy of a nuclear weapons explosion that is equal to 1000 tons of TNT.

Krypton: Another inert gas created and released by nuclear power plants, usually krypton-85 that has a half-life of 10 years.

Latent Period: The amount of time that lapse between exposure and the first sign of radiation damage.

LEU: Low Enriched Uranium that has a fissile uranium-235 content less than 20%. Usually 3-5% uranium-235 content for civil reactors and 12 to 19% for research reactors.

Leukaemia: A cancer of the blood distinguished by the over-production by the body of white blood cells.

LLW: Low Level radioactive waste

LMFBR: Liquid Metal Fast Breeder Reactor that uses liquid sodium as a coolant.

Low-level waste: Radioactive waste not classified as high-level waste, transuranic waste, spent nuclear fuel or by product material. Low-level and short-lived intermediate level nuclear waste is radioactive for anything from minutes to decades, emits mostly beta or gamma radiation and can emit some alpha radiation.

some examples of where low-level waste comes from are:

- Radioactive discharges into the air or sea from nuclear facilities;
- Producing radioactive isotopes at nuclear facilities;
- Contaminated protective clothing;
- Contaminated laboratory equipment and machinery;

- Parts of decommissioned nuclear power plants.

LWGR: Light Water Graphite Reactor see RBMK

LWR: Light Water Reactor that uses ordinary water as a coolant and moderator eg the PWR and BWR.

Moderator: a material such as water, heavy water or graphite used in nuclear reactors to slow down the high velocity neutrons that enable nuclear fission.

MOX: Mixed oxide fuel, a mix of plutonium and uranium. Plutonium is created in nuclear reactors, it does not occur naturally. The uranium used is usually freshly mined uranium and not the uranium recovered by reprocessing. Using plutonium reduces the amount of enriched uranium needed for fuel. The plutonium and uranium are mixed together as a powder and then turned into a ceramic fuel pellet (2cm high by 1cm wide). About 300 pellets are loaded into 3-metre long metal fuel pins.

Nuclear fuel cycle: All operations associated with the production of nuclear energy, including mining, processing and enrichment of uranium, manufacture of nuclear fuel, operation of nuclear reactors (including research reactors), reprocessing of nuclear fuel and storage of waste.

MUF: Material Unaccounted For, the term used to define any fissile materials lost during reprocessing for example. This material has not necessarily been stolen but may be stuck inside the plant or may have been as a result of a miscalculation before reprocessing occurs.

Natural Radiation: Radiation that comes outer space or naturally occurring materials such as granite.

Natural Uranium: Uranium as it occurs in nature. Only 0.7% is the fissile material, uranium-235 with the rest being uranium-238.

Neutron: Elementary particle, slightly heavier than a proton with no electric charge.

Neutron bomb: Enhanced radiation nuclear warhead which kills by radiation rather than by blast.

NNWS: Non-Nuclear Weapons States or those states who do not have nuclear weapons.

North Atlantic Treaty Organisation (NATO): Established in 1949 by the North Atlantic Treaty as a Western defence alliance. Article 5 defines the member-states' commitment to respond to an armed attack on any other member as if it were an attack upon themselves.

NPP: Common abbreviation for Nuclear Power Plant.

NPT: The nuclear Non-Proliferation Treaty

Nuclear fuel rods: see fuel rods above.

Nuclear waste: Radioactive waste that is produced at every stage of the nuclear fuel cycle. Nuclear reactors produce waste that stays highly radioactive for hundreds of thousands of years. Nuclear waste is everything from the mildly radioactive gloves and

overalls used by nuclear industry workers to the irradiated buildings of a nuclear power plant to extremely radioactive spent nuclear fuel rods. There's no safe way to dispose of nuclear waste.

Parts per million (ppm): Parts (molecules) of a substance contained in a million parts of another substance (or water).

Nuclear weapons: The collective term for atomic and hydrogen weapons of all types and their delivery systems. (Fusion and Fission)

Nuclear silo: A hardened underground facility for a fixed ballistic missile, designed to provide protection against attack and to act as a launch platform.

NWS: Nuclear Weapons States

PHWR: Pressurised Heavy Water Reactor

Plutonium: When uranium is used as fuel in a nuclear reactor, the resulting nuclear reactions create a large number of radioactive substances, including plutonium. Other radioactive substances created include caesium, ruthenium, iodine, krypton and strontium. Plutonium requires a sustained nuclear reaction to create it. Plutonium does not occur naturally in the environment.

Plutonium is a very toxic and radioactive substance that has no safe levels of exposure to the human body. Exposure to minute doses of plutonium, even inhalation of one thousandth of one gram, can cause cancer. Once present in the body, plutonium remains there for longer than a person's average life span with a half-life of up to 24,400 years. Within the body, plutonium may expose very sensitive parts of the body to damaging radiation. This can lead to genetic damage such as birth defects in offspring.

Pressure Vessel: The large container of welded steel that houses the core of most nuclear reactors.

Pu-239: A form of plutonium that is a highly toxic, radioactive element created by fission that is highly carcinogenic and has a half life of 24,400 years. Used as fuel in FBR's and is one of the two key ingredients of nuclear weapons, the other being U-235.

