

HISTORY AND DEVELOPMENT OF NUCLEAR WEAPONS

ИСТОРИЯ И РАЗВИТИЕ НА ЯДРЕНОТО ОРЪЖИЕ

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Abstract: An overview of the emergence and development of nuclear weapons has been made since its creation to the present day. Described are the attempts and consequences of using this weapon. What are the accumulated capacities in the world and what is their prospect for mankind? Described are the parameters of the current nuclear abatement agreements.

Keywords: control monitoring, radiation control, radiological risk, radionuclides, radiometric measurements, gamma background

1. Introduction

The nuclear weapon is the main powerful weapon of mass destruction of the enemy.

The energy of explosion of the charge of the normal explosive substance (BB) is released as a result of a chemical reaction, during which the explosive molecules become more resistant molecules of the explosive products. In these explosions the atoms do not undergo any alteration. In the nuclear explosion, the source of energy is nuclear reactions, resulting in which atoms of some elements are transformed into atoms of other elements.

Nuclear blasts are used to:

- the critical reaction of the division of the core elements;
- the reaction to the synthesis of the light element nuclei (thermonuclear reaction).

Chain reaction of division

A chain reaction of nucleation is called a reaction which, starting with one or more cores, can continue in the substance without external action, i.e., self-sustaining.

The division of atomic nuclei into nuclear munitions is under the influence of non-drones.

The heavy nucleus, affecting the neutron, becomes unstable and is divided into two parts, representing nuclei of the atoms of the lighter elements (Figure 1).

The division of the core is accompanied by the release of a significant amount of nuclear energy and the release of the two or three neutrons called secondary. Secondary neutrons are capable of dividing two or three new cores, resulting in two to three neutrons from each split core, etc. If the number of secondary neutrons causing the nucleus division is increased, an accelerated nucleation response occurs in the substance in which the number of fission nuclei grows avalanche (Figure 2). This reaction runs in millions of seconds and represents a nuclear explosion.

If the number of neutrons causing the division of the nuclei remains constant during the reaction, an explosion will not be produced. These reactions are used in nuclear power plants.

When the number of secondary neutrons leading to division is reduced, the reaction subsides.

Under the influence of neutrons, the nucleus of many of the heavy elements can be divided, however, most of the releasing neutrons are insufficient for the next division of the other nuclei, and the chain separation process is not possible.

From the natural isotopes only in uranium-235, and from the artefacts - in uranium-233 and pluton-239, a nuclear fission chain reaction can develop. It is these three isotopes that are used today as a division into nuclear power.

Chain reaction can develop not in any amount of nuclear material. In a less mass substance, much of the secondary neutrons formed by the separation will take off beyond the boundaries of the universe without causing further divisions.

The smallest mass of the fissionable substance in which under certain conditions a chain reaction can be developed is called critical. The mass of the substance less than the critical mass is

called the mass, and the mass exceeding the critical mass over the critical mass.

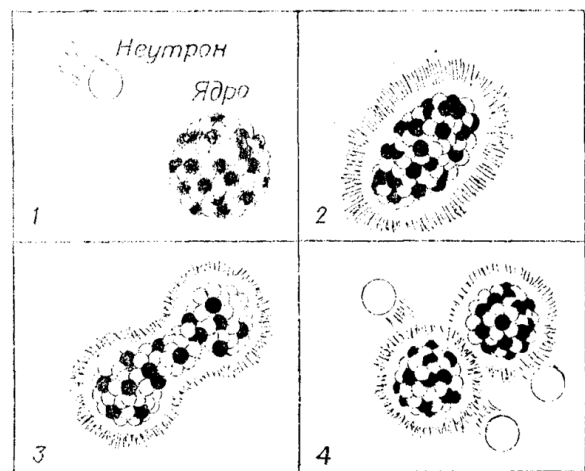


Figure 1. Core partition process:

1-core bombardment of neutron; 2 and 3 - the generation of an intermediate (excited) nucleus found in an unstable state; 4 - division of the core nucleus with particle formation - the nucleus of the new elements - n secondary neutrons

The magnitude of the critical mass depends mainly on the geometric shape, density and composition of the fissionable material and the surrounding material.

The smallest critical mass at other equal conditions has the ball-shaped charges. In these charges, the number of secondary neutrons that take off beyond its boundaries is minimal. The critical mass for a uranium-235 ball is 40-60kg, and for a pluton-239-10-20kg ball.

