

NUCLEAR ENERGY GLOSSARY

ABSORPTION. (1) Interception of radiant energy. (2) The extraction of one or more components from a mixture of gases when gases and liquids are brought into contact. This causes a physical and/or chemical change in the sorbent material.

ACTIVATION. Bombardment of a material with neutrons, protons or other nuclear particles to make it radioactive.

ALPHA PARTICLE. A positively charged particle emitted by certain radioactive materials. It is comprised of two neutrons and two protons bound together. The least penetrating of the three common types of radiation (alpha, beta, gamma) emitted by radioactive material, alpha particles can be stopped by a sheet of paper. It is not dangerous to plants, animals or man unless the alpha-emitting substance enters the body.

ATOM. The smallest particle of an element which can contain all its physical and chemical properties. All chemical compounds are formed of atoms, the difference between compounds being attributable to the nature, number, and arrangement of their constituent atoms.

ATOMIC (NUCLEAR) ENERGY. (1) The constitutive internal energy of the atom which was absorbed when it was formed. (2) Energy derived from the mass converted into energy in nuclear fission or fusion.

BACKGROUND RADIATION. The radiation in man's natural environment, including cosmic rays and radiation from the naturally radioactive elements, both outside and inside the bodies of men and animals; i.e., natural radiation. The term may also mean radiation that is unrelated to a specific experiment.

BETA PARTICLE. An elementary particle emitted from a nucleus during radioactive decay, it has a single electrical charge and a mass equal to $\frac{1}{1837}$ that of a proton. A positively charged beta particle is called a positron and a negatively charged beta particle is identical to an electron. Beta-emitters are harmful if they enter the body and beta radiation may cause skin burns; however, beta particles are easily stopped by a thin sheet of metal.

BIOLOGICAL SHIELD. A mass of absorbing material placed around a reactor or radioactive source to reduce the radiation to a level that is safe for human beings.

BOILING WATER REACTOR. A reactor in which water, used as coolant and moderator, is allowed to boil in the core. The resulting steam can be used directly to drive a turbine.

BREEDER REACTOR (BREEDER PILE): A nuclear reactor which produces a greater number of fissionable atoms than the number of parent atoms consumed.

BRITISH THERMAL UNIT (BTU). The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at, or near, its point of maximum density (39.1°F).

CALORIE. The amount of heat necessary to raise the temperature of one gram of water 1°C. The National Bureau of Standards defines the calorie as 4.18400 joules.

CAPACITY. The load for which a furnace, air conditioner, generator, transmission circuit, power plant, or system is rated. Capacity is also used synonymously with capability.

CHAIN REACTION. A reaction that stimulates its own repetition. In a fission chain reaction, a fissionable nucleus absorbs a neutron and fissions, releasing additional neutrons. These in turn can be absorbed by other fissionable nuclei, releasing still more neutrons. A fission chain reaction is self-sustaining when the number of neutrons released in a given time equals or exceeds the number of neutrons lost by absorption in non-fissioning material or by escape from the system.

CONDENSER. A mechanism in an electric power plant that converts steam back to water for reuse.

CONTAINMENT BUILDING. Designed to prevent escape of radioactive materials into the atmosphere, the containment building is made of concrete several feet thick, reinforced with steel. It houses the nuclear reactor, steam generator and reactor coolant equipment.

CONTROL ROD. A rod, plate, or tube containing a material that readily absorbs neutrons, used to control the power of a nuclear reactor. By absorbing neutrons, a control rod prevents the neutrons from causing further fission.

COOLANT. A substance circulated through a nuclear reactor to remove or transfer heat. Common coolants are water, air, carbon dioxide, liquid sodium and sodium-potassium alloy (NaK).

COOLING TOWER. A device used to cool power plant condenser water before it is returned to lake, river or ocean. The cooling tower is intended to prevent thermal pollution.

CORE. The central portion of a nuclear reactor containing the fuel assemblies.

COSMIC RAYS. Radiation of many sorts but mostly atomic nuclei (protons) with very high energies, originating outside the earth's atmosphere. Cosmic radiation is part of background radiation. Some cosmic rays are more energetic than any man-made forms of radiation.

CRITICAL. Capable of sustaining a chain reaction.

CRITICALITY. The state of a nuclear reactor when it is sustaining a chain reaction.

CRITICAL MASS. The smallest mass of fissionable material that will support a self-sustaining chain reaction under certain conditions.

CURIE. Named for Marie and Pierre Curie, who discovered radium in 1898, the Curie is the basic unit used to describe the intensity of radioactivity in a sample of material. It is equal to 37 billion disintegrations per second, which is approximately the rate of decay of one gram of radium. A curie is also a quantity of any nuclide having 1 curie of radioactivity.

