Nuclear Weapons Glossary

Aft Assembly: the mechanical assembly housing the gas boost reservoirs, the squib valve and the neutron generator(s)
Alpha: also weapon alpha, meaning the neutron multiplication rate in a fissile core
Alpha phase Plutonium: Plutonium metal in its highest phase density, of ~ 19.8 g/cm3
Beryllium: the best and lightest neutron reflector used in most contemporary fission warheads and "primaries", and used as ablators in "secondaries"
Bhangmeter: instrument consisting of a photocell connected to an oscilloscope measuring directly the yield as being proportional to the time between the double light flash peaks (does not work underground!)
Boosting: increasing the yield of a fission pit by a factor of two or more by flooding it with 14MeV neutrons from D+T gas injected in a hollow pit shell before implosion. Invented 1946 by E. Teler; re-discovered by Ya. Zeldovich and L. Feoktistov in 1957.
Boost gas: an equimolar mixture of Deuterium (D) and Tritium (T) gas stored at high pressure in a stainless steel bottle (reservoir). As Tritium (T) ages through radioactive decay, the reservoir is exchanged. Sometimes more T than necessary is pre-loaded (e.g. 6 g instead of 4 g) as to extend the time between changes by compensating for the T decay
Capsule: mechanical assembly of fissile pit of Pu or HEU or combination together with a reflector/tamper and possibly central initiator, to facilitate easy handling
Composite Core: a fissile core made of a Pu interior and HEU exterior; this evens out the burn-up flux and produces a correspondingly higher yield; originally done to save Pu
Compression: increasing density through the use of shock waves to increase the reaction rate. This decreases the critical mass of fissile material with the square of the density, or conversely, increases the thermonuclear burn rate of a secondary bomb assembly
Core: see also **Pit**; refers to the fissile material part of a bomb, either spherical, cylindrical, etc. It might have up to 4 to 5 layers: Pu/Gold Flashing/Be/Stainless Steel/Vanadium
Critical Mass: the minimum amount of fissile material that will self-sustain a fast neutron chain reaction. This varies with shape and type of fissile material. A critical mass does not explode; you need a super-prompt critical mass.
Critical Assembly: the mechanical combination of core and reflector/tamper assembly that is used to make criticality measurements
Cylinder: The name of the first thermonuclear experiment in 1951 to test the ignition of D+T using thermal x-ray radiation from an 8ft cylindrical HEU fission implosion
DAY: dial-a-yield, whereby in a nuclear explosive you can adjust the amount of boost gas injected in the pit to get the full yield, the yield of the boosted primary fission explosive, or the yield of the primary fission explosive without boosting
Detonator: a device that provides the means to initiate detonation in an explosive; usually a very thin exploding wire or foil that is vaporized when zapped with high voltage (e.g. 5 KV); the resulting shock wave initiates the explosion in the main charge. Very fast and accurate timing and low jitter provides high degree of simultaneity.
Deuterium: Deuterium or heavy hydrogen; used in combination with T for boosting, or with Lithium (Li) in LiD salt as thermonuclear fuel

Enrichment: increase in percentage of a particular isotope of an element. Typical methods are gaseous diffusion, electromagnetic spectrograph separation, thermal diffusion, ion exchange, ultra-centrifuges, or Atomic Vapor (or molecular) Laser Isotope Separation. Typical weapons uses are enrichment of natural Uranium to about 93% in U235, natural Li to about 40 to 60% in Li6, etc.
Equation of State (EOS): Formulas describing the relationship between density, pressure and temperature. Crucial for implosion calculations
External Neutron Source: usually a miniature ion accelerator tube, where Deuterium ions from a cathode source are accelerated by high voltage and slammed into an anode electrode impregnated with Tritium, to generate 14.7MeV neutron burst to start the nuclear fission chain reaction in a fissile core. The outputs can exceed 10E8 neutrons in a 100 ns pulse…Some weapons use 2 or 4 tubes for higher yield and reliability. Replaced dangerous, expensive and short-lived Po-Be internal initiator. Invented in 1945 by L. Alvarez.
Explosive: chemical compound that detonates when initiated by shocks, typically TNT, HPMX, PETN, etc. Used to compress materials, such as fissile cores in bombs.
