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“Nuclear Disarmament: Challenges, Opportunities and Next Steps”

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Background Knowledge

There are over 27,000 nuclear weapons in the world. In this number nearly half of them are deployed and ready to use. While the technology of nuclear weapons has been around for only 70 years, in the short amount of time people have managed to create and nearly perfect this unbelievable weapon. While only a select few hold this power, the presence of nuclear weapons has shaped the course of history.

The first nuclear devices to be created were fission bombs, also known as atomic bombs, which had two main designs: the gun assembly model and the implosion model. The first, the gun assembly model, consists of two sub critical masses of uranium placed at opposite ends of the device with one of the masses being set in front of an explosive charge (Nuclear 4). When the explosive detonates, it launches one subcritical mass into the other, creating a supercritical mass and a massive nuclear explosion. This weapon type was used in the 'Little Boy' weapon dropped on Hiroshima, Japan. The other type of fission bomb, an implosion-type, uses a layer of slow acting explosives over a layer of fast acting explosives to compress a sub critical uranium or plutonium center surrounded by a fissile "tamper" which is used to accelerate the fission process by reflecting neutrons back into the core (Nuclear 4-5). When the fissile center is compressed, it reaches a state of criticality and creates a massive explosion moderately more powerful than those created by gun-type fission bombs. Variations of implosion type nuclear devices include: levitated pit implosion devices, in which the fissile core and tamper are separated by an air space; two-point linear implosion devices, a compact but inefficient device in which the fissile core is embedded in a cylinder of high explosives with detonators at each end; and two-point hollow pit implosion devices, which represent the upper limits of normal implosion devices and have hollow plutonium centers, reducing the needed thickness of the fissile tamper and making levitation redundant. These are among the world's oldest nuclear devices, and despite their destructive capacity, they are substantially weaker than more modern nuclear devices.

The implosion design later entered the thermonuclear age with boosted fission weapons. Boosted fission weapons use nuclear fusion reactions to produce more neutrons to accelerate and increase the yield of implosion devices (Facts 3-4). Boosted fission weapons are considerably weaker than thermonuclear weapons that use nuclear fusion to produce explosions and are limited to approximately 1 megaton of explosive strength and 20% efficiency. An example of a boosted fission weapon is the Soviet Joe-4 device, which used nuclear fusion to produce a fission explosion from depleted uranium. While still dependent upon fission for the bulk of its destructive power, boosted fission weapons are technically dependent upon nuclear fusion reactions to function.

The more modern and destructive multi-stage thermonuclear weapons represent the upper limits of nuclear weapons' destructive capacity. These thermonuclear devices function in an inverse manner to boosted fission weapons and use nuclear explosions created by fission to create much larger explosions via nuclear fusion. This large nuclear explosion can then be used to create even larger fusion explosions (Facts 4-5). There are no theoretical limits to the size of an explosion that can be created through this weapon type; the current record holder is the Soviet 57 megaton Tsar Bomb. Variations to these weapons include: "clean bombs" which are designed be almost entirely dependent upon nuclear fusion for their destructive capacity; this reduces the amount of fallout produced, but also the device's yield; neutron bombs, which have yields that average 1/10th the strength of a fission device, but produce large amounts of radioactivity; and the theoretical "salted bomb" in which a highly radioactive isotope is packaged in with a multi-stage thermonuclear device in order to disperse the material over a very large region. These devices compose the bulk of most nations' nuclear arsenals and are considerably more dangerous than their fission predecessors.

While there are nine current nuclear powers in the world, the majority of the history of nuclear weapons design was written by two nations, the United States and Russia. The American nuclear weapons program started with the Manhattan Project, an extensive nuclear research program during World War II involving American, Canadian, and British nuclear physicists. This project was spread out over thirty facilities including the then-secret cities of Los Alamos, NM; Oak Ridge, TN; and Richland, WA, and encompassing some of the greatest contemporaries of physics (Manhattan 3-9). The program was a direct response to knowledge of a similar program in Nazi Germany, which ultimately was inconclusive due to Nazi Germany's capitulation. After three years of extensive research, three devices were produced by the Manhattan Project: the Trinity test implosion-type device, the 'Little Boy' gun assembly bomb dropped on Hiroshima, and the 'Fat Man" implosion type bomb dropped on Nagasaki.

The United States' exclusive control was short-lived, as Soviet espionage retrieved enough information from spies in the Manhattan Project, and using this research built, their first weapon, the implosion-type "Joe-1 ." After "Joe-1" was detonated in 1949, nuclear research yielded increasingly deadly weapons, as the United States detonated its first thermonuclear weapon, "Ivy Mike" in 1952, using a design created by Hungarian physicist Edward Teller (Cold 3-5). As in the case with fission bombs, espionage also allowed the Soviets to steal the designs to these incredibly dangerous weapons. For a time, the arms race focused on the creation of larger and more destructive devices.