CURRENT (ELECTRIC). The rate of transfer of electricity.

DECAY, RADIOACTIVE. The spontaneous transformation of one nuclide into a different nuclide or into a different energy state of the same nuclide. The process results in a decrease, with time, of the number of the original radioactive atoms in a sample.

DEMAND, (ELECTRIC). The requirement of a system to provide electric power at a given time.

DEUTERIUM. An isotope of hydrogen whose nucleus contains one neutron and one proton; therefore, it is about twice as heavy as the nucleus of normal hydrogen, which is only a single proton. Deuterium is often referred to as heavy hydrogen; it occurs in nature as 1 atom to 6500 atoms of normal hydrogen and is nonradioactive.

DEUTERON. The nucleus of deuterium, containing one proton and one neutron.

DOSE. Specific amount of radiation delivered to a portion of the body or particular area.

DOUBLING TIME. The time required for a breeder reactor to produce as much fissionable material as the amount usually contained in its core plus the amount tied up in its fuel cycle (fabrication, reprocessing, etc.). It is estimated as 10 to 20 years in typical reactors.

EFFICIENCY. The ratio of the useful work performed to the amount of energy used in the process.

ELECTRICITY. Energy derived from electrons in motion. Electrical energy can be generated by friction, induction, or chemical change.

ELECTROMAGNET. Coils of copper wire wound onto a soft iron core that acts as a magnet when electric current flows in the coils.

ELECTRON. The electron is a small particle having a unit of negative electrical charge, a small mass, and a small diameter. Every atom consists of one nucleus and one or more electrons.

ELEMENTS. Elements are substances which cannot be decomposed by the ordinary types of chemical change, or made by chemical union.

ENERGY. The capability of doing work. Potential energy is energy due to position of one body with respect to another or relative parts of the same body. Kinetic energy is due to motion.

ENERGY MIX. The various types of energy sources used in a particular geographical region.

ENRICHMENT. The addition of various substances to a material, making it more effective. In the nuclear fuel cycle, UF_6 is enriched to contain more than the 0.7% $U235$ found in natural uranium.

FAST BREEDER REACTOR. A reactor that operates with fast neutrons and produces more fissionable material than it consumes.

FIRST LAW OF THERMODYNAMICS or LAW OF CONSERVATION OF ENERGY.
"Energy can neither be created nor destroyed."

FISSION. A nuclear reaction from which the atoms produced are each approximately half the mass of the parent nucleus. In other words, the atom is split into two approximately equal masses. There is also the emission of extremely great quantities of energy since the sum of the masses of the two new atoms is less than the mass of the parent heavy atom. The energy released is expressed by Einstein's equation, $E = Mc^2$.

FISSION FRAGMENTS. The two nuclei formed by the fission of a nucleus. They are of medium atomic weight and are radioactive. Also called primary fission products.

FISSION PRODUCTS. The nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

FUEL. A substance used to produce heat energy, chemical energy by combustion, or nuclear energy by nuclear fission.

FUEL ASSEMBLY. Bundle of 12-14 ft. long fuel rods, located in a reactor core.

FUEL CYCLE. The series of steps in supplying fuel for nuclear power reactors, including mining, refining, fabrication of fuel elements, their use in a reactor, chemical processing to recover the fissionable material from the spent fuel, re-enrichment of the fuel material, and refabrication into new fuel elements.

FUEL ELEMENT. A rod, tube, plate, or other mechanical shape or form into which nuclear fuel is fabricated for use in a reactor.

FUEL REPROCESSING. Chemical processing of reactor fuel to recover the unused fissionable material.

FUEL ROD. Cylindrical rod 12-14 feet long containing nuclear fuel pellets.

FUSION (NUCLEAR). A nuclear reaction involving the combination of light atomic nuclei or particles into heavier ones with the release of energy from mass transformation. This is also called a thermonuclear reaction by reason of the extremely high temperature required to initiate it.

GAMMA RAYS (NUCLEAR X-RAYS). Emitted from radioactive substances, they are quanta of electromagnetic wave energy similar to, but of much higher energy than, ordinary X-rays.

GAS-COOLED REACTOR. A nuclear reactor in which the coolant is a gas.

GEIGER COUNTER. A device that measures gamma or beta radiation intensity from radioactive materials.

GENERATING CAPACITY The capacity of a power plant to generate electricity. Usually measured in megawatts (mw).

GENERATOR. A device that converts mechanical energy into electrical energy.

