The Neutron Bomb

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Abstract:

A *Neutron Bomb is* a new type of neuclear weapons which is totally different from other types, and has irrational properties.

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Introduction

Scientists have noticed the great use of radiation. So recently, it has been deployed in technology. As a result, it is wildly used in our life. Ordinary people worldwide understand the great perils of nuclear weapons, and lots of these weapons are classified in certain types.

The newest and the most mysterious type is the *Neutron Bomb.*

However, we still do not know how dangerous it is so far, but we can predict.

This issue is going to be discussed deliberately in this seminar to clarify some features.

The Neutron Bomb! Is it easy to be deployed in wars?

How dangerous is it? If it is tremendously dangerous, how could it be in that level of danger?

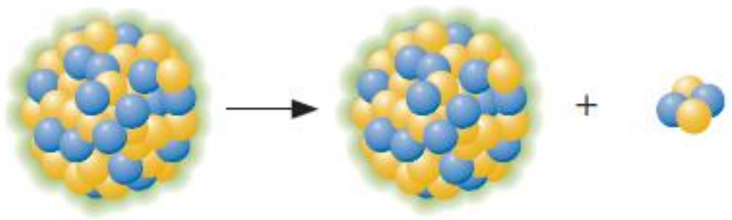
First of all, you have to know the Types of Radioactive Decay.

Types of Radioactive Decay

[1][1]There are six common types of radioactive decay:

1: *Alpha emission:* (abbreviated α) emission of $^{4}_{2}He$ nucleus, or alpha particle, from an unstable nucleus.

1. [1] Control, L.o.C., et al., *General Chemistry ninth edition* ed. D.E.K. Heinle and A.E.A. Galvin. 2009, U.S.A.: Houghton Mifflin Company Boston New York Executive Publisher: George Hoffman .Publisher: Charles Hartford



$$^{226}_{88}Ra \longrightarrow ^{222}_{86}Rn + ^{4}_{2}He$$

2: *Beta emission*: (abbreviated β^-) emission of a high-speed electron from an unstable nucleus. Beta emission is equivalent to the conversion of a neutron to a proton.

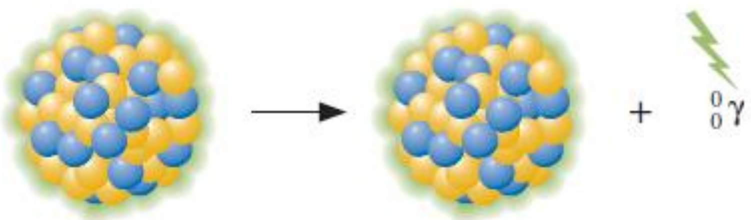
$$^{1}_{0}n \longrightarrow ^{1}_{1}p + ^{0}_{-1}e$$

$$^{1}_{0}n \longrightarrow ^{1}_{1}p + ^{0}_{-1}e$$

3: *Positron emission*: (abbreviated β^+) emission of a positron from an unstable nucleus. A positron, denoted in nuclear equations as $^{0}_{1}e$ is a particle identical to an electron in mass but having a positive instead of a negative charge. Positron emission is equivalent to the conversion of a proton to a neutron.

$$^{1}_{1}p \longrightarrow ^{1}_{0}n + ^{0}_{1}e$$

4: *Gamma emission*: (abbreviated γ) emission from an excited nucleus of a gamma photon, corresponding to radiation with a wavelength of about 10_12 m. In many cases, radioactive decay results in a product nucleus that is in an excited state. with the emission of electromagnetic radiation. For nuclei, this radiation is in the gamma-ray region of the spectrum.