Towards the close of the 1950s, the prospect of nuclear warfare became even more dangerous with the creation of intercontinental ballistic missiles which were created by both the Soviet Union and the United States within months of each other (Cold 3). Now, nuclear war could be triggered from defensible positions deep within enemy territory, and warning time dropped from approximately 8 hours to 30 minutes. Even more disturbing was the later advent of multiple independently targeted re-entry vehicles, which allowed single ICBMs to carry multiple warheads and strike multiple targets. At this stage, the only means to prevent a superiorly armed Soviet Union from being capable of incapacitating the nation in one fell swoop was to have the capacity to do the same to the Soviet Union, birthing the policy of Mutually Assured Destruction (Cold 3).

Barring a window of a few years after the first Strategic Arms Limitation Talks treaty and the close of the 1980s, the number of active nuclear weapons in the United States and the Soviet Union constantly grew. The sheer number of nuclear weapons not only raised issues regarding the survivability of a nuclear war, but also the capacity for both sides to keep track of all of them. After the collapse of the Soviet Union and the dimming of the potential of a nuclear war, the American nuclear program became oriented around three priorities: reducing the number of deployed weapons, modernizing the arsenal of nuclear weapons, and developing low-yield "bunker buster" devices (Physics Today, 1-3). While unlikely to use them in the near future, the United States continues to maintain a fairly large number of deployed nuclear devices as a strategic deterrent. Also, the United States has been searching for more specialized and less destructive uses for its future nuclear devices. The nuclear weapons program of the United States has, and most likely will, continue for sometime to shape the history of these horrifyingly destructive devices.

While founded upon stolen information from the American program, the Soviet nuclear weapons program arguably has been every bit as influential as ours in the history of nuclear weapons development. While Soviet interest in nuclear weapons dates back to the 1930s, their program began in earnest after the Soviet Union recruited a number of scientists working in the Manhattan Project, including Ethel and Julius Rosenberg, Morris Cohen, and Klaus Fuchs, to divulge information regarding nuclear weapons design and subsequent research on the mid to late 1940s (Soviet 1-3). The Soviets' espionage allowed them to develop an atomic weapon with fewer accidents than in the American program. In 1949, the Soviet Union created its first nuclear fission bomb, RDS- 1 or "Joe-1." The Soviet Union's espionage capabilities allowed it to match the United States' nuclear prowess, and it constructed enormous numbers of nuclear warheads (NRDC 2-3). Eager to deter a seemingly hostile United States, the Soviet Union produced massive amounts of nuclear weapons, eventually creating an arsenal substantially larger than that of the United States. The sheer number of weapons served only to further promote the doctrine of Mutually Assured Destruction between the Soviets and Americans. After the collapse of the Soviet Union, its nuclear weapons program was absorbed by the Russian Federation, which at the moment is pursuing a program of demobilization and modernization similar to that of the United States (91144, 2-4, 10-13).

Unfortunately, the Russian program is less secure and less funded than its American counterpart, causing concerns about proliferation of nuclear materials and expertise. In order to prevent the mutual threat posed by the proliferation of these materials and knowledge, the United States and Russia have been forced to collaborate more closely in their nuclear weapons programs. While the Soviet's outgrew the American nuclear weapons program, the Soviet and succeeding Russian program has left a considerable influence on the development of nuclear weapons. Although America and Russia were the two main contributors to the nuclear weapons state we have today, the other nuclear weapon countries can not be over looked.

