

# APPENDIX F

## GLOSSARY OF TERMS

**Accountability:** That part of the safeguards and security program that encompasses the measurement and inventory verification systems, records, and reports to account for nuclear materials.

**Assay:** Measurement that establishes the total quantity of the isotope of an element and the total quantity of that element.

**Atom:** The basic component of all matter. Atoms are the smallest part of an element that have all of the chemical properties of that element. Atoms consist of a nucleus of protons and neutrons surrounded by electrons.

**Atomic energy:** All forms of energy released in the course of nuclear fission or nuclear transformation.

**Atomic weapon:** Any device utilizing atomic energy, exclusive of the means for transportation or propelling the device (where such means is a separable and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, a weapon prototype, or a weapon test device.

**Blending:** The intentional mixing of two different assays of the same material in order to achieve a desired third assay.

**Book inventory:** The quantity of nuclear material present at a given time as reflected by accounting records.

**Burnup:** A measure of consumption of fissionable material in reactor fuel. Burnup can be expressed as (a) the percentage of fissionable atoms that have undergone fission or capture, or (b) the amount of energy produced per unit weight of fuel in the reactor.

**Chain reaction:** A self-sustaining series of nuclear fission reactions. Neutrons produced by fission cause more fission. Chain reactions are essential to the functioning of nuclear reactors and weapons.

**Chemical separation:** A process for extracting uranium and plutonium from dissolved spent nuclear fuel and irradiated targets. The fission products that are left behind are high-level wastes. Chemical separation is also used for reprocessing.

**Conversion:** A process by which the chemical or physical properties of a material are changed to facilitate further use.

**Criticality:** A term describing the condition necessary for sustained nuclear chain reaction.

**Decay (radioactive):** Spontaneous disintegration of the nucleus of an unstable atom, resulting in the emission of particles and energy.

**Depleted uranium:** Uranium that has a concentration of the uranium-235 isotope less than that occurring in nature (i.e., less than 0.711 percent).

**Down blending:** Reducing the concentration of the uranium-235 isotope in a given quantity of uranium.

**Enriched material:** Material in which the percentage of a given isotope has been artificially increased so that it is higher than the percentage of that isotope naturally found in the material. Enriched uranium contains more of the fissionable isotope uranium-235 than the naturally occurring percentage, which is 0.711.

**Enriched uranium:** Uranium that contains more of the fissionable isotope uranium-235 than the naturally occurring percentage, which is 0.711.

**Enrichment:** The process of increasing the relative concentration of a desired constituent (especially an isotopic constituent).

**Fissile:** The capability of being split by a low-energy neutron. The most common fissile isotopes are uranium-235 and plutonium-239.

**Fission:** The splitting or breaking apart of the nucleus of a heavy atom like uranium or plutonium, usually caused by the absorption of a neutron. Large amounts of energy and one or more neutrons are released when an atom fissions.

**Fissionable:** A nuclide capable of undergoing fission by any process.

**Fuel:** Natural or enriched uranium that sustains the fission chain reaction in a nuclear reactor.

**Fuel element:** Nuclear reactor fuel including both the fissile and structural materials, such as cladding, typically in the shape of a long cylinder or plate.

**Gaseous diffusion:** A uranium enrichment process based on the difference in rates at which uranium isotopes in the form of gaseous uranium hexafluoride diffuse through a porous barrier.

**Half-life:** The time it takes for one-half of any given number of unstable atoms to decay. Each isotope has its own characteristic half-life. Half-lives range from small fractions of a second to billions of years.

**Highly enriched uranium:** Uranium having a uranium-235 isotopic weight percent of 20 or more.

**Holdup:** The amount of nuclear material remaining in process equipment and facilities after the process material, stored materials, and product have been removed. Estimates or measured values of materials in holdup may be reflected in the facility's inventory records.

**Inventory:** (a) Book Inventory: The quantity of nuclear material present at a given time as reflected by accounting records; (b) Physical Inventory: The quantity of nuclear material that is determined to be on hand by physically ascertaining its presence using techniques that include sampling, weighing, and analysis.

**Inventory difference:** The algebraic difference between the nuclear material book inventory and a physical inventory.

**Isotopes:** Different forms of the same chemical element that differ only by the number of neutrons in their nucleus. Most elements have more than one naturally occurring isotope. Many more isotopes have been produced in reactors and scientific laboratories.

**Low enriched uranium:** Uranium having a uranium-235 isotopic weight percent of less than 20, but greater than natural.

**Material balance:** The comparison of input and output of material quantities for a process. Generally, the comparison of beginning inventory plus receipts with ending inventory plus shipments plus measured discards for a specific time interval.

**Material control and accountability:** The use of measurements, analyses, records, and reports to maintain knowledge of the quantities of nuclear materials present in each accountability area of a facility and the use of physical inventories and material balances to verify the presence of materials or to detect loss of materials after it occurs.

**Material unaccounted for (MUF):** An obsolete DOE term. See "Inventory Difference."

**Measurement:** The process of obtaining numerical results from experiments designed to determine a value for the physical, chemical, or isotopic property of a material or physical system. All measurements have associated random and systematic errors.