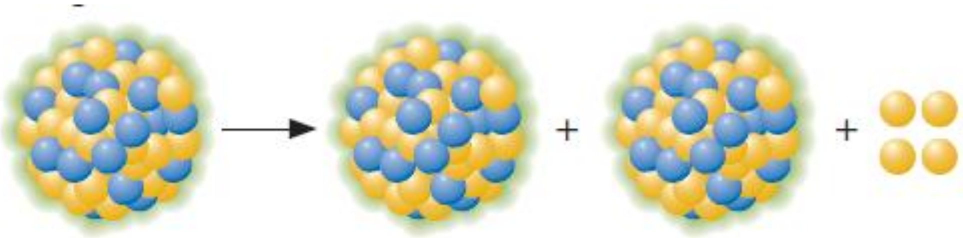


$$^{99m}_{43}Tc \longrightarrow ^{99}_{43}Tc + ^{0}_{0}\gamma$$

5: *Electron Capture*: (abbreviated EC) the decay of an unstable nucleus by capturing or picking up, an electron from an inner orbital of an atom. In effect, a proton is changed to a neutron, as in positron emission.

$$^{1}_{1}p \longrightarrow {}^{0}_{1}e^{-} + {}^{1}_{0}n$$

Heavy nucleus of mass number greater than 89 splits into lighter nuclei and energy is released.



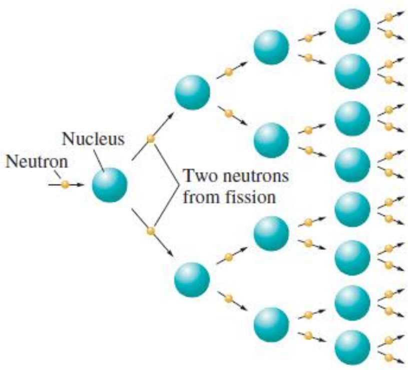
$$^{236}_{92}U \longrightarrow {}^{96}_{39}Y + {}^{136}_{53}I + 4{}^{1}_{0}n$$

Nuclear Fission and Nuclear Fusion

[1]

- [2]*Nuclear Fission:*

The nuclear fission is the process whereby the nucleus of a particular heavy element is struck by a neutron splits into (generally) two nuclei of lighter elements nucleus.[3]



Nuclear Fission

Figure 1:the nuclear fission

[2] Ibid. 1.
[3] Handbook

- *Neclear Fusion:*

Large amounts of energy can be obtained by combining light nuclei into a heavier nucleus by nuclear fusion.

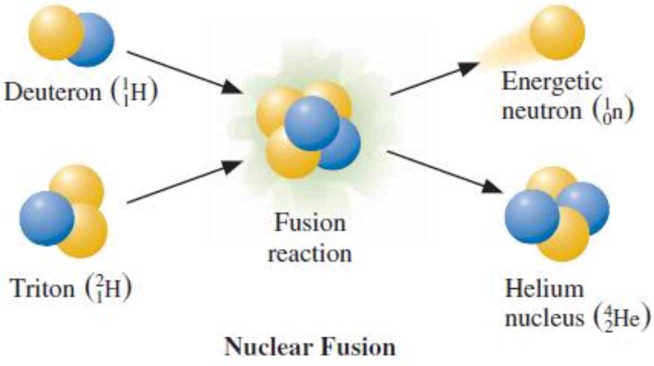
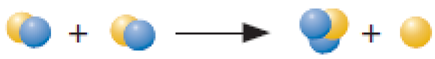


Figure 2:the nuclear fusion

To get the nuclei to react, the bombarding nucleus must have enough kinetic energy to overcome the repulsion of electric charges of the nuclei.



$$^{2}_{1}H + ^{2}_{1}H \longrightarrow ^{3}_{2}He + ^{1}_{0}n$$

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n$$

Figure 3:equations of fusion

. A plasma is an electrically neutral gas of ions and electrons.

The hydrogen bomb also employs nuclear fusion for its destructive power. High temperature is first attained by a fission bomb. This then ignites fusion reactions in surrounding material of deuterium

Another way to give nuclei sufficient kinetic energy to react is by heating the nuclear materials to a sufficiently high temperature.For practical purposes, the temperature will have to be about 100 million °C. At this temperature, all atoms have been stripped of their electrons, so a *plasma* results.At 100 million °C, the plasma is essentially separate nuclei and electrons.

History of the neutron bombs

[4] [2]In thr 20th century, Jews created bombs. Weapons of mass destruction Most famously, there was J. Robert Oppenheimer who ran the Manhattan Project, which gave the world the atom bomb. After him came Edward Teller, the Hungarian Jew who engineered an incredibly destructive upgrade: the hydrogen bomb.