Despite its small size and lack of military clout, the United Kingdom was the third nation in the world to acquire nuclear weapons. The British, who had researched nuclear weapons design in 1940 under the “Tube Alloys” project and subsequently participated in the Manhattan Project with the United States and Canada, convened the Gen 75 Committee on August 29th, 1945 in order to assess the viability of independently developing a nuclear weapon. (Britain's 1) The pursuit of nuclear weapons gained traction after the United States began to restrict foreign access to its nuclear weapons technology in the wake of World War II via legislation such as the McMahon Act of 1946. This convinced the British government that possession of a nuclear device would be the only real means for their nation to retain military influence in the nuclear age, and prompted the government to organize a program under the control of the Atomic Energy Research Establishment. In 1952, the program’s efforts came to fruition, and the United Kingdom tested its first fission device off the northwest coast of Australia in Operation Hurricane and produced its first deployed fission device, the “Blue Danube.” But within a mere two years, the United Kingdom’s arsenal was rendered obsolete by the testing of fusion weapons by both the Americans and the Soviets, prompting a frantic catch-up campaign by the Britain between 1956-1958 dubbed Operation Grapple (Britain's 8-13). Operation Grapple was initially a disappointment, with the first thermonuclear device detonated yielding a scant 300 kilotons, well within the potential yield of a fission device. However, later developments produced weapons that were considerably more powerful, the largest device yielding a 3 megaton blast in its test. After its first successful test of a thermonuclear weapon in 1957, Britain signed a mutual defense treaty with the United States a year later, which instituted an exchange of nuclear weapons technology in order to build more effective weapons (British 1-11). After the treaty was signed, the United Kingdom began to focus the energies of its nuclear weapons program on submarine based missile delivery using American Polaris rockets and the modernization of its nuclear arsenal. This shift of focus was not entirely unfounded, as the British isles small size and close proximity to the Soviet Union, hence the nation's infamous 'four minute warning' after the invention of ICBMs, made building land based silos an exercise in futility in the era's atmosphere of mutually assured destruction. Perhaps the last major nuclear weapons program of the United Kingdom was the "Chevaline," a multiple independently targeted re-entry vehicle warhead program, designed to make Britain's Polaris rockets less vulnerable to the defensive Anti-Ballistic Missile installations defending Moscow while seemingly saving money by not upgrading to the new American Trident rockets (Britain's 4-5). The program was begun in 1970 under Prime Minister Howard Wilson under the name "Super Antelope" and remained secret until its public revelation by Margaret Thatcher's administration in 1980. The resulting missile, which entered service in 1982, was a debacle for the British government, as the "improved" missile had a range 22% shorter than its single warhead predecessor and had cost a whopping £1 billion to develop. After the Cold War, the United Kingdom pursued a similar route of modernizing and shrinking its nuclear arsenal (Britain's 1-5). In 1994, the United Kingdom finally began the transition from Polaris to Trident ICBMs, eventually pulling its Polaris missiles from service in 1996. The United Kingdom's stockpiles have also been trimmed by between 30-40% from a peak of over 300 weapons in the 1970s to a current total of approximately 200.

While the United Kingdom's nuclear weapons arsenal has always been overshadowed by the much larger American and Soviet/Russian stockpiles, it retains a unique history.

France was the 4th country to become a nuclear weapons state and, despite its relatively small arsenal currently totaling approximately 350 weapons, has been one of the most active testers of nuclear devices. The French nuclear program began informally in the late 1940s after World War II with the production of plutonium at nuclear power plants. It was formally militarized in 1956, with the goal of producing both a weapon, and a missile delivery system (France's Nuclear Weapons, 1-3). The French, like the British did not receive American assistance until well after they created a nuclear weapon, and its initial pursuit for a nuclear deterrent led France to cooperate with a number of outside parties, including the British, who secretly sold the French 10 grams of plutonium in 1955; the Israelis, whose Dimona nuclear plant and a plutonium reprocessing and extraction plant were secretly built by the French in 1958; and the Italians and West Germans, who had originally been invited to join a collaborative research project until the project was made an unilateral affair by President Charles de Gaulle in 1958. The first French device, a fission weapon, was atmospherically tested in Algeria in 1960, followed by 16 underground tests of fission weapons over six years. After the suspension of nuclear tests in Algeria, the French would focus their energies on improving weapons delivery systems and carry out 193 further underground and atmospheric tests in French Polynesia for 40 years (France's Nuclear Weapons, 3-5). Among the tests was France's first test of a thermonuclear weapon, the 2.6 megaton Canopus device. France's atmospheric tests, which continued even after the Cold War, would earn it the ire of both environmentalist groups, as well as every other nuclear state aside from China, which agreed to suspend atmospheric testing in the Partial Test Ban Treaty due to concerns about the levels of radioactive particulates being emitted into the atmosphere. After the Cold War, France followed a similar, albeit more aggressive, program of modernization and more recently reduction of its nuclear stockpile (Boniface 10-24). France has also invested resources in the development of more modern missile delivery systems, and has begun to withdraw its older plane-based weapons from its stockpile. France has also remained relatively aggressive in its policy regarding use of nuclear weapons, using them as an active deterrent against nations threatening French interests, and has recently shifted from the "zero-use" policy of former French President Jacques Chirac. While the French did not have much impact on the development of nuclear weapons, it has had a reasonable impact on the formation of treaties regarding nuclear weapons.

