

# GLOSSARY

- Actinides** The group of elements heavier than and including actinium (atomic number 89).
- Activity** The number of nuclear disintegrations occurring per unit of time in a quantity of radioactive material.
- Aerodynamic Process** A type of uranium enrichment process in which a mixture of uranium hexafluoride ( $\text{UF}_6$ ) and a light gas (for example, hydrogen or helium) is made to flow at a high speed in a circular path. The resulting centrifugal force tends to cause separation of the heavier  $^{238}\text{UF}_6$  molecules from the lighter  $^{235}\text{UF}_6$  molecules.
- Alpha,n** (alpha-neutron) A nuclear reaction in which an alpha particle reacts with a nucleus (usually of a low-Z element such as beryllium), causing a neutron to be emitted.
- Alpha Particle ( $\alpha$ )** A positively charged particle of matter consisting of two protons and two neutrons, that is, a helium-4 nucleus. The alpha particle has a very short range in air and a very low ability to penetrate other materials, but it has a strong ability to ionize materials. Alpha particles are unable to penetrate even the thin layer of dead cells of human skin and, consequently, are not an external radiation hazard. Alpha-emitting nuclides inside the body as a result of inhalation or ingestion are a considerable internal radiation hazard.
- Amalgam** An alloy of mercury.
- Ammonium Diuranate** Symbol:  $(\text{NH}_4)_2\text{U}_2\text{O}_7$ . A uranium compound that is commonly the product of uranium ore concentration plants. See Yellow Cake.
- Anode** The positive electrode of an electrolytic cell.
- Aqueous Phase** Refers to a solution in which water is the principal component. In reprocessing and chemical exchange, the aqueous phase usually is an acidic solution containing uranium and/or plutonium salts.
- Aqueous Solution** A solution in which water is the solvent.
- Atomic Mass Unit** A unit of mass equal to one-twelfth the mass of a neutral atom of  $^{12}\text{C}$ . This is approximately  $1.66 \times 10^{-24}$  grams. A proton and a neutron each have a mass of about 1 amu. Thus, when expressed in atomic mass units, the atomic mass of an atom is approximately equal to its atomic mass number.

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| <b>Atomic Number</b>                 | The number of protons in the nucleus of an atom. Each chemical element has a unique atomic number.   |
| <b>Atomic Vapor Laser</b>            | A method of uranium enrichment based on the selective absorption of  |
| <b>Isotope Separation</b>            | laser light by vaporized $^{235}\text{U}$ atoms.   |
| <b>Autoclave</b>                     | An airtight chamber used to heat an object placed within it. The heat often comes from steam. Autoclaves are often used to cure shapes made of resin-impregnated filamentary material.   |
| <b>Barn</b>                          | A unit of area used in expressing nuclear cross sections.  |
| <b>Barrier</b>                       | The material through which $\text{UF}_6$ gas is passed to separate uranium isotopes in the gaseous diffusion process. The lighter $^{235}\text{UF}_6$ molecules flow through the barrier slightly faster than the heavier $^{238}\text{UF}_6$ molecules, producing a small amount of enrichment/depletion at each stage. |
| <b>Becker Nozzle</b>                 | A nozzle used in the Becker aerodynamic isotope separation process. See Separation Nozzle Process.   |
| <b>Becquerel</b>                     | A unit of radioactive decay rate defined as 1 disintegration per second.   |
| <b>Beta Particles</b><br>( $\beta$ ) | High-energy electrons emitted from the nucleus of an atom during radioactive decay. Beta particles normally can be stopped by the skin or by a very thin sheet of metal.   |
| <b>Black Oxide</b>                   | See Uranous Uranyl Oxide.  |
| <b>Blanket</b>                       | A region of fertile material (e.g., uranium-238) placed around or within a reactor core for the purpose of conversion or breeding.   |
| <b>Bq</b>                            | Becquerel.   |
| <b>Bremsstrahlung</b>                | X- or gamma radiation which is created by striking a foil or target with a beam of high-energy electrons.  |
| <b>Bridge</b>                        | A narrowed portion of a printed circuit element in a detonator header. When a sudden, large electric current is applied to the element, the bridge explodes and initiates a deflagration or detonation in an explosive material.   |
| <b>Bridgewire</b>                    | That element of an electro-explosive device (commonly a fine wire with a circular cross section) which, when heated or exploded by an applied electric current, initiates the desired detonation or burning in an explosive.   |
| <b>Brown Oxide</b>                   | See Uranium Dioxide.   |