Explosive Lens: device that shapes detonation shock wave to a desired form, e.g. plane or spherical shock wave. Usually made of binary system, combining explosives, metals, foam, etc. see also LENS
Explosive Valve (squib valve): a valve that has a stem driven by an explosive squib to sever thin tube ends connecting the boost gas reservoir to the hollow pit, thus allowing the boost gas to fill the pit
FRP: Fire resistant pit, whereby the pit is clad with Vanadium to contain molten Plutonium in jet fuel fire
Firing Set: a combination of electronics that produces high voltage, stores it in capacitors, and discharge the voltage into detonators upon external command (timer, radar, barometer, etc). Modern sets use a semiconductor laser and fiber optics to detonate the high explosive.
Fission: process where a neutron causes certain elements, such as Uranium or Plutonium, to split and release enormous energy ($E=mc^2$=~180MeV); basis of fission explosives
Fission Weapon: nuclear weapons that use the principle of fast nuclear fission chain reaction in U235 or Pu239 to liberate enormous energy in less than 100 nanoseconds…
Fizzle: a weak explosion, where the output is less than a couple of percent of design yield
Fuzing and Firing: integrated electronics assembly that provides the sensors that provide the firing signals (impact crystals, barometer switched, radar altimeters, accelerometers, etc) to the firing set electronics discharging high voltages into detonators
Gas Boosting: use of D+T gas to undergo thermonuclear reactions inside a compressed pit to speed up (or boost) the fission chain reaction, and thus the energy release by a factor of two to ten, depending on design
Gas Transfer System: the mechanical and electrical assembly of D+T gas reservoirs, pit tubing, squib gas transfer valve, and associated electronics.
Gun-type Weapon: consists of two subcritical HEU pieces, where a subcritical projectile is fired into a HEU target, thereby creating a supercritical explosive assembly
HEU: Highly Enriched Uranium; means Uranium enriched in fissile isotope 235 to 80% or more, typically 93%. In US, also known as Oralloy

High Explosive: chemical explosive that has high detonation velocity, usually in excess of 6000 m/s
Hohlraum: black body cavity, same as hydrogen bomb radiation confinement case
Hollow Boosting: refers to fission yield enhancement in a hollow fissile material pit filled with D+T boost gas that releases copious amounts of thermonuclear neutrons
Hydrodynamics: branch of Fluid Dynamics that explores behavior of materials under intense shock pressure; extensively used in implosion calculations to calculate time-dependent compression of pit or canned TN assembly, and thus, supercriticality or thermonuclear burn rate
IHE: Insensitive High Explosive, a very safe type of explosive that can be detonated only by a strong shock; a bullet impact will have no effect
Implosion: uniform squeezing of matter by shock waves or radiation. It can be in 3 dimensions (spherical), 2 dimensions (cylindrical), or 1 dimension (linear)
Implosion-type weapon: assembly of fissile core material by explosive-driven implosion
Initiator: device that provides a squirt of neutrons to start or "initiate" a divergent chain reaction in a super-prompt critical fissile core assembly. There are two basic types: internal Polonium-Beryllium types (original name "Urchin"), and external neutron generator tubes (original name "zipper"
Interstage: usually material containing BeO which absorbs the primary x-rays and re-radiates lower wavelength x-rays over longer time for a more complete secondary assembly implosion and compression
Interval Time: time between the fission primary emission of radiation and the production of thermonuclear output
Isentropic Compression: replaces shock compression with a smooth continuous pressure increase using soft, layered impactors, thereby decreasing heating and allowing much greater compression. Increases yields by a factor of 2 or 3…
Lens: a binary explosive device, where the difference in detonation velocity results in refractive shaping of the output detonation wave; used in early implosion weapons to produce spherical implosions. Superseded by air lenses, flat lenses, and multi-point laser detonation systems.