HALF-LIFE. The time in which half the atoms of a particular radioactive substance disintegrate to another nuclear form. Measured half-lives vary from millionths of a second to billions of years.

HEAT. Energy possessed by a substance in the form of kinetic energy of its molecules, usually measured in calories or in space heating, by the British thermal unit (BTU). Heat is transmitted by conduction, convection, or radiation.

HEAT ENERGY. Energy that causes an increase in the temperature of an object. It may change the object from solid to liquid or from liquid to gas.

HEAVY WATER. Water containing significantly more than the natural proportion (one in 6500) of heavy hydrogen (deuterium) atoms to ordinary hydrogen atoms. Heavy water is used as a moderator in some reactors because it slows down neutrons effectively and also has a low cross section for absorption of neutrons.

HEAVY WATER-MODERATED REACTOR. A reactor that uses heavy water as its moderator. Heavy water is an excellent moderator and thus permits the use of inexpensive natural (unenriched) uranium as a fuel.

ION. An atom or group of atoms that is not electrically neutral but instead carries a positive or negative electric charge. Positive ions are formed when neutral atoms or molecules lose valence electrons; negative ions are those which have gained electrons.

IONIZING RADIATION. Radiation that disrupts molecular structure and function by driving electrons out of atoms.

ISOTOPE. A variation of an element having the same atomic number as the element itself, but having a different atomic weight because of a different number of neutrons. Different isotopes of the same element have different radioactive behavior.

KILOCALORIE. Heat energy equal to 4.19×10^3 joules.
(1,000 calories)

KILOVOLT. 1,000 volts.

KILOWATT (KW). The unit of power equal to 1,000 watts, or 1.3414 horsepower. Roughly a power of one kw is capable of raising the temperature of a pound (pint) of water 1°F in one second.

KILOWATT-HOUR (KWH). A unit of work or energy equal to that expended by one kilowatt in one hour.

LIGHT WATER REACTOR. A power plant using ordinary water rather than heavy water.

LOAD (ELECTRIC). The amount of electric power delivered by a system to users in a certain area.

MASS. A measure of the weight of matter in an object. The weight of an object depends on its mass. The United States standard mass is the avoirdupois pound as defined by $1/2.20462$ kilograms.

MATTER. Anything which is solid, liquid or gaseous.

MECHANICAL ENERGY. The kind of energy that is released to make objects move.

MEGAWATT (MW). A unit of power equal to 1,000 kilowatts or one million watts.

MILLIREM. A unit measuring radiation dosage, equalling one-thousandth of a rem.

MODERATOR. A material, such as ordinary water, heavy water or graphite, used in a reactor to slow down high-velocity neutrons, thus increasing the likelihood of further fission.

MOLECULE. The smallest particle of a substance that retains the properties of the substance and is composed of one or more atoms.

NEUTRON. A neutral elementary particle of mass number 1. It is believed to be a constituent particle of all nuclei of mass number greater than 1.

NUCLEAR ELECTRIC POWER PLANT. One in which heat for making steam is provided by nuclear fission rather than combustion of fossil fuel.

NUCLEAR ENERGY. The energy released during reactions of atoms' nuclei.

NUCLEAR FUEL. Fissionable material of such composition and enrichment that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction and produce heat in a controlled manner for process use.

NUCLEAR POWER. Electric power produced from a power plant by converting the energy obtained from nuclear reaction.

NUCLEAR REACTION. A reaction involving a change in an atomic nucleus, such as fission, fusion, neutron capture, or radioactive decay, as distinct from a chemical reaction, which is limited to changes in electron structure surrounding the nucleus.

NUCLEAR REGULATORY COMMISSION (NRC). Federal agency authorized to regulate and inspect nuclear installations.

NUCLEUS. The dense central core of the atom in which most of the mass and all of the positive charge is concentrated.

PEAKING. Power plant operation to meet the highest portion of the daily load.

PHYSICS. The science of matter and energy.

PLUTONIUM. A fissile element artificially produced by neutron bombardment of U^{238} .

POWER. The time rate at which work is done. If an amount of work W is done in time t the power or rate of doing work is $P=W/t$. Power will be obtained in watts if W is expressed in joules and t in seconds.

PRESSURIZED WATER REACTOR. A power reactor in which heat is transferred from the core to a heat exchanger by water kept under high pressure to achieve high temperature without boiling in the primary system. Steam is generated in a secondary circuit.

PRIMARY ENERGY. Energy in its naturally occurring form-- coal, oil, gas, uranium, etc., before conversion to end use forms.