And then there was Samuel T. Cohen, the lesser-known Jewish physicist who rounds off this troika but whose invention, the neutron bomb. Like the other two, Cohen, a Manhattan Project veteran, was present at the creation.

Cohen was born in Brooklyn in 1921 to Jewish immigrants who had moved there from Austria via the poor East End of London, and died on November 28, 2010 at the age of 89, and received the requisite New York Times obituary in recognition of his unique contribution to the technology of mass killing.

[3, 4] 5 Summer 1958- While conducting researching on developing a large thermonuclear weapon, Sam Cohen introduces the idea of removing the uranium casing from a hydrogen bomb to allow neutrons to travel great distances and penetrate even heavily shielded armor and structures.

6[5]The neutron bomb, or "enhanced radiation" device with its supposed promise of a "clean" kill was believed to be the strategic answer to a hole in the Cold War arsenal

The key to his "moral weapon" was in the redesign of the bombshell and its components, limiting the effects of the blast and releasing even more energy in the form of neutrons — subatomic particles that would go through tanks and buildings but would kill any living thing in less than an hour.

Cohen believed that this was a way to make nuclear weapons more tactical and limit the incredible devastation caused by Teller's giant hydrogen bomb. The neutron bomb could be deployed in such a way that its effects would be felt by only enemy soldiers (and any hapless civilians) within a limited geographical area.

Six different presidents refused to even consider Cohen's bomb. Ronald Reagan was the first to warm to the concept and a version of the neutron bomb was created. But George H.W. Bush, not long after taking office, destroyed the weapon's entire stock.

Cohen's lifelong struggle to get presidential administrations to give an honest hearing to his ideas made him untrusting of government.

But Cohen ascribed great significance to these childhood experiences, writing in his memoir that it was no coincidence that he became fascinated with the side effects of nuclear weapons on human beings. Because of his mother, he experienced during his

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Beckerman, G., *Creator of Neutron Bomb Leaves an Explosive Legacy*, in http://forward.com/ 2. [4]
2011, Forward: http://forward.com/

./NeuclearFiles, et al., *the neutron bomb*. 2015: http://www.nuclearfiles.org .4 [5]

.BBC, *Neutron bomb: Why 'clean' is deadly.* BBC, 2015(the neutron bomb) .5 [6] childhood constant bouts of nausea and diarrhea — the primary symptoms of exposure to radiation.

"As to what extent this loving upbringing of mine affected my interest, make it obsession, in nuclear weapons whose principle effect was radiation, your guess is as good as mine," Cohen wrote in his memoir. "Was this obsession over radiation an expression of the most insidious revenge I could think of against a monstrous enemy that had brutally attacked my beloved country and countrymen?

Cohen took an unusual path to this field. He had just received his bachelor's degree in physics from the University of California, Los Angeles, when World War II broke out. The Army sent him to the Massachusetts Institute of Technology and then to Los Alamos to help on the Manhattan Project. He worked there on "Fat Man," the bomb that would be dropped on Nagasaki. There he saw Oppenheimer and Teller and the many other Jewish physicists who were building the deadliest weapon ever devised.

Cohen, who never got a doctorate, said he invented the neutron bomb in 1958, using "a simple slide rule my dad had given me on my fifteenth birthday."

> A choice quotes from his published book 'As for my inventing the neutron bomb, over my dead body will I admit to any feeling of shame.'

Although the idea met fierce criticism _one American president after another thought it would shift the balance of power between the United States and the Soviets to such a degree as to be dangerous_ Cohen promoted his weapon relentlessly through his work at RAND, and continued once he was forced into an early retirement from the think tank in 1969, after his superiors grew annoyed with his incessant attempts to bring nuclear weapons to the battlefield. Only in 1981 did Reagan take Cohen on as a policy adviser early in his presidency and agree to develop 700 neutron bombs. But, according to Cohen's memoir, they were designed in such a way that they undermined his purpose, exploding close enough to the ground to cause more damage than he intended. The weapon was never integrated into America's arsenal and was eventually scraped completely by George H.W. Bush. By then, Cohen had retired.

