Uranium Primer - Glossary of Uranium Industry Terms

Actinide: An element with atomic number of 89 (actinium) to 103. Usually applied to those above uranium-93 and higher (also called transuranics). Actinides are typically radioactive with long half-lives. They are therefore significant in wastes arising from nuclear fission, e.g. used fuel.

Atom: A particle of matter that cannot be broken up by chemical means. Atoms have a nucleus consisting of positively charged protons and uncharged neutrons of about equal mass. The positive charges on the protons are balanced by a number of negatively charged electrons in motion around the nucleus.

Boiling water reactor (BWR): A common type of light water reactor (LWR), where water is allowed to boil in the core, thus generating steam directly in the reactor vessel, which in turn, drives a turbine generator directly before being recirculated in the reactor.

CANDU: Canadian deuterium uranium reactor, moderated and (usually) cooled by heavy water.

Chain reaction: A reaction that stimulates its own repetition, in particular where the neutrons originating from nuclear fission cause an ongoing series of fission reactions.

Cladding: The metal tubes containing oxide fuel pellets in a reactor core.

Control rods: Devices to absorb neutrons so that the chain reaction in a reactor core may be slowed or stopped by inserting them further, or accelerated by withdrawing them.

Conversion: Chemical process that converts uranium oxide (U_3O_8) into uranium hexafluoride (UF_6) to prepare for the enrichment process.

Coolant: The liquid or gas used to transfer heat from the reactor core to the steam generators or directly to the turbine-generators.

Core: The central part of a nuclear reactor containing the fuel elements and any moderator.

Critical mass: The smallest mass of fissile material that will support a self-sustaining chain reaction under specified conditions.

Criticality: Condition of being able to sustain a nuclear chain reaction.

Decommissioning: Removal of a nuclear facility (reactor) from service, followed by safe storage, dismantling, and making the site available for unrestricted use.

Depleted uranium: Uranium having less than the natural content of 0.7% U-235. As a by-product of enrichment in the fuel cycle, it generally has 0.25-0.30% U-235, the rest being U-238.

Enriched uranium: Uranium in which the proportion of U-235 (to U-238) has been increased above the natural 0.7%. Reactor-grade uranium is usually enriched to about 3.5-5% U-235, whereas weapons-grade uranium is more than 90% U-235.

Enrichment: Physical process of increasing the proportion of U-235 to U-238. (See also SWU)

Enrichment Tails: Depleted uranium hexafluoride with less than 0.7% U-235.

Fast breeder reactor (FBR): A fast neutron reactor configured to produce more fissile material than it consumes, using fertile material such as depleted uranium in a blanket around the core.

Fast neutron reactor: A reactor with no moderator that uses fast neutrons. It normally burns plutonium while producing fissile isotopes in fertile material such as depleted uranium (or thorium).

Fission: The splitting of a heavy nucleus into two, accompanied by the release of a relatively large amount of energy and usually two or more neutrons. It may be spontaneous, but usually is due to a nucleus absorbing a neutron and thus becoming unstable.

Fuel assembly: Structured collection of fuel rods or pins, the unit of fuel in a reactor.

Fuel fabrication: Making reactor fuel assemblies, usually from sintered UO_2 pellets that are inserted into zircalloy tubes, comprising the fuel rods or pins.

Half-life: The period required for half of the atoms of a particular radioactive isotope to decay and become an isotope of another element.

Heavy water: Water containing an elevated concentration of molecules with deuterium ("heavy hydrogen") atoms.

Heavy water reactor (HWR): A reactor that uses heavy water as its moderator, such as the Canadian CANDU (pressurized HWR or PHWR).

High-level wastes: Extremely radioactive fission products and transuranic elements (usually other than plutonium) in spent (used) nuclear fuel. They may be separated by reprocessing the used fuel, or the spent fuel containing them may be regarded as high-level waste.

Highly enriched uranium (HEU): Uranium enriched to at least 20% U-235.