PROTON. An elementary particle having a positive charge equivalent to the negative charge of the electron but possessing a mass approximately 1,837 times as great. The proton is, in effect, the positive nucleus of the hydrogen atom.

RADIATION. The emission and propagation of energy through space or through a medium in the form of waves.

RADIOACTIVE ISOTOPE. An isotope that has an unstable nucleus which stabilizes itself by emitting radiation.

RADIOACTIVE WASTE. Equipment and materials which are radioactive and for which there is no further use. Wastes are generally classified as high-level (having radioactivity concentrations of hundreds to thousands of curies per gallon or cubic foot), low level (in the range of 1 microcurie per gallon or cubic foot), or intermediate (between these extremes).

RADIOACTIVITY. The spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation.

RADON. A radioactive element, one of the heaviest gases known. Its atomic number is 86, and its atomic weight is 222. It is a daughter of radium in the uranium radioactive series.

REACTOR TRIP. The automatic insertion of control rods into the core of a nuclear reactor to stop the chain reaction.

REACTOR VESSEL. A thick, steel tank that houses the core, coolant and control rods of a nuclear reactor.

RECOVERABLE RESOURCE. That portion of a resource expected to be recovered by present day techniques and under present economic conditions. Includes geologically expected but unconfirmed resources as well as identified reserves.

REM. (Acronym for roentgen equivalent man.) The unit of dose of any ionizing radiation which produces the same biological effect as a unit of absorbed dose of ordinary X rays.

REPROCESSING. Chemical recovery from spent nuclear fuel of unused uranium, plutonium and other fission products.

RESOURCES. The estimated total quantity of a natural resource such as minerals in the ground; includes undiscovered mineral reserves.

ROENTGEN. Named after Wilhelm Roentgen, German scientist who discovered X rays in 1895. A unit of exposure to ionizing radiation. It is that amount of gamma or X rays required to produce ions carrying 1 electrostatic unit of positive or negative electrical charge in 1 cubic centimeter of dry air under standard conditions.

SECOND LAW OF THERMODYNAMICS. One of the two "limit" laws which govern the conversion of energy. It can be stated in several equivalent forms, all of which describe the inevitable loss of some energy in any energy conversion.

SHIELD (SHIELDING). A body of material used to reduce the passage of radiation.

STEAM. The vapor formed by water when heated to the boiling point.

SYSTEM EFFICIENCY. The ratio of energy output to energy input expressed as percentage, Coefficient of Performance or Energy Efficiency Ratio. The system efficiency of an energy delivery system is the amount of energy delivered to the site at the point of use divided by the energy extracted from the ground at its source.

TECHNOLOGY. Applied science.

THERMAL REACTOR. A reactor in which the fission chain reaction is sustained primarily by thermal (slow) neutrons. Most reactors are thermal reactors.

TRITIUM. A radioactive isotope of hydrogen containing two neutrons and one proton in the nucleus. It is man-made and is heavier than deuterium (heavy hydrogen). Tritium is used in industrial thickness gauges, and as a label in experiments in chemistry and biology. Its nucleus is a triton.

URANIUM. A silvery heavy radioactive metallic element that is found especially in pitchblende and uraninite and exists naturally as a mixture of three isotopes of mass number 234, 235, and 238 in the proportions of 0.006 percent, 0.71 percent, and 99.28 percent respectively.

URANIUM (ENRICHED). The increase of fissionable isotope of U235 above the 0.7% contained in natural uranium. Enriched fuel is usually used in a nuclear plant because it is more able to sustain a chain reaction.

URANIUM TAILS. Depleted uranium derived as a by-product of enrichment.

VOLT. The unit of electromotive force. It is the difference in potential required to make a current flow through a resistance.

WATT (W). A unit of measure for electric power equal to the transfer of one joule of energy per second. The watt is the unit of power most often associated with electricity (1 horsepower = 746 watts) determined by multiplying required volts by required amperes (volts x amps = watts).

WORK. A force acting against resistance to produce motion in a body; measured by the product of the force acting and the distance moved through against the resistance.

X-RAY. A penetrating form of electromagnetic radiation emitted either when the inner orbital electrons of an excited atom return to their normal state (these are characteristic X rays), or when a metal target is bombarded with high speed electrons (these are bremsstrahlung). X rays are always nonnuclear in origin.

YELLOWCAKE. The material which results from the first processing (milling) of Uranium ore.

ZIRCONIUM. A metallic element, which has a high resistance to corrosion. Because of high resistance to corrosion, zirconium is used as fuel element covering.

Some glossary terms compiled from Nuclear Terms, A Glossary (U.S. Atomic Energy Commission) and an American Gas Association Energy Glossary.