[7][6]The warheads were never deployed in Europe, and U.S. production ceased in the 1980s. By the 1990s, with the Cold War confrontation over, both the missile warheads and artillery shells were withdrawn.

Other countries tested neutron bombs during the 1970s and '80s, including the Soviet Union, France, and China (the latter possibly using plans stolen from the United States).

[7] .6 .staff, B.s.e., *the neutron bomb.* Encyclopedia Britannica, 2015(neauclear weapons)

[8] [7] *Types of nuclear bombs*

1: *Pure Fission Weapons:*

These are weapons that only use fission reactions as a source of energy. Fission bombs operate by rapidly assembling a subcritical configuration of fissile material (plutonium or enriched uranium) into one that is highly supercritical. The original atomic bombs tested in 16 July 1945 (device name: Gadget, test name: Trinity) and dropped on Japan in 6 August 1945 (Little Boy, over Hiroshima) and 9 August 1945 (Fat Man, over Nagasaki) were pure fission weapons.

These are the easiest nuclear weapons to design and manufacture, and the capability to do so is a prerequisite for developing any of the other weapon types.

There are practical limits to the size of pure fission bombs. Larger bombs require more fissionable material, which becomes increasingly difficult to maintain as a subcritical mass before detonation.

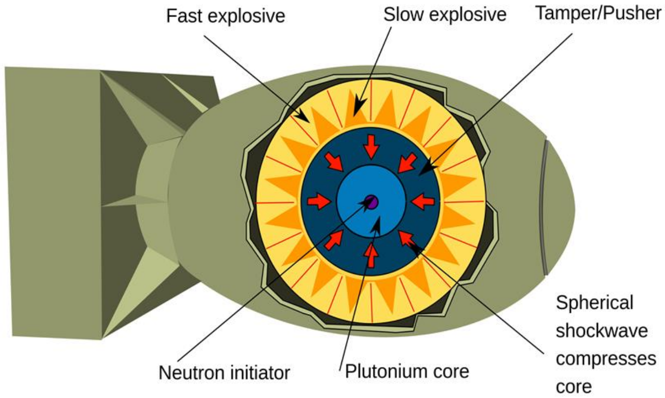


Figure 4 Fat Man Bomb's design

2: *combined Fission/Fusion Weapons:*

[8] Sublette, C., *Nuclear Weapons Frequently Asked Questions.* 1998(Nuclear Weaponss). 7.

All nuclear weapons that are not pure fission weapons use fusion reactions to enhance their destructive effects. All weapons that use fusion require a fission bomb to provide the energy to initiate the fusion reactions. This does not necessarily mean that fusion generates a significant amount of the explosive energy, or that explosive force is even the desired effect.

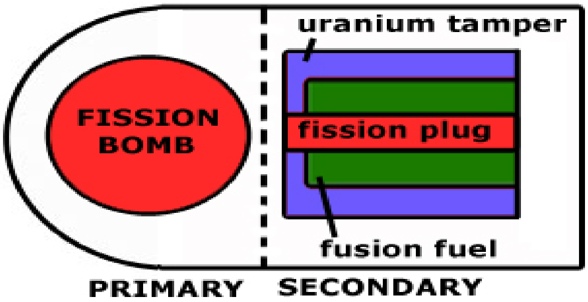


Figure 5 combined fission/fusion bomb's design

Boosted Fission Weapons:

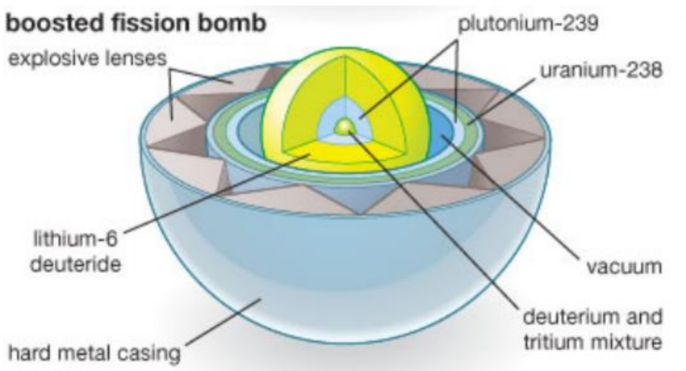


Figure 6 boosted fission bomb's design

The earliest application of fusion to useful weapons was the development of boosted fission weapons. In these weapons a few grams of a deuterium/tritium gas mixture are included in the center of the fissile core. When the bomb core undergoes enough fission, it becomes hot enough to ignite the D-T fusion reaction which proceeds swiftly. This reaction produces an intense burst of high-energy neutrons that causes a correspondingly intense burst of fissions in the core. This greatly accelerates the fission rate in the core, thus allowing a much higher percentage of the material in the core to fission before it blows apart. Typically no more than about 20% of the material in an average size pure fission bomb will split before the reaction ends (it can be much lower, the *Hiroshima bomb* was 1.4% efficient). By accelerating the fission process a boosted fission bomb increase the yield 100% (an unboosted 20 kt bomb can thus become a 40 kt bomb). The actual amount of energy released by the fusion reaction is negligible, about 1% of the bomb's yield, making boosted bomb tests difficult to distinguish from pure fission tests (detecting traces of tritium is about the only way).

Staged Radiation Implosion Weapons:

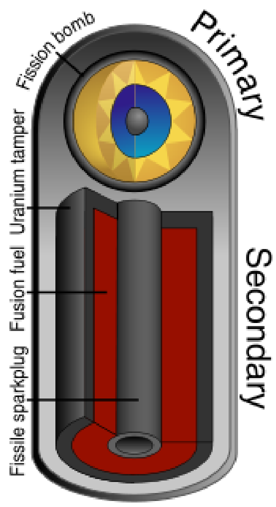
This class of weapons is also called "Teller-Ulam" weapons, or (depending on type) *fission-fusion* or *fission-fusion-fission* weapons. These weapons use fusion reactions involving isotopes of light elements (e.g. hydrogen and lithium) to remove the yield limits of fission and boosted fission designs, to reduce weapon cost by reducing the amount of costly enriched uranium or plutonium required for a given yield, and to reduce the weight of the bomb. The fusion reactions occur in a package of fusion fuel ("the secondary") that is physically separate from the fission trigger ("the primary"), thus creating a two-stage bomb (the fission primary counting as the first stage). X-rays from the primary are used to compress the secondary through a process known as radiation implosion. The secondary is then ignited by a fission "spark plug" in its center. The energy produced by the fusion second stage can be used to ignite an even larger fusion third stage. Multiple staging allows in principle the creation of bombs of virtually unlimited size.

The fusion reactions are used to boost the yield in two ways:

_ By directly releasing a large amount of energy in fusion reactions.

_ By using high-energy or "fast" neutrons generated by fusion to release energy through fission of a fissionable jacket around the fusion stage. In the past this jacket was often made of natural or depleted uranium, so that energy is produced by fast fission of cheap U-238. Thorium may also be used for this purpose.

Bombs that release a significant amount of energy directly by fusion, but do not use fusion neutrons to fission the fusion stage jacket, are called Fission-Fusion weapons. If they employ the additional step of jacket fission using fusion neutrons they are called Fission-Fusion-Fission weapons. .



Teller-Ulam bomb's design5 Figure

Figure 6:Fissin bomb designs: boosted fission bomb's design

The Alarm Cock/sloika (Layer Cake):

This system was dubbed "Layer Cake" by the Soviets because it uses a spherical assembly of concentric shells. In the center is a fission primary made of U-235/Pu-239, surrounding it is an (optional) layer of U-238 for the fission tamper, then a layer of lithium-6 deuteride/tritide, a U-238 fusion tamper, and finally the high explosive implosion system. The process begins like an ordinary implosion bomb. After the primary in the center completes its reaction, the energy it releases compresses and heats the fusion layer to thermonuclear temperatures. The burst of fission neutrons then initiates a coupled fission-fusion-fission chain reaction. Slower fission neutrons generate tritium from the lithium, which then fuses with deuterium to produce very fast neutrons, that in turn cause fast fission in the fusion tamper, which breed more tritium. In effect the fusion fuel acted as a neutron accelerator allowing a fission chain reaction to occur with a large normally non-fissionable U-238 mass. While spiking the fusion layer with an initial dose of tritium is not strictly necessary for this approach, it helps boost the yield.