The peoples Republic of China entered into trade agreements with former U.S.S.R. During the early 1950s, China would supply uranium ore for technical assistance in developing a nuclear energy program. After initiating this program, the decision to implement a nuclear weapons program so followed. The same physics applies to all weapons programs as China needed to decide on a gun-type or a implosion device and whether to focus on producing Pu-239 from a reactor or separate U-235. In 1955, China chose to develop a uranium, implosion device. China tested it first fission bomb on October 16, 1964 and its first hydrogen bomb on June 14,1967. (China 1-3) Thus China became the fifth member of the nuclear club in the community of the world and was raised to the level of a superpower. China's motivation for a nuclear weapons program might have been to discourage any potential threats from the former U.S.S.R. and the United States. However, as soon as China became a nuclear weapons state, it began to advocate a no-first use policy of nuclear weapons. As the weapons program progressed, China has developed various delivery systems and miniaturizations of warheads.

South Africa became the first nation in Africa to develop nuclear weapons, as well as the only state to develop and dismantle their entire stockpile. South Africa's nuclear program traces its origins to a secret program by the nation's Atomic Energy Board and continued on into the 1970's in order produce nuclear weapons to act as a deterrent to outside aggressors, primarily Angola, the Soviet Union, Cuba, and a number of hostile guerilla groups participating in a war in then South African-controlled Namibia between 1966-1989, and at the same time force Western support (South 1-4). Due to pressure from both the Soviet Union and the United States, as well as most of the international community, South Africa never formally tested any of the six gun-type devices it built during the project's lifetime. However, there is still considerable suspicion that the South Africans may have secretly tested a nuclear weapon in the Indian Ocean, as the United States Vela satellite recorded a double flash, characteristic of a nuclear explosion, near the Prince Edward Islands to the south of South Africa. It is also commonly alleged that South Africa collaborated with Israel in their efforts to develop nuclear weapons (NTI 1-9). These accusations are not entirely unfounded, as Israel, which was already believed by the CIA in the 1970s to possess nuclear weapons, had traded weapons technology with the South Africans numerous times. This would include an incidence where Israel traded 30 grams of tritium, a common component of nuclear weapons, to South Africa in return of 50 tons of uranium in 1977, and had collaborated in the development of South Africa's RSA-3 missile. Also, both nations have never carried out a publicized test of their nuclear weapons, which has led some to believe that the double flash observed by the Vela satellite in 1977 may have been a joint detonation of a nuclear weapon by Israel and South Africa. South Africa would ultimately scrap their entire arsenal of six weapons, and one being assembled in 1990 under the orders of then-President F.W. de Kierk (South 1-4). This dismantling was done in anticipation of the sweeping political changes in South Africa that would follow with free elections in the coming year. In 1991, South Africa became a signatory to the Nuclear Non-Proliferation Treaty. While South Africa's weapons were destroyed, the expertise and equipment that built them were not, raising concerns about nuclear proliferation (NTI 3). Some reports have suggested that a portion of South Africa's nuclear equipment was sold to a number of outside parties, possibly including Libya. The whereabouts of South Africa's former nuclear technicians are even more disturbing, as individuals who worked for the South African nuclear weapons program were found to be involved with the distribution of techniques and technology needed to produce nuclear weapons under Abdul Qadeer Kahn in

Pakistan to Libya, Iran, and North Korea, and other individuals are believed to be actively working in nuclear weapons programs in the Middle East. South Africa's contributions to the history of nuclear weapons, while easily overlooked, are arguably some of the most relevant to modern concerns about nuclear proliferation.

Israel is unique among all other nuclear weapons states in that it neither confirms nor denies the existence or size of its nuclear stockpile, and is one of four current nuclear weapons states that is not a signatory to the Nuclear Non-Proliferation Treaty, the others being India, Pakistan, and North Korea. While very little is known for certain regarding Israel's history of nuclear weapons, it is generally accepted that the Israeli pursuit for a nuclear deterrent dates back to 1949, when the science division of the Israel Defense Force began geological surveys of the Negev Desert in order to find naturally occurring sources of uranium (Nuclear-Weapons 5). Like many of its counterparts in the nuclear club, Israel's development of nuclear weapons was assisted by outside parties. Known complicit parties included the French, who built the Dimona reactor, also called the Negev Nuclear Research Center, in 1958 in order to fulfill an obligation to the Israelis for their collaboration with the British and French in the Suez Crisis of 1956. A second is the British, who engaged in hundreds of secret sales of fissile material to Israel during the 1950s-1960s. Although it is not fully proven, South Africa is believed to have collaborated with Israel in the 1970s in the exchange of nuclear weapons technology and weapons testing. The actual timetable for Israeli weapon development is fairly vague, some sources suggesting that the Israelis may have produced their first weapons shortly before the Six-Day War in 1967 (Nuclear Weapons 3-4). Israel is also believed to have thermonuclear weapons, based off of an information leak in 1986 by a former member of the Israeli nuclear weapons program. Currently, estimates regarding the size of Israel's nuclear arsenal range between 100-200 warheads, with a variety of missile delivery systems capable of fielding them. The first public revelation regarding a definite Israeli nuclear stockpile came with former Negev Nuclear Research Center employee Mordechai Vanunu (Israel's 2-4). Vanunu claimed that the Dimona facility he worked at not only produced fission weapons, as was already widely speculated, but had also produced fusion weapons. Vanunu's testimony was apparently fairly valid, as he was abducted from Italy by Mossad agents in late 1986 and secretly tried and sentenced to 18 years imprisonment for treason and espionage in 1988. Due to the clandestine nature of the Israeli program, it is not conclusively known whether or not there have been recent developments in the program (Israel 1-2). Some sources have suggested that Israel may have acquired low-yield "bunker buster" nuclear warheads from the United States. While it is not known whether or not Israel's nuclear technicians have been involved in nuclear proliferation beyond South Africa, there is significant concern as to whether or not Israel's nuclear deterrent would be actively employed against a hostile neighboring nation (e.g. Iran or Syria) has nuclear weapons, a scenario which Israeli leadership has called a threat to their nation's very existence. While Israel's history with nuclear weapons remains ambiguous due to the lack of knowledge regarding it, it remains a source of concern due to its unstable surroundings.