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| <b>Busbar</b>                    | A heavy, rigid metallic conductor, usually uninsulated, used to carry a large current or to make a common connection between several circuits. A busbar is often a metal bar of rectangular cross section.  |
| <b>Calciner</b>                  | Equipment which heats bulk material to a temperature below its melting point to effect a thermal decomposition or a phase transition other than melting.  |
| <b>Calutron</b>                  | A type of electromagnetic isotope separation device. IMIS devices modeled after those developed by the U.S. during World War II are known as calutrons.   |
| <b>Cascade</b>                   | An arrangement of isotope separation devices, connected in series so that they multiply the effect of each individual device. There may be many cascades one isotope separation flow cycle.   |
| <b>Cask</b>                      | A container used for transferring radioactive materials, including fuel assemblies, spent fuel, and radioactive waste.  |
| <b>Cathode</b>                   | The negative electrode of an electrolytic cell.   |
| <b>Cladding</b>                  | The outer jacket of a nuclear reactor fuel element. It prevents corrosion of the fuel and the release of fission products into the coolant. Aluminum or its alloys, stainless steel, and zirconium and its alloys are common cladding materials. Also known as Clad. In addition to the fuel rods, many other structures within the reactor vessel are clad.  |
| <b>Cold Isostatic Processing</b> | This is a method by which powdered reactive chemicals are compressed to achieve the maximum percentage of their theoretical density. The materials are placed into a flexible, impermeable "boot," and this is then placed into the liquid in an isostatic press. On activation of the press, the liquid compresses the material isostatically (although "hydrostatically" might be a more accurate term). It's called "cold" isostatic processing because no or very little (less than a few hundred degrees) heat is added to the system. The plastic bonded high explosives for nuclear weapon mainbody high explosive parts are processed this way, as well as lithium deuteride parts. |
| <b>Collector Plate</b>           | A plate on which atoms or molecules of enriched (or depleted) uranium collect in EMIS or AVLIS. After a period of operation, the collector plate is removed from the isotope separation system, and the enriched uranium removed from it.   |
| <b>Column</b>                    | A vertical, cylindrical vessel used in chemical operations such as distillation and liquid-liquid exchange. Columns are also known as towers.   |
| <b>Composition B</b>             | Or Comp B. A mixture of 60 percent RDX and 40 percent TNT. Comp B is used in many types of explosive ordnance. There are subcompositions of Comp B with different percentages and different designations.   |
| <b>Cracker</b>                   | A systems which "cracks" complex molecules into simpler molecules.  |