This design should probably be considered distinct from other classes of nuclear weapons. This design is something of a hybrid and could be considered either a type of boosted fission device, or a one-stage type of fission-fusion-fission bomb.

Cobalt Bombs and other salted Bombs:

A "salted" nuclear weapon is reminiscent of fission-fusion-fission weapons, but instead of a fissionable jacket around the secondary stage fusion fuel, a non-fissionable blanket of a specially chosen salting isotope is used (cobalt-59 in the case of the cobalt bomb). This blanket captures the escaping fusion neutrons to breed a radioactive isotope that maximizes the fallout hazard from the weapon rather than generating additional explosive force (and dangerous fission fallout) from fast fission of U-238.

But ….

What is the Neutron Bomb?

[6] [9] *Neutron bomb*,also called enhanced radiation warhead(ER), specialized type of nuclear weapon that would produce minimal *blast* and heat but would release large amounts of lethal radiation which can penetrate armor or several feet of earth,

[4][10]which means,it maximizes damage to people but minimizes damage to buildings and equipment. [8]Thus, neutron bombs are generally seen more as a tactical nuclear weapon than a strategic one. Due to this focus on tactical us.

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staff, B.s.e., *the neutron bomb.* Encyclopedia Britannica, 2015(neauclear weapons). 6. [9]

NeuclearFiles, et al., *the neutron bomb*. 2015: http://www.nuclearfiles.org/. 4. [10]

Simply, *Cohen* argued that if the *uranium* casing of a *hydrogen bomb* were removed, the neutrons released would travel great distances, penetrating even well-shielded structures with lethal doses of radiation and harming anyone inside.[6][11] within a somewhat a radius of 1,000–2,000 meters the fusion reaction would throw off a powerful wave of neutron and *gamma* radiation.

[6][12]Actually, it is a small thermonuclear bomb in which a few kilograms of *plutonium* or *uranium*, ignited by a conventional explosive, would serve as a fission "trigger" to ignite a fusion explosion in a capsule containing several grams of *deuterium-tritium.* [13][8]Then, as we mentioned, the resulted neutrons will not be absorbed inside the weapon, but allowed to escape. The X-ray mirrors and shell of the weapon are made of chromium or nickel so that the neutrons are permitted to escape. This intense burst of high-energy neutrons is the principle destructive mechanism..

The term "**enhanced radiation**" refers only to the burst of ionizing radiation released at the moment of detonation, not to any enhancement of residual radiation in fallout (contrast this with salted bombs).

[11] 6. staff, B.s.e., *the neutron bomb.* Encyclopedia Britannica, 2015(neauclear weapons).
[12] 6. Ibid.
[13] 8. W.M.C. and S. Cohen, *The Truth About the Neutron Bomb: The Inventor of the Bomb Speaks Out,* . 1983(the neutron bomb).

Two units are commonly used to measure exposure to radiation. The **gray** (Gy), the SI unit of absorbed dose, corresponds to the absorption of 1 J of energy per kilogram of tissue. The **rad** (*r*adiation *a*bsorbed *d*ose) corresponds to the absorption of 1 * 10–2 J of energy per kilogram of tissue. Thus, 1 Gy = 100 rad. The rad is the unit most often

The Neutron Bomb ia also called "Landlord Bomb"

Design of a Neutron Bomb:

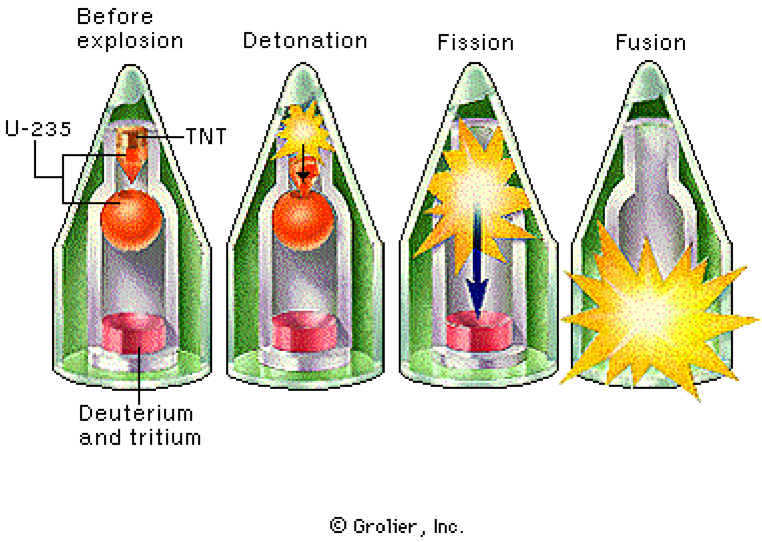

Figure 7 Design of a neutron bomb

The consequences of the Neutron Bomb

[14][9]In general, a nuclear detonation produces effects that are overwhelmingly more significant than those produced by a conventional explosive.

Office of the Under Secretary of Defense for Acquisition, T.a.L., *the effect of nuclear weapons*. 9. [14]

[15][10]Blast:

The rapid release of energy in an explosion creates a shock wave of overpressure. Very close to the centre of a nuclear explosion, overpressure is equivalent to several thousand pounds per square inch (psi). This is hundreds of times greater than the pressure in a pressure cooker.

[16][9] Nuclear yields:

In general, the energy released in the detonation of a nuclear weapon, measured in terms of the kilotons or megatons of trinitrotoluene (TNT) required to produce the same energy Release.

Yields are categorized as follows:

very low: less than 1 kiloton

low: 1 kiloton to 10 kilotons

medium: over 10 kilotons to 50 kilotons

high: over 50 kilotons to 500 kilotons; and

very high: over 500 kilotons.

For our bomb, it causes very high nuclear yields, but we don't know the exact measurement because it hasn't deployed yet.

[17][11]When matter absorbs radiation, the radiation energy can cause atoms in the matter to be either excited or ionized. In general, we call this radiation an *ionizing radiation*, is far more harmful to biological systems than radiation that does not cause ionization.the

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Office of the Under Secretary of Defense for Acquisition, Technology and Logistics The nuclear matters handbook

[15] 10. NeuclearFiles, D. Krieger, and N.A.P.F. President, *effects of a nuclear weapon on a target.* NuclearFiles.org, 2015(the nuclear weapons).

[16] 9. Office of the Under Secretary of Defense for Acquisition, T.a.L., *the effect of nuclear weapons*.

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[17] 11. Brown, T., et al., *The Central Science 13TH Edition*. The cntral sciense, ed. C.A.J. Editor in Chief, et al. 2015, United states.

nonionizing radiation, and we found that the resulted radiation from the *neutron bomb* is ionizing.which means , it is very dangerous.

So, these high-energy *neutrons*, though short-lived, could penetrate armour or several metres of earth and would be extremely destructive to living tissue. Because of its short-range destructiveness and the absence of long-range effects, the neutron bomb might be highly effective against tank and infantry formations on the battlefield.

In other words,most living tissue contains at least 70% water by mass.When ionizing radiation passes through living tissue, electrons are removed from water molecules, forming highly reactive $H2O^+$ ions. An $H2O^+$ ion can react with another water molecule to form an H_3O^+ ion and a neutral OH molecule:

$$H_2O^+ + H_2O \longrightarrow H_3O^+ + OH$$

In cells and tissues, hydroxyl radicals can attack biomolecules to produce new free radicals, which in turn attack yet other biomolecules. Thus, the formation of a single hydroxyl radical can initiate a large number of chemical reactions that are ultimately able to disrupt the normal operations of cells.