India and Pakistan's want for nuclear weapons go hand in hand. The two countries have been in three wars and countless skirmishes in the past 50 years. When one country developed a nuclear weapon naturally, the second was close behind to try to regain a state of balance between the two countries. India took its first step into nuclear research remarkably early. In March of 1944 Dr. Homi Jehangir Bhabha submitted a proposal to create a nuclear research institute. This was a year before any country had even conducted a nuclear weapons test. On September 7, 1972 the Bhabha Atomic Research Center was given the go ahead to manufacture and test a nuclear device. On the 18th of May, 1974 India conducted its first nuclear experiment formally dubbed the "Peaceful Nuclear Explosive" or PNE, but commonly called Smiling Buddha. (India's 1-5). Shortly after this, Pakistan began to conduct nuclear weapons research, and on 6 April 1998, Pakistan conducted its first test of the nuclear weapon dubbed Ghauri. (Pakistan's 1-3). These two countries continue to be tied together in their militaristic choices.

The most recent entrant into the nuclear club, North Korea, has a nuclear weapons program that remains shrouded in mystery North Korea’s nuclear weapons program apparently dates back to 1984, when the hermit nation began to investigate the possible use of its reactors at the Yongbyon Nuclear Scientific Research Center to weaponize fissile material (North 1-2), In the 1990s and the first years of the current decade, the North Korean government began a program of international duplicity, feigning compliance to international demands for North Korea to scrap its nuclear weapons program while secretly continuing work on further research and development, In the midst of its campaign of duplicity, North Korea became increasingly aggressive regarding its aspirations for a nuclear deterrent, culminating in the isolated nation’s withdrawal from the NPT in 2003. On October 9, 2006, the North Korean government issued a statement claiming that it had successfully tested a nuclear weapon (North 2-3). While South Korean and Japanese seismologists did indeed detect seismic activity in North Korea that day, the strength of the activity, 4.2 on the Richter scale, only accounted for an explosion of a magnitude of 800 tons. While atmospheric testing following the test ruled out the possibility that the explosion was conventional in nature, it remains unknown whether the exceptionally low yield was created by the failure for the device to fully detonate, a phenomenon known as a "fizzle", or a deliberately low yield design. Since the October 9th test, a number of developments have taken place regarding North Korea's nuclear weapons program (World 1). One of the most directly related effects was the North Korean shutdown of the Yongbyon plant in September 2007, and more recent attempts to reopen it. Also, the announcement of North Korea's nuclear capability has prompted neighboring South Korea and Japan to explore the possibility of expanding their military forces. Aside from the already hair-raising possibility of North Korea using a nuclear device as a terror weapon via its inaccurate missile systems, North Korea potential to exacerbate nuclear proliferation is equally nightmarish (Japan 1). The cash-strapped nation has already been known to have aided Syria in the attempted construction of a nuclear reactor and is rumored to also be supplying fellow nuclear aspirant Iran with enrichment and missile technology. Even more disturbing is the possibility of the North Korean state selling a completed weapon to terrorist groups for funding, as the results of even a "fizzle" would have the potential to kill thousands through the resulting blast and dispersion of fissile material. Despite its short history with nuclear weapons, North Korea is arguably one of the most active current contributors to nuclear weapons history.

The world community has over 20,000 nuclear weapons in the hands of eight or nine nations. It may require as little as 400 nuclear warheads to destroy mankind and it could begin with a first use scenario, an over-reaction to conventional weapons, an "accident", mistaken intentions, or a non-state player in control of a nuclear weapon. The total elimination of nuclear weapons may not be possible in the immediate future but reaching the SORT goals of 1700 to 2200 deployed strategic weapons is realistic. (Younger 3). However, the first order of business is to renew the Nuclear Nonproliferation Treaty (NPT) next year. The NPT has been signed by 98% of all the nations and has been effective in limiting the vertical and horizontal proliferation of nuclear weapons since 1970. (Younger 1).