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| <b>Critical Point</b>        | The temperature and pressure at which two phases of a substance, in equilibrium with each other, become identical and form one phase.  |
| <b>Criticality</b>           | A term describing fissionable material relative to its ability to sustain a chain reaction. Criticality of less than one would correspond to a subcritical mass; exactly one, to a critical mass; and greater than one, to a supercritical mass.   |
| <b>Cross Section</b>         | A measure of the probability of a specified interaction between an incident radiation and a target particle or system of particles.  |
| <b>Crucible</b>              | In a nuclear sense, a container used in casting uranium and plutonium and in the production of uranium and plutonium metals from their fluorides, UF <sub>4</sub> and PuF <sub>3</sub> . Such crucibles must be capable of withstanding chemical attack by liquid uranium and plutonium at high temperatures.  |
| <b>Curie (Ci)</b>            | A unit of radioactive decay rate defined as 3.7 x 10 <sup>10</sup> disintegrations per second. This is approximately the number of disintegrations per second in 1 gram of radium.   |
| <b>Current Amplification</b> | In a photomultiplier tube, the ratio of the output signal current to the photoelectric signal current emitted by the photocathode.   |
| <b>Cyclotol</b>              | The generic name (in the U.S.) for mixtures of RDX and TNT, cyclotol is also called Hexolite in France, Fullpulver in Germany, Tritolite in Italy, Tritolita in Spain, and Hexotol in Sweden.  |
| <b>Cyclotron</b>             | An accelerator in which charged particles are successively accelerated by a constant-frequency alternating electric field that is synchronized with movement of the particles on spiral paths in a constant magnetic field normal to their path.   |
| <b>Decay</b>                 | The process by which an unstable element is changed to another isotope or another element by the spontaneous emission of radiation from its nucleus. For example, tritium decays to helium-3 by emitting a beta particle, thereby effectively changing one neutron to a retained proton and the emitted beta particle. The helium-3 nucleus has two protons and one neutron and is stable; that is, not radioactive. |
| <b>Decibel (dB)</b>          | One tenth of a bel. A unit based on the ratio of two powers or voltages to express gains or losses in a system. The difference between voltages, V <sub>1</sub> and V <sub>2</sub> , in decibels is given by: 20 log <sup>10</sup> (V <sub>1</sub> /V <sub>2</sub> ).  |
| <b>Denitrator</b>            | Equipment which removes nitrates or nitrogen from bulk material. Sometimes this is accomplished by calcination.  |

**Dense Plasma**

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| <b>Focus</b>          | In a dense plasma focus accelerator, a plasma of deuterium or deuterium/tritium is accelerated down an annulus surrounding the central axis of the tube. When the plasma emerges from the end of the tube, a magnetic pinch effect causes the plasma to collapse in on itself to a very high density. Out of this dense plasma comes neutrons from D-D or D-T reactions. Pulse characteristics of 10 <sup>9</sup> neutrons in 50 ns would be typical. A dense plasma focus device can be miniaturized to some extent and might be used in a large nuclear weapon. |
| <b>Desublimer</b>     | A system which, by cooling, changes a gas directly to a solid with no intermediate liquid state.  |
| <b>Deuterium</b>      | A heavier, stable isotope of hydrogen ( <sup>2</sup> H or D). Ordinary hydrogen has a nucleus containing one proton and no neutrons. The deuterium nucleus contains one proton and one neutron.   |
| <b>Dewar</b>          | A Dewar flask. A vessel having double walls, the space between being evacuated to prevent the transfer of heat and the surfaces facing the vacuum being heat-reflective; used to hold liquid gases and to study low-temperature phenomena.  |
| <b>Diffuser</b>       | In tritium production, a diffuser is a chamber or cylinder of a material, such as palladium-silver, which allows hydrogen isotopes to diffuse through the walls but retains other molecules.  |
| <b>Diffusion Pump</b> | A vacuum pump in which a stream of heavy molecules, such as mercury vapor, carries gas molecules out of the volume being evacuated. Diffusion pumps can also be used for separating isotopes according to weight, the lighter molecules being pumped preferentially by the vapor stream.  |
| <b>Dingot</b>         | The uranium ingot which is taken from the reduction bomb after the reduction reaction. The dingot is still somewhat contaminated with reaction products.  |
| <b>Dissolver</b>      | A system wherein spent fuel is dissolved in nitric acid preparatory to being reprocessed.   |
| <b>Dynode</b>         | An electrode that performs current amplification by means of secondary electron emission.   |
| <b>Electrode</b>      | An electrical conductor through which an electric current enters or leaves a medium such as an electrolyte.   |
| <b>Electrolysis</b>   | The production of chemical changes by causing electric current to flow through an electrolyte.  |
| <b>Electrolyte</b>    | A substance that dissociates into ions and conducts electricity when dissolved in a solvent or when molten.   |

**Electromagnetic****Isotope**

**Separation** A method of uranium enrichment based on the slight difference in trajectories followed by ions of different isotopes in a magnetic field.

**End-Effector** The part of a robot which performs the end action.

**Epithermal**

**Neutrons** Neutrons with energies greater than those of thermal neutrons but less than those of fast neutrons (energy in the MeV range). In calculations, an energy range from about 0.6 electron volt to about 1000 electron volts is often used.