**Molecules:** Larger structures formed by the bonding of atoms.

**Natural uranium:** Uranium that has not been through the enrichment process. It is made of 99.3 percent uranium-238 and 0.7 percent uranium-235.

**Neutron:** A subatomic particle found in the nucleus of an atom. Together with protons, neutrons makeup 99.9 percent of an atom's mass. Uranium and plutonium atoms fission when they absorb neutrons; therefore the chain reactions that make nuclear reactors and weapons work depend on neutrons. Manmade elements can be manufactured by bombarding natural and other man-made elements with neutrons in reactors.

**Normal operating loss (NOL):** The measured loss of material (solids, liquids, or gases) that is separated from a process stream as waste and is not intended to be recovered. NOLs include material (1) discharged to tanks or stored in drums or other containers; (2) discharged to settling ponds, sewers, cribs, stacks, or burial grounds; (3) discarded in contaminated items such as equipment, laundry, and shoe covers; or (4) otherwise lost or discarded. NOLs must be determined by measurement or by estimate on the basis of measurement.

**Nuclear components:** Those nuclear explosive or device parts or subassemblies that contain fissile and/or radioactive and other materials.

**Nuclear Materials Management and Safeguards System (NMMSS):** The national database and information support system for nuclear materials controlled by the U.S. Government, created to support national safeguards and management objectives in the domestic and foreign utilization of nuclear resources.

**Nuclear reactor:** A device that sustains a controlled nuclear fission chain reaction.

**Nuclear Regulatory Commission (NRC):** An independent agency of the Federal Government created by the Energy Reorganization Act of 1974, which abolished the AEC and transferred its regulatory function to the NRC. The NRC is responsible for ensuring adequate protection of public health and safety, the common defense and security, and the environment in the use of nuclear materials in the United States. It is also responsible for regulation of commercial nuclear power reactors; nonpower research, test, and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials; and the transport, storage, and disposal of nuclear materials as waste.

**Nuclear weapons complex:** The chain of foundries, uranium enrichment plants, nuclear reactors, chemical separation plants, factories, laboratories, assembly plants, and test sites that produces nuclear weapons.

**Nucleus:** The protons and neutrons at the center of an atom that determine its identity and chemical and nuclear properties.

**Physical inventory:** The quantity of material that is determined to be on hand by physically ascertaining its presence using techniques that include sampling, weighing and analysis. The process of identifying, physically locating, and determining accountability values for nuclear material on hand.

**Plutonium:** A manmade fissile element. Pure plutonium is a silvery metal that is heavier than lead. Material rich in the plutonium-239 isotope is preferred for manufacturing nuclear weapons. Plutonium-239 has a half-life of 24,000 years.

**Production reactor:** A nuclear reactor that is designed to produce tritium or plutonium. The United States had 14 such reactors: nine at the Hanford Site and five at the Savannah River Site.

**Proton:** A positively charged subatomic particle. All atoms of the same chemical element have the same number of protons. The number of protons in the atom is the atomic number of the element.

**Research reactor:** A class of nuclear reactors used to do research into nuclear physics, reactor materials and design, and nuclear medicine. Some research reactors also produce isotopes for industrial and medical use.

**Safeguards:** An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized possession, use, or sabotage of nuclear materials. Safeguards include the timely indication of possible diversion, and credible assurance that no diversion has occurred.

**Special nuclear material (SNM):** Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, has been determined to be special nuclear material.

**Spent fuel:** Nuclear fuel removed from a reactor following irradiation or that is no longer usable because of depletion of fissile material, poison buildup, or radiation damage.

**Spent fuel reprocessing:** The processing of spent nuclear fuel, after its use in a reactor, to remove fission products and to recover fissile and other valuable materials.

**Tails:** Uranium depleted in uranium-235 and withdrawn from the bottom stages of an isotope enrichment plant.

**Transactions:** Any recorded change affecting the inventory data base.

**Transmutation:** The conversion of one isotope into another isotope achieved through the capture or loss of subatomic particles such as neutrons, protons, alpha particles, gamma rays, etc. For uranium, two transmutation processes are important: (1) the capture of a neutron by uranium-235 leading to the production of uranium-236. This process is sometimes termed “parasitic capture” since uranium-235 fission does not occur, and (2) the capture of a neutron by uranium-238 leading to the production of uranium-239, followed by two radioactive (beta) decays that produce plutonium-239 (a manmade fissile material).

**Uranium:** The basic material for nuclear technology. It is a slightly radioactive naturally occurring heavy metal that is more dense than lead.

**Uranium hexafluoride:** A volatile compound of uranium and fluorine, symbol  $\text{UF}_6$ , used in the gaseous diffusion process.

**Uranium-233:** A manmade fissile isotope of uranium.

**Uranium-235:** The lighter of the two main isotopes of uranium. Uranium-235 makes up less than 1 percent of the uranium that is mined from the ground. It has a half-life of 714 million years. Uranium-235 is the only naturally occurring fissile element.

**Uranium-238:** The heavier of the two main isotopes of uranium. Uranium-238 makes up over 99 percent of uranium as it is mined from the ground. It has a half-life of 4.5 billion years and is not easily split by neutrons.

**Yellowcake:** A common uranium compound,  $\text{U}_3\text{O}_8$ , named for its typical color. Uranium is sent from the uranium mill to the refinery in this form.