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Glossary

- fission – the splitting of uranium or plutonium atoms, releasing energy. This involved hitting a nucleus with a neutron, destabilizing it.
- fusion – combining hydrogen isotopes to create helium, releasing energy, isotopes are deuterium and tritium.
- E=MC^2 – energy = mass x speed of light ^2
- atom – The basic unit of matter, concerning nukes, these are split to release incredible amounts of energy
- alpha decay – decay of an atom releasing a particle consisting of 2 protons and 2 neutrons
- beta decay – particle with a negative charge that comes from the nucleus, released when a neutron becomes a proton
- induced fission – when the decay of a uranium atom is not natural
- enriched – when uranium 235 is separated from uranium 238 to a point
- critical mass – the minimum mass required for a chain reaction for fission
- uranium – element 92, 235 isotope used for nuclear fission, heaviest naturally occurring element
- plutonium – trans-uranium element, could also be used for fission, not as easily fissionable. Must use the implosion type method. Man made radioactive metallic element that is highly toxic. 15 isotopes exist, most important is plutonium-239, which is fissile
- neutron generator – small pellet of polonium and beryllium, separated by foil in the fissionable core. Foil is broken when core comes together and polonium emits alpha particles, which collide with beryllium 9 to create beryllium 8 and neutrons, which induced fission
- tamper – usually made of uranium 238, used to confine the fission reaction, expands by the core, which exerts pressure back on the core and slows the expansion. Also reflects the neutrons back to the core, increasing reaction efficiency
- gun triggered bomb- fires one subcritical mass into another. Small bullet is taken from a sphere of uranium and a barometric pressure determines when it is set off. Bullet is fired down a barrel into the sphere and generator, initiating fission
- implosion triggered bomb – consists of a sphere of U-235 and Plutonium 239 surrounded by high explosives. The explosives go off, creating a shockwave and compressing the core.
- modern implosion bomb – explosions propel subcritical masses into a sphere and a pellet of polonium/beryllium at the center, creating fission
- fusion/thermonuclear bomb – uses a fission reaction to fuse hydrogen isotopes together, creating a higher kiloton yield
- x-rays – majority of radiation giving off in fission, provides the temperatures and pressures to initiate fusion
- half life – amount of time it takes for a half of some material to decay
- teller-ulam fusion bomb – a bomb casing you have an implosion fission bomb and a cylinder casing of uranium-238 (tamper). Within the tamper is the lithium deuteride (fuel) and a hollow rod of plutonium-239 in the center of the cylinder. Separating the cylinder from the implosion bomb is a shield of uranium-238 and plastic foam that fills the remaining spaces in the bomb casing. Detonation of the bomb caused the following sequence of events:

· The fission bomb imploded, giving off X-rays.

· These X-rays heated the interior of the bomb and the tamper; the shield prevented premature detonation of the fuel.
· The heat caused the tamper to expand and burn away, exerting pressure inward against the lithium deuterate.
· The lithium deuterate was squeezed by about 30-fold.
· The compression shock waves initiated fission in the plutonium rod.
· The fissioning rod gave off radiation, heat and neutrons.
· The neutrons went into the lithium deuterate, combined with the lithium and made tritium.
· The combination of high temperature and pressure were sufficient for tritium-deuterium and deuterium-deuterium fusion reactions to occur, producing more heat, radiation and neutrons.
· The neutrons from the fusion reactions induced fission in the uranium-238 pieces from the tamper and shield.