The critical mass of the fissile is reduced as the density increases. This allows, by artificially raising (for example, by blasting a normal BB by means of an explosion), the density of the particle to reduce its critical mass.

The critical mass of the fissionable substance can be reduced by placing the charge in a reflector sheath that returns a portion of the neutrons to the reaction zone.

The division of all atomic nuclei contained in one gram of uranium or pluton releases approximately as much energy as the 20 tons of explosion.

In the reaction zone of blasting division the temperature reaches tens of millions of degrees and the pressure - tens of billions of atmospheres. Under the action of such a high temperature and pressure, most of the charge substance is sprayed and the reaction is quickly quenched.

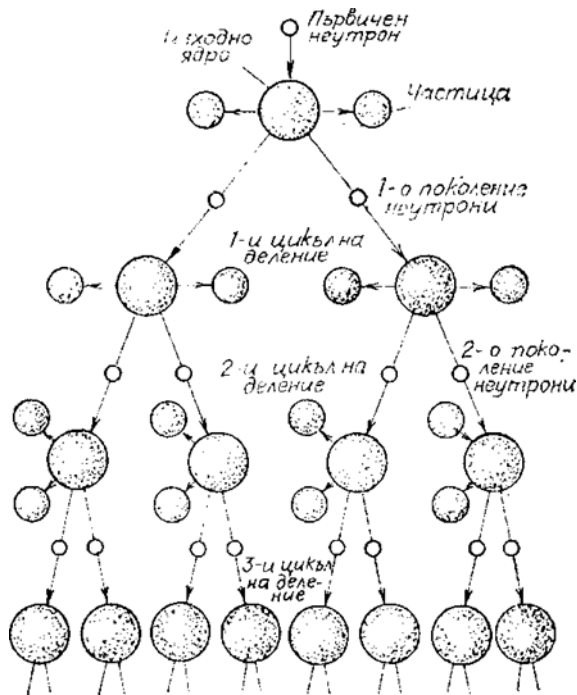


Fig. 2 - The development of a nuclear fission chain reaction

2. Synthesis reaction (thermonuclear reaction)

In the synthesis reaction, light cores are formed to form heavier ones. A mixture of hydrogen isotopes - deuterium and tritium, as well as lithium isotopes - is used to effect the synthesis of nuclear fuel.

The synthesis reaction is possible only at temperatures of several tens of millions of degrees. To create such temperature conditions a nuclear explosion based on the split reaction is used. Therefore, the thermonuclear explosions take place in two stages: the explosive reaction of the division of the nuclear charge, which is something like a detonator, then the synthesis reaction.

When joining all the cores contained in 1 g of deuterium-tritium mixture, approximately the same energy is released as in the 80 tons of explosion.

In the thermonuclear reactions neutrons with very high energy occur. They can cause a division of the nuclear atoms of uranium-238.

This feature has allowed us to use the comparatively cheap and most common in nature uranium-238 for nuclear fuel. In its use, the nuclear explosion takes place in three stages: the reaction of the division of uranium-235 or pluton-239 creates conditions for the synthesis reaction, and the synthesis of neutrons causes division of the uranium-238 nuclei.

2.2. Principles of Nuclear Munitions

Devices designed to carry out nuclear explosions are called nuclear charges. Nuclear charges are the nuclear explosive substance (sometimes referred to as nuclear fuel) in which the explosive splitting or synthesis reaction may take place.

Depending on the nature of the explosive reactions, we distinguish nuclear charges of division (or atomic charges), fusion-synthesis fusion charges, fission-synthesis-division fusion charges or combined thermonuclear charges.

The main elements of the nuclear charge divisions are: a fissionable substance (the nuclear charge itself), a neutron reflector, a charge of the ordinary explosive, and an artificial source of neutrons.

The formation of the overcritical mass of the particle in the nuclear divisions can be accomplished in different ways.

In the so-called 'charge' charges, the formation of the overcritical mass occurs by increasing the density of the fissile by virtue of its non-uniform approximation by the explosion

pressure of the ordinary explosive. The fissile in these charges has a mass less than the critical mass and is charged in the charge of a normally explosive substance. At blasting of a normally explosive material is subject to high pressure, its density increases, the mass becomes overcritical (Figure 3) and a split response develops. The higher the pressure, the higher the supercritical the nuclear fuel and the higher the explosive power, respectively. When increasing the density of the dividable substance, for example twice the critical mass is reduced four times.