**Equation of****State**

The relationship among the thermodynamic properties of a material, for example, pressure, density, and temperature. Equation of state information is vital in modeling the performance of nuclear explosive devices.

**Etalon**

Two adjustable parallel mirrors mounted so that either one may serve as one of the mirrors in a Michelson interferometer; used to measure distances in terms of wavelengths of spectral lines.

**Excimer****Laser**

A laser containing a noble gas, such as helium or neon, which is based on a transition between an excited state in which a metastable bond exists between two gas atoms and a rapidly dissociating ground state.

**Exciplex****Laser**

An excimer laser which uses an excited electron donor-acceptor complex which is dissociated in the ground state.

**Explosion****Proof**

Features of a machine tool or other equipment which are meant to preclude an explosion. For machine tools which machine explosives, one explosion proofing feature is to seal all places, such as a switch, where a spark might occur so that explosive dust cannot get into the area.

**Fast****Neutrons**

Neutrons that have not been thermalized, i.e., having energy comparable to their energy immediately after production from fission.

**Flow****Forming**

A forming process in which a quasi-cylindrical shape surrounding a mandrel is spun, and rollers pressing against the outside cause the shape to change and conform to the shape of the mandrel. The high pressure of the rollers causes the material of the shape to “flow” during the operation.

**Fluidized****Bed**

A cushion of air or hot gas blown through the porous bottom slab of a container which can be used to float a powdered material as a means of drying, heating, quenching, or calcining the immersed components.

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| <b>Fluorinated Hydrocarbon</b>          | A hydrocarbon-like material in which the hydrogen atoms have been (mostly) replaced with fluorine atoms. These materials are used in situations in which moderation of neutrons by hydrogen atoms is to be avoided.  |
| <b>Fluorocarbon</b>                     | A fluorinated hydrocarbon.   |
| <b>Fuel Cycle</b>                       | See Nuclear Fuel Cycle.  |
| <b>Gain</b>                             | Same as current amplification.   |
| <b>Gamma Rays (<math>\gamma</math>)</b> | High-energy photons emitted from the nucleus of atoms; similar to x-rays. They can penetrate deeply into body tissue and many materials.   |
| <b>Gas Centrifuge</b>                   | A device for enriching uranium in which gaseous uranium hexafluoride ( $\text{UF}_6$ ) is contained in a cylindrical tube (referred to as the rotor), which is spun at high speed. The heavier $^{238}\text{UF}_6$ molecules tend to be closer to the rotor wall than are the lighter $^{235}\text{UF}_6$ molecules. |
| <b>Gaseous Diffusion</b>                | A process for enriching uranium that uses gaseous uranium hexafluoride ( $\text{UF}_6$ ) as the working fluid. The lighter $^{235}\text{UF}_6$ molecules flow through a porous barrier slightly faster than the heavier $^{238}\text{UF}_6$ molecules.   |
| <b>Gray</b>                             | A unit of absorbed dose from ionizing radiation. One gray is equal to the amount of ionizing radiation that leads to the absorption of 1 joule of energy per kilogram of absorbing material. One gray equals 100 rad.  |
| <b>Greensalt</b>                        | Uranium tetrafluoride.   |
| <b>GS Process</b>                       | Girdler-Sulfide (or Girdler-Spevack), a water-hydrogen sulfide exchange process used in deuterium production.  |
| <b>Gy</b>                               | Gray.  |
| <b>Gyrotron</b>                         | A type of microwave tube in which microwave amplification or generation results from cyclotron resonance coupling between microwave fields and an electron beam in vacuum. Gyrotrons are also known as cyclotron resonance masers.   |
| <b>Half-Life</b>                        | The time required for half of all the remaining radioactive atoms in a substance to decay. For example, the half-life of tritium is about 12.3 years; that is, every 12.3 years, the amount of tritium is reduced to one-half the amount present at the beginning of that 12.3-year period.                          |
| <b>Heavy Water</b>                      | A form of water in which the common hydrogen isotope ( $^1\text{H}$ ) is replaced by deuterium ( $^2\text{H}$ or D). Heavy water is also referred to as deuterium oxide ( $^2\text{H}_2\text{O}$ or $\text{D}_2\text{O}$ ).  |