- hypocenter/ground zero – the center of the nuclear bomb blast
- proliferation – the spread of nuclear weapons
- nonproliferation – the attempt to prevent the spread of nuclear weapons to other countries short of military means; includes export controls, material inspections, international treaties, cooperative destruction of past weapon facilities, defense conversion, retraining of workers, and popular education.
- deterrence – actions threatening retaliation taken by a state or group to states to discourage a potential enemy from attacking. These actions, such as deploying nuclear weapons, show the enemy the price of an attack would be too great
- ABACC – Brazil-Argentine Agency for Accounting and Control of Nuclear Materials
- ABM – anti-ballistic missile treaty
- AEC – Atomic Energy Commission
  - atomic – Relating to atoms, the smallest part of an element with all the properties of that element. Consists of protons, neutrons, and electrons.
- atomic bomb –a weapon that uses the fission of isotopes of uranium or plutonium to create an explosion, also known as a nuclear bomb
- ballistic missile – a missile whose flight is powered only in the first segment of its trajectory and then travels unpowered past its apogee into a final stage where it falls to the Earth. Long-range missiles reach their apogee in space and contains a reentry vehicle to protect its payload as it reenters the atmosphere.
- chain reaction – a self-sustaining process that occurs when a critical mass of a fissile isotope is bombarded with neutrons and splits into lighter elements
- CIA – Central Intelligence Agency
- confidence-building measures – Actions agreed to by states to reduce tension between them and avoid conflict. Can include communication agreements, limits on activities in certain areas, data exchanges, and inspections.
- counterproliferation – military efforts to destroy, damage, or render unusable facilities, material, or troops associated with weapons of mass destruction, particularly against countries not possessing such weapons
- cruise missile – an unmanned missile that typically flies slowly and close to the ground and is powered by conventional fuel and an air-breathing motor. Can be launched from the ground, ships, submarines, and aircraft and could be equipped to deliver nuclear, biological, chemical, or conventional payloads

- CTBT – Comprehensive Nuclear-Test-Ban Treaty
- CTBTO – Comprehensive Nuclear –Test-Ban Treaty Organization
- CTR – cooperative threat reduction
- DCI – Director of Central Intelligence
- de-alerting – in regard to nuclear weapons, to take steps that would make immediate launch of a country's missiles impossible. According to supporters, these actions – which include separated the warhead from the missile in storage – would improve stability in a crisis and reduce the chance of an accidental launch
- dirty bomb – a weapon combing conventional explosives with radioactive materials in order to contaminate an area. These do not use nuclear reactions and are used by organizations unable to create a fission or fusion bomb
- DOD – department of defense (USA)
- DOE – Department of Energy (USA)
- downblend – a process through which nuclear material with a higher enrichment level is converted into a material with a lower enrichment level, typically weapons-grade material to nuclear fuel
- DPRK – Democratic People's Republic of Korea (N. Korea).
- DTRA – Defense Threat Reduction Agency (USA).
- enrichment – the process of increasing the concentration of one isotope of a given element, ex uranium 235
- Entry-into-force – The date on which all the provision of a treaty become legally binding on its parties. Normally requires a certain majority of states eligible for a treaty both to sign and ratify the agreement.
- EURATOM – European Atomic Energy Community
- first strike – the launch of a surprise attack on an opponent's nuclear forces to destroy or weaken their military capabilities and therefore reduce the ability to retaliate
- fissile material – substances possessing nuclei with a greater tendency to give off electrons and energy when bombarded by neutrons, enabling them to sustain a chain reaction. Ex uranium 235 and plutonium 239
- FMCT – fissile material cutoff treaty
- gaseous diffusion – a method of separating isotopes that uses the fact that gas atoms with different masses diffuse through a porous barrier at different rates. Used to separate U-235 from U-238
- heavy water – water whose hydrogen atoms contain an extra neutron compared to ordinary water. Heavy water is used as a moderator in uranium reactors, allowing them to imbed themselves in fissile atoms. The imbedded neutrons is a more effective moderator than normal water and does not have to be enriched to be used in a heavy-water reactor. Is also used as a coolant
- Highly enriched uranium (HEU) – Uranium in which the percentage of U-235 has been increased to a higher level than naturally occurring uranium (.7%) to some level greater than 20% through a process such as gaseous diffusion, for the purpose of creating a chain reaction. To maximize efficiency of the reaction, nukes usually have 90% concentration of U-235 and reactors have a lower level
- horizontal proliferation – the spread of nukes to states that currently do not have them