Actually,the damage produced by radiation depends on the activity and energy of the radiation, the length of exposure, and whether the source is inside or outside the body. *Gamma rays* are particularly harmful outside the body because they penetrate human tissue very effectively, just as *X rays* do. Consequently, their damage is not limited to the skin. In contrast, most *alpha rays* are stopped by skin, and *beta rays* are able to penetrate only about 1 cm beyond the skin surface.Neither *alpha rays* nor *beta rays* are as dangerous as *gamma rays*, therefore, unless the radiation source somehow enters the body. Within the body, *alpha rays* are particularly dangerous because they transfer their energy efficiently to the surrounding tissue, causing considerabl damage.

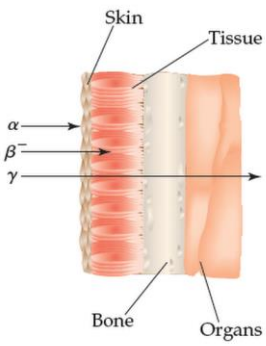

Figure 7:α,β and γ radiation

In general, the tissues damaged most by radiation are those that reproduce rapidly, such as bone marrow, blood-forming tissues, and lymph nodes. The principal effect of extended exposure to low doses of radiation is to cause cancer. *Cancer* is caused by damage to the growth-regulation mechanism of cells, inducing the cells to reproduce uncontrollably. *Leukemia*, which is characterized by excessive growth of white blood cells, is probably the major type of radiation-caused cancer.

[18][8]We can summarize this if we say that the *neutron bomb* kills all living things while leaving the infrastructure relatively intact. Though a neutron bomb does cause infrastructure damage and some long term radiation

Neuclear weapons and international humanitarian law

[4][19]The values and roles still assigned to nuclear weapons—deterrence, power, prestige, and wealth—are grounded in a state-centric, balance-of-power world view that does not comport with the globalized interdependency of the modern world and assumes that economic and technological power centered on militarism constitutes a viable long-term trajectory. Furthermore, the risk of proliferation remains high as long as some states maintain nuclear weapons; the root causes of regional or international insecurity cannot

W.M.C. and S. Cohen, *The Truth About the Neutron Bomb: The Inventor of the Bomb Speaks* , .8 [18]
.*Out,* . 1983(the neutron bomb)
NeuclearFiles, et al., *the neutron bomb*. 2015: http://www.nuclearfiles.org/. 4. [19]

be resolved by governments that have the means to posit an existential threat over others. The challenge of eliminating nuclear weapons will be greatly aided by their delegitimization, which requires a new discourse about security, as well as nuclear weapons themselves.

A remarkable and welcome outcome of the 2010 NPT Review Conference was that the final document included language expressing "deep concern at the catastrophic human consequences of any use of nuclear weapons" and reaffirming "the need for all States at all times to comply with applicable international law, including international humanitarian law."

The Review Conference statement strongly implies the illegality of nuclear weapons in any circumstance, advancing the 1996 advisory opinion of the International Court of Justice (ICJ). It without question develops the norm of non-use of nuclear weapons. Indeed, when combined with the practice of non-use since the US atomic bombings of Japanese cities, the provision strengthens the case for a customary legal obligation categorically prescribing non-use. In effect, the Review Conference takes the ICJ opinion further than did the Court itself. While the ICJ opinion stopped at stating that the threat or use of nuclear weapons is "generally contrary" to international law, the Review Conference links the catastrophic humanitarian consequences of "any" use of nuclear weapons with the call for compliance with law "at all times," implying that use of nuclear weapons is unlawful in all circumstances. The Review Conference's statement reinforces the moral unacceptability and presumptive unlawfulness of any use of nuclear weapons.

Important glossary:

X-ray:

Electromagnetic radiations of high energy having wavelengths shorter than those in the ultraviolet region.

Conclusion

All in all, to encapsulate the whole matter we can say that the *Neutron Bomb* is a special type of nuclear weapons which produces less blast and heat than other types; they are considered more as a tactical nuclear weapon than a strategic one, and at the same time it produces large amounts of lethal radiation, which means a great threat of our future if it

is used somehow.

This dangerous bomb has never deployed in wars. Therefore, we cannot precise the immense range of the disaster that might happen, we just can predict.

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