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| <b>High Explosive</b>          | An explosive which when used in its normal manner detonates, rather than deflagrates or burns; that is, the rate of advance of the reaction zone into the unreacted material exceeds the velocity of sound in the unreacted material.  |
| <b>Highly Enriched Uranium</b> | Uranium in which the percentage of <sup>235</sup> U nuclei has been increased from the natural level of 0.71 percent to some level greater than 20 percent. HEU used in weapons is normally enriched to around 92.5 percent.   |
| <b>HMX</b>                     | Cyclotetramethylene tetranitramine. A high performance explosive similar to RDX and used in castable TNT-based binary explosives called Octols. It is the main ingredient in high-performance plastic-bonded explosives and in high-performance solid propellants. It is also called Octagen in Russia.  |
| <b>HNS</b>                     | Hexanitrostilbene. HNS is a secondary high explosive used in some military precision detonators.   |
| <b>Hot Cell</b>                | A shielded room with remote handling equipment for examining and processing radioactive materials. In particular, hot cells may be used for reprocessing spent reactor fuel. Also known as a Shielded Cell.  |
| <b>Inconel</b>                 | An alloy, principally of nickel, iron, and chromium, typically used for the tubing in a PWR steam generator.   |
| <b>INFCIRC/254/Part 1</b>      | Part 1 of International Atomic Energy Agency Information Circular 254, which contains Guidelines for Nuclear Transfers and the Trigger List.   |
| <b>INFCIRC/254/Part 2</b>      | Part 2 of International Atomic Energy Agency Information Circular 254, which contains Guidelines for Transfer of Nuclear-Related Dual-Use Equipment, Material, and Related Technology and the Dual-Use Annex, also referred to simply as the Annex.  |
| <b>Initiate</b>                | In nuclear devices, the detonation of the high explosive is <i>initiated</i> by detonators, and the nuclear chain reaction is <i>initiated</i> by a neutron source.  |
| <b>Ion</b>                     | An electrically charged atom or molecule.  |
| <b>Ionization</b>              | A process by which a neutral atom or molecule loses or gains electrons, thereby acquiring a net charge.  |
| <b>Isostatic Press</b>         | A press which uses a fluid to exert the same pressure on a part at every point on the part's surface.  |
| <b>Isotope</b>                 | A specific element always has the same number of protons in the nucleus. That same element may, however, appear in forms that have different numbers of neutrons in the nucleus. These different forms are referred to as "isotopes" of the element. For example, deuterium ( <sup>2</sup> H) and tritium ( <sup>3</sup> H) are isotopes of ordinary hydrogen (H). |

