Glossary

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Breeder—A nuclear reactor that produces more fissile nuclei than it consumes. The fissile nuclei are produced by the capture of neutrons in fertile material. (See definitions below.) The resource constraint for breeder reactors is thus fertile material, which is far more abundant in nature than fissile material. These reactors have not yet reached commercialization. Fast breeders do not contain a moderator (see definition below) to slow neutrons down; i.e., fast neutrons are used. Thermal breeders do contain a moderator; i.e., slow neutrons are used.

Centrifuge—A rotating vessel that can be used for enrichment of uranium. The heavier isotopes of the UF_6 gas tend to concentrate at the walls of the rotating centrifuge.

Chain Reaction—A series of nuclear fissions, each one stimulated by a neutron emitted in a Previous fission. A chain reaction occurs when at least one of the two or more neutrons released in a fission initiates another fission.

Critical Mass—The minimum amount of fissile material required to sustain a chain reaction. The exact mass varies with many factors such as the particular fissile isotope present, its concentration and chemical form and the geometrical arrangement of the material.

Dedicated Facility—A facility built indigenously (possibly clandestinely) in order to produce fissile material for nuclear weapons. It might be a plutonium production reactor, a uranium enrichment plant or a reprocessing plant.

Denaturing—A technique to render fissile nuclear material unsuitable for explosive weapons by mixing in other isotopes of the same element.

Diffusion—A technique for enrichment of uranium based on the fact that the lighter isotopes of a gas will diffuse through a porous barrier more rapidly than the heavier isotopes.

Diversion—The removal of material from some point in the commercial nuclear fuel cycle to use in nuclear weapons.

Enrichment—The process of increasing the concentration of one isotope of a given element.

Fast Neutron—A fast-moving, neutral subatomic particle. Neutrons are emitted when a nucleus, such as uranium-235, fissions.

Fertile Isotope—An isotope not itself fissile but that is converted into a fissile isotope, either directly or after a short decay process following absorption of a neutron. Example: U^{238} can capture a neutron to give U^{239}. U^{239} then decays to Np^{239} which in turn decays to fissile Pu239.

Fissile Isotope—An isotope that will split, or fission, into two (or more) lighter elements plus extra neutrons when it is struck by a neutron,

Fission—The splitting of a nucleus usually into two or more lighter elements. The total mass of the resulting particles is less than that of the original atom, the difference being converted into energy.

Fresh Fuel—Nuclear fuel ready for insertion into a power reactor.

Fuel Cycle—The set of chemical and physical operations needed to prepare nuclear material for use in reactors and to dispose of or recycle the material after its removal from the reactor. Existing fuel cycles begin with uranium as the natural resource and create plutonium as a byproduct, Some future fuel cycles may rely on thorium and produce the fissile isotope uranium-233.

Fuel Fabrication Plant—A facility where the nuclear material (e.g., enriched or natural uranium) is fabricated into fuel elements to be inserted into a reactor.

Gun-Type Nuclear Weapon—A device in which gun propellants are used to move

two **or more subcritical masses of fissile material together to produce an explosion.**

Implosion-Type Nuclear Weapon—A device in which high explosives surrounding a subcritical configuration of fissile material compress it into a condition of supercriticality to produce an explosion.

Isotopes-Atoms of the same chemical element whose nuclei contain different numbers of neutrons and hence have different masses, even though chemically identical. Isotopes are specified by their atomic mass number, that is, the total number of protons plus neutrons, and a symbol denoting the chemical element, e.g., U^{235} for uranium-235.

Mixed-Oxide Fuel—Nuclear reactor fuel composed of plutonium and uranium in oxide form. The plutonium replaces some of the fissile uranium, thus reducing the need for uranium ore and enrichment. This is the form of the fuel that would be used in plutonium recycle.

Moderator—A component (usually water, heavy water, or graphite) of some nuclear reactors that slows neutrons, thereby increasing their chances of being absorbed by a fissile nucleus.

Multinational Fuel-Cycle Facilities (MFCF)-A concept for joint national ownership and management of certain steps of the nuclear fuel cycle-especially those steps that are particularly vulnerable to national diversion. Multinational reprocessing plants and spent-fuel storage facilities are currently under study.

Nth Country—A nation judged to have high potential of becoming a nuclear-weapons state—because of its technical and economic ability and its political motivations.

Neutron—Neutral particles which, together with protons, comprise the nucleus of an atom.

Non-State Adversary—Any individual or group that wishes to use destructive force to further its own goals.

Nuclear Fission Weapons—Devices that derive their explosive force from the energy released when a large number of nuclei fission in a very short period of time.

Plutonium-239 (Pu^{239})-A fissile isotope created as a result of capture of a neutron by U^{238}. It is excellent material for nuclear weapons.

Plutonium-240 (Pu^{240})—A fissile isotope whose presence complicates the construction of nuclear explosives because of its high rate of spontaneous fission. It is produced in reactors when a Pu^{239} atom absorbs a neutron instead of fissioning.

Protons—Positively charged particles which, together with neutrons, comprise the nucleus of an atom.

Reactor—A facility that contains a controlled nuclear fission chain reaction. It may be used to generate electrical power, to conduct research, or exclusively to produce plutonium for nuclear explosives.

Reactor-Grade Plutonium—Plutonium that contains more than 7 percent of the isotope plutonium-240. It is created in most power reactors under normal operating conditions, although the liquid metal fast breeder reactor does produce weapons-grade plutonium in one portion of the reactor.

Recycle—The reuse of unburned uranium and plutonium in fresh fuel after separation from fission products in spent fuel at a reprocessing plant.

Reprocessing-Chemical treatment of spent reactor fuel to separate the plutonium and uranium from the fission products and (under present plans) from each other.

Safeguards-Sets of regulations, procedures, and equipment designed to prevent and detect the diversion of nuclear materials from authorized channels.

Special Nuclear Material (SNM)-Plutonium, or uranium enriched in U^{235} or U^{233}.

Spent Fuel—Fuel elements that have been removed from the reactor because they contain too little fissile material and too high a

concentration of radioactive fission products. They are both physically and radioactively hot.

Strategic Special Nuclear Material (SSNM)-Plutonium, U^{233}, or uranium enriched to 20 percent or more in U^{235}.

Spiking—A technique to deter theft of nuclear fuel by the addition of radioactive substances.

Thermal neutrons—Low energy, or slow moving neutrons.

Thorium-232 (Th^{232})-A fetile, naturally occurring isotope from which the fissile isotope uranium-233 can be bred.

Uranium-233 (U^{233})-A fissile isotope bred by fertile thorium-232. It is similar in weapons quality to plutonium-239.

Uranium-235 (U^{235})-The only naturally occurring fissile isotope. Natural uranium has 0.7 percent of U^{235}; light water reactors use about 3 percent and weapons materials normally consist of 90 percent of this isotope.

Uranium-238 (U^{238})—A fertile isotope from which Pu239 can be bred. It comprises 99.3 percent of natural uranium.

Weapons-Grade Plutonium—Plutonium that contains less than 7 percent of plutonium-240, an isotope that complicates the design of nuclear weapons.