High-level waste (HLW): Highly radioactive material arising from nuclear fission. It can be what is left over from reprocessing spent (used) fuel, though some countries regard spent (used) fuel itself as HLW. It requires very careful handling, storage, and disposal.

In-situ recovery (ISR): The recovery by chemical leaching of minerals from porous orebodies without physical excavation. Also known as in-situ leaching and solution mining.

Light water reactor (LWR): A common nuclear reactor cooled and usually moderated by ordinary water.

Low-enriched uranium (LEU): Uranium enriched to less than 20% U-235. (Uranium in commercial reactors is typically 3.5-5.0% U-235.)

Low-level waste (LLW): Mildly radioactive material usually disposed of by incineration and burial.

Megawatt (MW): A unit of power, = 106 watts. MWe (megawatts electric) refers to electric output from a generator.

Mill Tailings: Ground rock remaining after particular ore minerals (i.e., uranium oxides) are extracted.

Milling: Process by which minerals are extracted from ore, usually near a mine site.

Mixed-oxide fuel (MOX): Reactor fuel that consists of both uranium and plutonium oxides, usually about 5% Pu, which is the main fissile component.

Natural uranium: Uranium with an isotopic composition as found in nature, containing 99.3% U-238, 0.7% U-235 and a trace of U-234. Can be used as fuel in heavy water-moderated reactors.

Nuclear reactor: A device in which a nuclear fission chain reaction occurs under controlled conditions so that the heat yield can be harnessed or the neutron beams utilized. All commercial reactors are thermal reactors, using a moderator to slow down the neutrons.

Oxide fuels: Enriched or natural uranium in the form of the oxide UO_2, used in many types of reactor.

Plutonium: A transuranic element, formed in a nuclear reactor by neutron capture. It has several isotopes, some of which are fissile and some of which undergo spontaneous fission, releasing neutrons. Weapons-grade plutonium is produced in special reactors to give >90% Pu-239, reactor-grade plutonium contains about 30% non-fissile isotopes. About one third of the energy in a light water reactor comes from the fission of Pu-239, and this is the main isotope of value recovered from reprocessing used fuel.

Pressurized water reactor (PWR): The most common type of light water reactor (LWR), using water at very high pressure in a primary circuit and forming steam in a secondary circuit, which is subsequently used to drive a turbine-generator.

Reactor pressure vessel: The main steel vessel containing the reactor fuel, moderator, and coolant under pressure.

Reprocessing: Chemical treatment of spent (used) reactor fuel to separate uranium and plutonium and possibly transuranic elements from the small quantity of fission product wastes, leaving a much-reduced quantity of high-level waste.

Separative Work Unit (SWU): This is a complex unit that is a function of the amount of uranium processed and the degree to which it is enriched, i.e., the extent of increase in the concentration of the U-235 isotope relative to the remainder. The unit is strictly designated kilogram Separative Work Unit, and it measures the quantity of separative work (indicative of energy used in enrichment) when feed and product quantities are expressed in kilograms. About 100-120,000 SWU are required to enrich the annual fuel loading for a typical 1,000 MWe LWR. Enrichment costs are related to electrical energy used. The gaseous diffusion process consumes about 2,400 kWh per SWU, while gas centrifuge plants require only about 50-60 kWh/SWU.

Spent fuel: Used fuel assemblies removed from a reactor after several years use and treated as waste.

Uranium (U): A mildly radioactive element with two isotopes that are fissile (U-235 and U-233) and two isotopes that are fertile (U-238 and U-234). Uranium is the basic fuel of nuclear energy.

Uranium hexafluoride (UF_6): A compound of uranium that is a gas above 56°C and is thus a suitable form in which to enrich the uranium.

Uranium oxide concentrate (U_3O_8): The mixture of uranium oxides produced after milling uranium ore from a mine, sometimes referred to as "yellowcake."

Zircaloy: Zirconium alloy used as a tube to contain uranium oxide fuel pellets in a reactor fuel assembly.

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