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| <b>Krytron</b>                                   | A cold-cathode, gas-filled (spark-gap type) switch used to trigger the main spark gap switch in a nuclear weapon firing set.   |
| <b>Laser</b>                                     | A device that converts input power into a coherent, monochromatic beam of electromagnetic radiation, which is usually in the infrared, visible, or ultraviolet wavelength bands. The word “laser” is an acronym for light amplification by stimulated emission of radiation.   |
| <b>Liquor</b>                                    | Supernatant liquid decanted from a liquid-solids mixture in which the solids have settled.   |
| <b>Low Enriched Uranium</b>                      | Uranium in which the percentage of $^{235}\text{U}$ nuclei has been increased from the natural level of 0.71 percent to less than 20 percent, usually 3 to 6 percent. With the increased level of fissile material, low enriched uranium can sustain a chain reaction when immersed in light water and is used as fuel in light water reactors.                                |
| <b>Maraging Steel</b>                            | A special class of high-strength steel. The term maraging derives from “martensitic aging.” These steels typically have very high nickel, cobalt, and molybdenum contents and very low carbon content. Maraging steel is normally described by its yield strength of $6 \times 10^9$ Pa. Maraging steels used in gas centrifuge components usually are of Grade 300 or higher. |
| <b>Marx Generator</b>                            | A system of large, high-voltage capacitors which are charged in parallel and discharged in series into a machine such as a flash x-ray generator.  |
| <b>Mixer Settler</b>                             | A reprocessing system in which aqueous and nonaqueous solutions are mixed and then allowed to settle and separate.   |
| <b>Mohs Scale</b>                                | An empirical scale consisting of 10 minerals with reference to which the hardness of all other minerals is measured. It includes, from softest (designated 1) to hardest (10): talc, gypsum, calcite, fluorite, apatite, orthoclase, quartz, topaz, corundum, and diamond.   |
| <b>Molecular Laser Isotope Separation (MLIS)</b> | A method of uranium enrichment based on the selective absorption of laser light by molecules of $^{235}\text{UF}_6$ .  |
| <b>Muffle Furnace</b>                            | A furnace with an externally heated chamber, the walls of which radiantly heat the contents of the chamber.  |
| <b>Neutron (n)</b>                               | An uncharged elementary particle found in the nucleus of atoms.  |
| <b>Nuclear Reaction</b>                          | A reaction involving a change in an atomic nucleus; e.g., fission, fusion, neutron capture, or radioactive decay.  |

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| <b>Octol</b>                     | The generic term for castable mixtures of TNT and HMX, commonly 75 percent HMX and 25 percent TNT. Used as a high-energy explosive fill in military applications.  |
| <b>Opacity</b>                   | The resistance of a material to passing through of photon radiation.   |
| <b>Order of Magnitude</b>        | The change in a quantity by a factor of 10. For example, there is one order of magnitude difference between 5 and 50, two orders between 5 and 500, and three between 5 and 5000.  |
| <b>Organic Phase</b>             | Refers to a solution in which an organic liquid (e.g., kerosene) is the principal solvent. In reprocessing and chemical exchange, the organic phase usually consists of tributyl phosphate dissolved in kerosene or other hydrocarbons.  |
| <b>Packing</b>                   | An element inserted in a column to promote contact between two phases of a material undergoing a process such as distillation or liquid-liquid exchange. Columns in which packing is used are called packed columns.   |
| <b>Parahydrogen</b>              | Those states of hydrogen molecules in which the spins of the two nuclei are antiparallel; sometimes known as spin isomers.   |
| <b>Passivation</b>               | Treatment of a surface to decrease its reactivity in the presence of corrosive materials.  |
| <b>PETN</b>                      | Pentaerythritoltetranitrate. An HE used extensively in detonators, detonating fuzes, and priming compounds. Also called penthrite and penta in English-speaking countries; pentrit, niperyth, nitropenta, and NP in Germany; and TEN in Russia. PETN is normally thought of as a secondary explosive, although there is some disagreement. |
| <b>Photocathode</b>              | An electrode used to convert incident light into photoelectrons.   |
| <b>Pig</b>                       | A heavily shielded container, usually lead, used to ship or store radioisotopes and other radioactive materials.   |
| <b>Pitot Tube</b>                | An instrument that measures the stagnation pressure of a flowing fluid, consisting of an open tube pointing into the fluid and connected to a pressure-indicating device. The pressure is a measure of the velocity of the fluid.  |
| <b>Plasma Separation Process</b> | This technology includes those processes that utilize an ionized plasma and a combination of electric and magnetic fields to selectively remove isotopes from the plasma by utilizing the difference in their ion cyclotron resonance frequencies.   |
| <b>Plastic Bonded Explosive</b>  | A solid explosive made by mixing HMX or RDX powder with a plastic binder and compressing the mixture in a cold isostatic press. The resulting solid shape can then be machined to final dimensions.  |