- hydrogen bomb – bomb that uses fusion, rather than fission, to create energy. Also known as thermonuclear bombs
- IAEA – International Atomic Energy Agency
- ICBM – intercontinental ballistic missile
- INF – Intermediate-range nuclear forces treaty
- isotopes – atoms of the same element with different atomic weights
- KEDO – Korean Peninsula Energy Development Organization
- kilogram – metric weight equal to 2.2 pounds
- kiloton – 1000 tons. With nuclear weapons, it is described as the amount of explosive power; 1 kiloton nuclear explosion is power of 1000 tons of TNT
- light-water reactor – nuclear reactor that uses conventional water as coolant and the moderator. These reactors normally use uranium enriched to 3% and create electricity by turning water to steam to run turbine generators
- low-enriched uranium – material that has undergone the industrial process to increase the amount of U-235 to over .7% but under 20%
- LWR – light water reactor
- megawatt (MW) – measure of energy equal to 1000000 watts. MW electric (MWe) refers the potential electrical power that could be generated by a reactor. MW thermal (MWt) refers to the amount of heat a reactor could generate and is larger than the MWe rating. Power reactors are generally listed in MWe and research reactors as MWt
- metric ton – 1000 kilograms, equals 1.1 tons
- MIRV – multiple independently targetable reentry vehicle. Describes multiple warhead ballistic missiles, each which would target different things after reentry
- MTCR – Missile Technology Control Regime
- NATO – North Atlantic Treaty Organization
- NIS – newly independent states (of the Soviet Union)
- NNWS – non-nuclear weapon state
- NORAD – North American Air (later Aerospace) Defense Command
- NPT Treaty on the Non-Proliferation of Nuclear Weapons/Nuclear Non-Proliferation Treaty
- NSC – National Security Council
- NSG – Nuclear Suppliers Group
- nuclear reactor – a device in which a controlled, self-sustained nuclear chain reaction can be maintained and the heat generated by extracted to provide energy for civilian purposes. Can also create fissional material (ex. Plutonium that can be used as a source of fissile material for weapons. 3 categories of reactors: power reactors (for electricity), production reactors (for plutonium 239), and research reactors (to supply neutrons for experiments)
- nuclear weapons – a collective term for atomic bombs, hydrogen bombs
- NWFZ – nuclear weapon free zone
- NWS - nuclear weapon state
- OPANAL – Agency for the Prohibition of Nuclear Weapons in Latin American and the Caribbean
- PAL – permissive action link
- PNE – peaceful nuclear explosion
- PSI – proliferation security initiative

- radioactivity – the spontaneous release of energy from the nucleus of an atom. Energy released in the form of beta or alpha emissions results in the transformation of an atom into a different element
- ratification – the formal process established by a country to legally bind its government to the terms of a treaty. Normally involves the approval of a certain percentage of parliament or other legislative body (ex. In the U.S., requires 2/3 of the Senate
- reprocessing – chemical treatment of irradiated reactor fuel to separate uranium and plutonium from the unwanted radioactive waste and from each other
- research reactors – small fission reactors built to produce neutrons for purposes such as scientific research, medical isotope production, and training. Many research reactors use highly enriched uranium
- SAC – Strategic Air Command
- safeguards – in the nuclear field, mechanisms to prevent the theft or diversion of fissile material. These can include antitamper technologies, such as tags and seals on containers holding such materials, as well as certain procedures such as the periodic inspections of the facilities, the use of cameras and motion detectors, and the requirement of a "two person" rule for the handling of any material
- SALT – Strategic Arms Limitation Talks
- SDI – Strategic Defense Initiative
- signature – the initial approval of a treaty by a country's official representative (ex president or secretary of state) indicating that the country agrees to the terms of the treaty. States are not legally bound by a treaty until the ratification is completed but, in common international practice, may be under an assumed moral obligation not to comply with treaty obligations while the ratification process is taking place
- SLBM – submarine-launched ballistic missile
- SORT – U.S.-Russian Strategic Offensive Reduction Treaty or Moscow Treaty
- SSBN – nuclear-powered ballistic missile submarine
- START – Strategic Arms Reduction Treaty
- STRATCOM – U.S. Strategic Command
- strategic nuclear weapons – nuclear armaments deployed for the purpose of deterring an attack on a country's homeland and/or to attack another country's homeland. During the Cold War, US and Soviet strategic nuclear warheads were placed on long-range delivery systems, including land-based intercontinental ballistic missiles (with ranges greater than 5,000 km), submarine-launched ballistic missiles, and long-range bombers. The US and Russia still maintain 1000s of these weapons. For countries whose enemies are located close by, strategic and tactical nuclear weapons may be synonymous
- tactical nuclear weapons – nuclear armaments intended for use in short-range battlefield situations. Ex.- nuclear land mines, nuclear artillery shells, and earth-penetrating nuclear bombs to destroy underground bunkers. Yields range from >1 kiloton to 10s or hundreds of kilotons
- thermonuclear weapon – also known as the hydrogen bom
- U-235 – uranium 235
- UN – United Nations
- UNMOVIC – UN Monitoring, Verification, and Inspection Commission
- UNSCOM – UN Special Commission on Iraq

- verification – the process of collecting data to demonstrate whether or not a state has complied with a treaty or agreement. Means for verifying treaty compliance include satellites, seismic monitoring, on-site inspections, and intelligence gathering.
- vertical proliferation – increase in the size or destructive capacity of existing nuclear weapons arsenal
- Weapons of Mass Destruction (WMD) – Armaments capable of inflicting large-scale casualties and whose effects are indiscriminate between military and civilian victims. Typically describes nuclear, biological, and chemical weapons
- weapons-grade – fissile material of the type most suitable for producing a chain reaction and nuclear explosion (uranium with 90% U-235 and plutonium with 93% plutonium 239)
- yield – total energy released from a nuclear explosion

Sources:
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