Levitation: method using a gap between fissile core and tamper, allowing tamper to gain momentum before slamming into the pit; the result is much higher compression due to amplification by the hammer ($E=mv^2/2$) effect
Lithium: metal used either to breed Tritium in reactors to make boost gas, or used in Lithium Deuteride thermonuclear fuel; Li6 isotope has higher cross-section than natural Li7 and is the preferred TN fuel in miniaturized warheads, but both produce Tritium. Ignorance of Li7 cross-section caused the Castle Bravo TN bomb test in 1954 to run away by a factor of 3 yielding 15 MT.
Lithium Deuteride: solid gray salt used as TN fuel in the secondary assembly of a thermonuclear explosive. Usually the Li is enriched to 40 to 60% Li6. Sometime the Li6D is spiked with Tritium (Sakharov's 1953 Sloika layer cake design used Li6DT)
Margin: the additional yield of a fission explosive beyond what is needed to drive the explosion of the thermonuclear secondary assembly to full yield
Multipoint Detonation System: replaces the bulky lensed spherical high explosive implosion assembly with multiple individual detonators on the surface of HE sphere. Used successfully in UK in very compact and lightweight Octopus/ super-Octopus

system; used in China's first HEU implosion test (252 detonators). Currently implemented using a high power semiconductor laser and fiber optics cables.
Neutron Initiator: see Initiator
Neptunium: produced in reactors as a by-product, isotope 237 is fissile and can also be used in fission explosives
NTS: Nevada Test Site, used for testing nuclear weapons
Neutron Generator: an integrated assembly of a neutron tube, power supply, timers and triggering system. Some power supplies are electronic, some are explosive ferroelectric or magnetocumulative generators
Neutron Tube: see External Neutron Source
Neutronics: branch of nuclear reactor theory concerned with criticality calculations, such as the variation of degree of criticality with core compression by high explosives
NW: Nuclear weapon
PAL: Permissive Action Link, a mechanical or electronic combination lock preventing the use of a nuclear weapon by unauthorized persons; currently using crypto chips
PBX: Plastic Bonded Explosive, a mix of HE powder pressed together with a plastic binder to make easily handled and machined parts
Pit: the central metal core assembly containing an inner fissile shell of Pu or HEU, usually flashed with gold or Nickel, and an outer shell of either stainless steel, Beryllium, or Vanadium, or a combination; see also **Core**, and **FRP**
Pit Tube: a thin stainless steel tube carrying boost gas from the reservoir to the hollow core of the pit at the time of detonation
Plasma: fourth state of matter, whereby the material is completely ionized
Plutonium: element 94. The isotope 239 sustains fast neutron chain reaction and is the fissile material used in fission explosives. Reactors also produce the isotope 240 material, fissionable only by fast neutrons, which has high spontaneous neutron emission that could cause pre-initiation and fizzle yield.
PNE : peaceful nuclear explosives; typically minimizes fission products
Polonium: a high emitter of alpha particles with a half life of 138 days; it was used in combination with Beryllium to generate neutrons for initiating a fission chain reaction
Pre-detonation: detonation of fission explosive before the optimum time, usually before achieving maximum compression of fission core because of high rate of spontaneous fission – see **Pre-initiation**
Pre-heating: the heating of TN secondary assembly by fission primary before radiation implosion is completed, leading to reduced compression and TN fizzle yield
Pre-initiation: initiation before the optimum time, usually before achieving maximum compression of fission core; causes significant decrease in yield, usually a "fizzle" yield
Primary: primary bomb, usually a fission explosive providing the soft x-ray radiation driving the implosion of a secondary (thermonuclear) bomb to achieve high compression
Radiation Case: metal case containing the primary radiation long enough to implode the secondary; usually stainless steel, aluminum, or plastic with Uranium or Lead coating. Also known as a hohlraum
Radiation Implosion: thermal X-rays from a fission explosive cause ablation of the TN secondary assembly surface, thus driving a strong implosion and high compression of the assembly to make it yield most of the explosive energy. AKA Teller-Ulam principle

Radiation Implosion Compression Mechanism: in the initial US design, the radiation heated a radiation channel filler (foam) to a plasma that pushed against the secondary assembly to compress it (like steam pressure against turbine blades).