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| <b>Prepreg</b>           | Fibrous or filamentary material which has been impregnated with resin.   |
| <b>Primary HE</b>        | An explosive which is extremely to heat and shock and is usually used to initiate a secondary high explosive.  |
| <b>Proton (p)</b>        | A positively charged elementary particle found in the nucleus of atoms.  |
| <b>Purex</b>             | A system for reprocessing spent fuel. The term derives from Plutonium Uranium Recovery by EXtraction. Purex was the trade name for tri-n-butyl phosphate, which, diluted in kerosene, is used for extracting uranium and plutonium from other fission products in spent fuel.  |
| <b>Pyrophoric</b>        | The term describing a material which can spontaneously ignite in air.  |
| <b>Rad</b>               | A unit of absorbed dose from ionizing radiation. One rad is equal to the amount of ionizing radiation that leads to the absorption of 0.01 joule of energy per kilogram of absorbing material. One rad equals 0.01 gray.   |
| <b>Radioisotope</b>      | A radioactive isotope.   |
| <b>Radioluminescence</b> | The luminescence produced by particles emitted during radioactive decay.   |
| <b>Radionuclide</b>      | A radioactive nuclide, that is, a radioactive nuclear species that is characterized by the number of protons, number of neutrons, and energy content in its nucleus.   |
| <b>Raschig Rings</b>     | Rings, usually made of glass or borated glass, which are put into a vat of enriched uranium or plutonium solution to form a matrix which will preclude a critical mass forming. The vat is filled with the rings before the solution is introduced. The rings may have a significant length dimension so that they could be called cylinders. Raschig rings are also used to provide catalyst matrices in some chemical processes. |
| <b>RDX</b>               | From "Research Department Explosive," cyclotrimethylenetrinitramine. A high-performance explosive used extensively in castable TNT-based binary explosives such as cyclotols and Comp B and as the primary ingredient in plastic-bonded explosives. Also called hexogen, cyclonite, and T4.  |
| <b>Reduction Bomb</b>    | A closed chamber with ceramic or refractory inner walls in which the reduction of uranium or plutonium compounds takes place. The reaction is very exothermic and the reduction bomb must withstand the temperature and contain the products of the reaction.  |
| <b>Reformer Furnace</b>  | A furnace used to re-form a gas; e.g., separating ammonia into nitrogen and hydrogen.  |
| <b>Refractory</b>        | Description of a material that is heat resistant and has a high melting point.   |

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| <b>RF</b>                | Radio frequency. A discrete frequency range of electromagnetic radiation, roughly from 10 kHz to 100 GHz.   |
| <b>RH</b>                | Ranque-Hilsch. A type of vortex tube used in aerodynamic isotope separation.  |
| <b>Root Mean Square</b>  | The square root of the time average of the square of a quantity; for a periodic quantity the average is taken over one complete cycle. It also is known as the effective value.   |
| <b>Secondary HE</b>      | A high explosive which is relatively insensitive to heat and shock and is usually initiated by a primary high explosive.  |
| <b>Specific Activity</b> | The activity per unit weight of a sample of radioactive material.   |
| <b>Spin Forming</b>      | A forming process in which a quasi-cylindrical shape surrounding a mandrel is spun, and rollers pressing against the outside cause the shape to change and conform to the shape of the mandrel. Spin forming is different from flow forming in that there is little change in wall thickness of the shape during the operation.   |
| <b>Sprytron</b>          | A small, cold-cathode, vacuum-tube switch used in nuclear weapons to trigger the main switch in the firing system.  |
| <b>Stainless Steel</b>   | (Nuclear grade or hydrogen compatible.) Stainless steel (typically Series 300, e.g., 316, 304, 304L) is used in reprocessing spent reactor fuel to recover plutonium. This steel must be extremely high quality; severe quality control measures are required. Common sizes for fuel reprocessing are 3 inches or less internal diameter (ID) for process stream piping and 6 to 8 inches for off-gassing. Stainless steel designated 304L can also be used to contain hydrogen and can be used in nuclear weapon boosting systems. |
| <b>Sublime</b>           | A material sublimates when it changes state directly to a gas from a solid with no intermediate liquid state.   |
| <b>Target</b>            | A material inserted into a nuclear reactor core or an accelerator for the production of desired isotopes. For example, a target containing ${}^6\text{Li}$ can be used to produce tritium.  |
| <b>TATB</b>              | Triaminotrinitrobenzene. An insensitive high explosive.   |
| <b>Thermal Neutrons</b>  | Neutrons that have been slowed by collisions with nuclei. They have an energy of about 0.025 electron volt and a speed of typically about 2000 m/s.   |
| <b>Tonne</b>             | A metric ton; that is, 1000 kg or 2205 lb.  |
| <b>Tower</b>             | See column.   |