PWR: Pressurised Water Reactor – a reactor in which the heat from the core is transferred into a heat exchanger under high pressure to achieve a high water temperature without boiling the water. A second circuit then produces the steam to drive turbines to generate electricity.

Ra-226: Radium, a radioactive, metallic substance found in nature with a half-life of 1,600 years.

Rad: The special unit for radiation absorbed dose, which is the amount of energy from any type of ionizing radiation (eg, alpha, beta, gamma, neutrons, etc.) deposited in any medium (eg, water, tissue, air). A dose of one rad means the absorption of 100 ergs (a small but measurable amount of energy) per gram of absorbing tissue (100 rad = 1 gray).

Radiation dose: The quantity of radiation energy deposited in a material, such as human tissue.

Radiation sickness: Symptoms resulting from excessive exposure (greater than 200 rads or 2 gray) of the whole body (or large part) to ionizing radiation. The earliest of these symptoms are nausea, fatigue, vomiting, and diarrhoea, which may be followed by loss of hair haemorrhage, inflammation of the mouth and throat and loss of energy. In severe cases, where the radiation exposure has been approximately 1000 rad (10 gray) or more, death may occur within two to four weeks.

Radioactivity: The spontaneous transformation of an unstable atom, often resulting in the emission of radiation. This process is referred to as a transformation, a decay or a disintegration of an atom.

Radioactive material: Any material that contains radioactive atoms.

Radioactive waste: Radioactive materials at the end of a useful life cycle or in a product that is no longer useful.

Radioisotope: An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

Radionuclide: A radioactive variant of an element with a different atomic weight but similar characteristics.

RBMK: Stands for Graphite Moderated Boiling Water reactor. A Soviet pressure tube type reactor that uses graphite as a moderator and water as a coolant. The Chernobyl nuclear reactor was of this type.

Rem: Stands for Roentgen Equivalent Man rarely used today for measuring an absorbed dose in biological matter (100 Rem = 1 Sievert)

Reprocessing: The treatment of spent nuclear fuel to separate unused uranium, plutonium and fission waste products. The highly radioactive fuel elements and toxic chemicals necessary make reprocessing dangerous, requiring specially constructed facilities and components. Fission products are classed as high-level nuclear waste. They are among the most radioactive compounds known to science.

Reprocessing plant: Facility separating the plutonium and uranium present in spent reactor fuel.

Rn-222: Radon gas given off by radium and found in most houses. Is also given off during uranium mining.

Safeguards: Measures implemented by the International Atomic Energy Agency to prevent the diversion of nuclear materials from nuclear plants.

Scram: A sudden shut-down of a nuclear reactor usually through the insertion of the control rods into the core.

Spent nuclear fuel: Fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons. Spent fuel rods are extremely hot and highly radioactive as a result of the new radioactive elements created by the fissioning process.

SQ: Significant Quantity – the term used to define the minimum amount of nuclear material that might be used for a nuclear bomb.

Sr-90: Strontium-90 another beta emitting radioactive material created by nuclear reactors with a half-life of 28.78 years.

Steam Generator: The boiler in which the hot coolant from the reactor raises steam to feed turbines to create energy.

Sv: Abbreviation for sievert the most common way of measured the absorbed radioactive dose in humans.

Tactical nuclear weapon: Low-yield, short-range weapon deployed with general-purpose forces along with conventional weapons, sometimes referred to as battlefield nuclear weapon.

Thermonuclear weapons: Weapon that gets a substantial part of its energy from fusion reactions.

Thorium: A naturally occurring slight radioactive element.

Transuranic element: An artificially made, radioactive element.

Transuranic waste: Material contaminated with transuranic elements that is produced primarily from reprocessing spent fuel and from use of plutonium in fabrication of nuclear weapons.

Type-A packages: Packages used to transport radioactive materials with medium level activity eg uranium oxide.

Type-B packages: Packages used to transport radioactive materials with high level activity eg spent nuclear fuel.

Uranium: A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (0.7 percent of natural uranium), which is fissile, and uranium-238 (99.3 per cent of natural uranium), which is fissionable by fast neutrons and is fertile. Natural uranium also includes a minute amount of uranium-234.

U-235: Fissile uranium.

U-238: Non-fissile uranium.

UF-6: Uranium hexafluoride gas made from yellowcake and then used as the feed material in uranium enrichment.

Vertical Proliferation: An increase in the number of nuclear weapons held by the nuclear weapons States in the world.

Vitrification: The fusing of High Level Waste into glass-like solids before long-term storage as nuclear waste.

VVER: Soviet type PWR.

Warhead: Part of a weapon which contains the explosive or other material intended to inflict damage.

W or Watt: Unit of electrical power used eg to describe the maximum generating capacity of a nuclear power plant.

Wh: Stands for Watt-hours, another measurement of units of electrical energy.

Weapons of mass destruction: As defined in 1948 by the Commission of Conventional Armaments, these weapons include atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above.

Yellowcake: Solid form of mixed uranium oxide produced from uranium ore in uranium milling.