Radiation driven ablation was discovered accidentally when trying to miniaturize a warhead by using a secondary with a Beryllium-reflected HEU wrap around the LiD fuel and sparkplug; Be is a very good ablator (very high velocity of ablated ejecta) thus providing much greater compression and increased yield from a smaller secondary assembly than "exploding" foam. Latest designs used "doped" or profiled ablators to provide a near isentropic compression, similar to laser fusion capsules.
In UK and France, the initial design used the "explosive pusher" concept, where the external metal layer (iron) around the secondary was heated by the thermal x-rays, half blowing outwards, the other half pushing inside, for modest compression.
Reactor-grade Plutonium: Plutonium produced in power reactors with a high content (greater than 20%) of the undesirable isotope 240; unfortunately still a good nuclear explosive material
Reflector: material that reflects neutrons; a good reflector surrounding a fissile core decreases the critical mass of fissile material. Best core reflector is Beryllium metal
Reservoirs: metal containers, usually stainless steel, storing boost gas, deuterium and tritium, under high pressure or absorbed in metals as hydrides
RV: missile re-entry vehicle, housing the nuclear warhead and the arming, fuzing, and firing system, and interface to the missile "bus"
Secondary: secondary or auxiliary bomb, a physically separate component containing thermonuclear fuel such as Lithium Deuteride surrounded by a fusion tamper such as natural Uranium or, for increased yield in a compact package, HEU. Known as Canned Sub-Assembly (CSA)
Separation: process of enriching an element in the percentage of the desired isotope
Shocks: a steep pressure wave, generated by explosives, ballistic impact, electrostatic implosion, etc.
Shot: a nuclear test explosion
SNM: special nuclear material, same as fissile material, Plutonium 239, or HEU
Sparkplug: informal term denoting a fissile core inside a thermonuclear (TN) fuel container that is used to start the thermonuclear burn in the previously compressed TN fuel. Initially used Plutonium, currently HEU
Spontaneous Fission: typically natural spontaneous nuclear fission of Uranium 238 or Plutonium 240 nuclei producing high level of neutron background; main cause of pre-detonation
Sprytron: a gas filled triggered spark-gap tube used as an ultra fast switch to fire the detonators
SRD: Secret Restricted Data, one of the numerous information classification categories
Staging: physical separation of the primary fission stage from the TN secondary stage to allow time for radiation implosion and prevent its destruction by primary material debris
Stockpile: quantity of nuclear weapons ready for use
SSS: Science-based Stockpile Stewardship, a program whereby the stockpile can be certified using computer simulations and statistical sampling and dissection of stockpiled weapons that they are reliable and safe without nuclear testing

Supercriticality: the state of a fissile assembly sustaining a divergent chain reaction with prompt neutrons alone; more correctly, super prompt criticality
Tamper: also Inertial Confinement Tamper, usually a heavy material surrounding the core providing additional inertial confinement to allow extra fissions for a larger yield
Thermal Battery: solid state battery that is usually activated by heating by a pyrotechnic device to provide power to the NW electronics, detonators, etc.
Thermonuclear weapons: usually a two stage weapon where the radiation from the fission explosive is contained and used to transfer energy to compress and ignite a physically separate component containing thermonuclear fuel
Teller-Ulam: inventors of contentious staged radiation implosion principle-separation of stages and radiation driven implosion of the secondary
Timer: electronics or explosive chain used to precisely control with 10-100 nanosecond accuracy the sequence of events in the NW detonation sequence, e.g. activate thermal batteries, inject boost gas, fire detonators, trigger neutron initiator, etc.
TN: thermonuclear
Transit Time: time for a shock wave to travel from the exterior of the explosive charge to the center of the fissionable core; used to set the timing for the neutron tube firing
Tritium: artificial extra heavy Hydrogen element produced in reactors by transmutation of Lithium. Tritium burns 100 times faster when combined with Deuterium and produces copious quantities of fast neutrons, thus its use as a boost gas
Uranium: element 92. The isotope 235 sustains neutron chain reaction and is the fissile material used in fission explosives; it occurs naturally in 0.7% of natural Uranium, the rest being the inert isotope 238 material, fissionable only by fast neutrons.
Weapons-grade Plutonium: Plutonium containing 93+% Pu239 isotope
Yield: the energy output of a NW, usually expressed in kilotons (kT) or megatons (MT)