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| <b>Transducer</b>                  | A measuring device which changes one type of energy—for instance, mechanical—into an electrical output.   |
| <b>Tr-<i>n</i>-butyl Phosphate</b> | A water-immiscible liquid used in reprocessing and in uranium enrichment. It is used to extract uranium and plutonium from an acidic aqueous solution. Tributyl phosphate is usually diluted with an organic solvent such as kerosene.  |
| <b>Triple Point</b>                | A particular temperature and pressure at which three phases of one substance can coexist in equilibrium.  |
| <b>Tritium</b>                     | A heavier, unstable isotope of hydrogen ( $^3\text{H}$ or T). Ordinary hydrogen has a nucleus containing one proton and no neutrons. The tritium nucleus contains one proton and two neutrons. Tritium is radioactive, decaying with a half-life of about 12.3 years.   |
| <b>Uranium Enrichment</b>          | Any process by which uranium-bearing feed material is separated into two fractions, called the enriched fraction and the depleted fraction. The enriched fraction is said to be enriched in $^{235}\text{U}$ because it has a higher $^{235}\text{U}$ concentration than the feed material. The depleted fraction is depleted in $^{235}\text{U}$ relative to the feed.   |
| <b>Uranium Dioxide</b>             | ( $\text{UO}_2$ ) Purified uranium. The form of natural uranium used in heavy water reactors. Also the form of uranium that remains after the fluorine is removed from enriched uranium hexafluoride. Produced as a powder, uranium dioxide is, in turn, fabricated into fuel elements. Also known as "brown oxide," even though it is nearly black when pressed into pellets.  |
| <b>Uranium Hexafluoride</b>        | ( $\text{UF}_6$ ) A volatile and very corrosive compound of uranium and fluorine. Uranium hexafluoride is a solid at atmospheric pressure and room temperature, but can be transformed into gas by heating. Uranium hexafluoride gas (alone, or in combination with hydrogen or helium) is the feedstock in some uranium enrichment processes and is sometimes produced as an intermediate product in the process of purifying yellowcake to produce uranium oxide. |
| <b>Uranium Oxide</b>               | ( $\text{U}_3\text{O}_8$ ) The most common oxide of uranium found in typical ores. Uranium oxide is extracted from the ore during the milling process. The ore typically contains only 0.1 percent uranium oxide; yellowcake, the product of the milling process, contains about 80 percent uranium oxide.  |
| <b>Uranium Tetrafluoride</b>       | ( $\text{UF}_4$ ) A solid compound of uranium and fluorine commonly referred to as "green salt." Uranium tetrafluoride is an intermediate product in the production of uranium hexafluoride or of uranium metal. It is produced by reacting uranium dioxide with hydrogen fluoride.   |

**Uranium Trioxide** ( $\text{UO}_3$ ) An intermediate product in the refining of uranium and in the treatment of uranium recovered from fuel reprocessing operations. Also called "orange oxide."

**Uranous Uranyl Oxide** ( $\text{U}_3\text{O}_8$ ) A mixed oxide ( $2\text{UO}_3\text{-UO}_2$ ) of uranium known as "black oxide." The uranium content of various ores and concentrates is usually expressed in terms of  $\text{U}_3\text{O}_8$  equivalent.

**Yellowcake** A concentrate produced during the milling process that contains about 80 percent uranium oxide ( $\text{U}_3\text{O}_8$ ). In preparation for uranium enrichment, the yellowcake is converted to uranium hexafluoride gas. In the preparation of natural uranium reactor fuel, yellowcake is processed into purified uranium dioxide. Sometimes uranium hexafluoride is produced as an intermediate step in the purification process.