Other charging schemes are possible. For example, in the so-called gunnery charges, nuclear fuel is divided into two or more subcritical dimensions in order to initiate a self-sustaining chain reaction in each of them.

If nuclear fuel is divided into two parts, the supercritical mass is formed by joining the parts using the ejection charge of BB (Figure 4, a).

The speed of convergence of these parts to a large wall depends on the fullness of the reaction flow and, ultimately, on the explosive power. These charges are relatively simple in design, small in size, and can be used to shoot small-scale nuclear munitions. When splitting nuclear fuel into several parts (Figure 4, b), the overcritical mass is also created by blowing up the BB charges, resulting in all parts of the fissile being joined together in the center of the nuclear charge and converging. This fracture of the burst by explosion of ordinary BB increases the power of the nuclear explosion.

The neutron reflector provides a reduction in the critical mass of the charge and helps to increase the explosive power at the same amount of fissionable substance.

Artificial and non-tropical artefacts are used to excite the splitting chain reaction at the exact time to increase the number of concurrent starting divisions.

The fission-synthesis fusion charges (Figure 5) have in their composition a nuclear charge of fission and fusion fuel, lithium deuteride (a chemical compound of deuterium with the isotope of lithium-lithium-6), and in the case of the detonation of such charges the third is obtained directly in the blast process (when neutrons affect lithium-6).

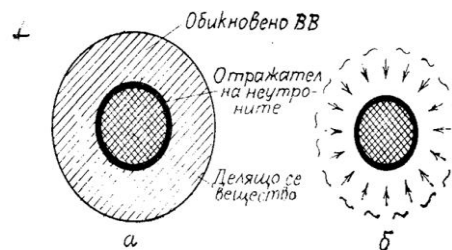


Fig. 3- Nuclear charge of the split-type implosives type: a - before the explosion (density of the divider - normal, mass less than the critical mass); b - in the moment of the explosion (density of the dispenser, higher than normal, mass greater than the critical mass)

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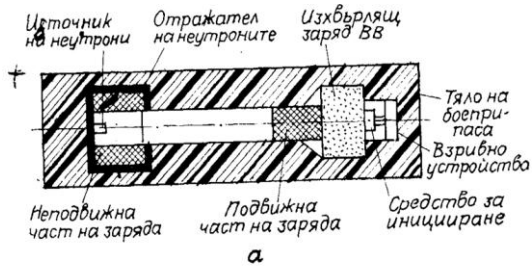


Fig. 4. Nuclear charge scheme:

a - the dispenser is divided into two parts; b - the divider is divided into several parts

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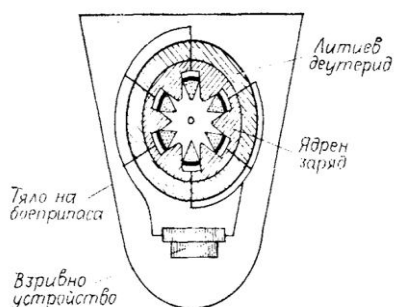


Fig. 5. Scheme of "fusion-synthesis" fusion devices

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The power of fusion charges depends on the amount of deuterium and tritium and practically is unlimited.

For warfare, depending on their purpose, the nuclear charges are placed in one or the other bundle and supplied with the explosive device to provide a blast at a specific time or at a specific height.

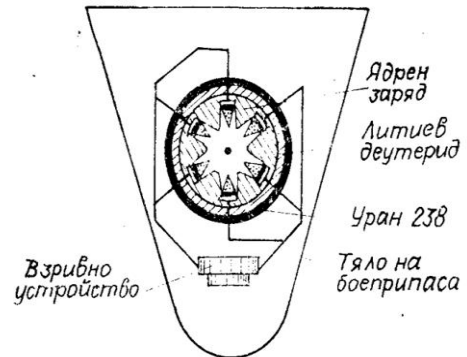


Fig. 6. (schematic diagram of a combo-fusion device of the "division-synthesis-division")

Nuclear munitions are called nuclear and fusion missile heads (missiles) of rockets of various types and purposes, aviation bombs, torpedoes, underwater bombs, artillery shells, and special nuclear mines.

The power of nuclear munitions is characterized by the trolley equivalent b, ie by the weight of the trotyl charge, the explosive energy of which is equal to the energy of the nuclear charge explosion.

Current nuclear charges may range from several tons to hundreds of millions of tons.

Depending on the power, nuclear munitions are widely divided into the following caliber:

- overweight - less than 1000 (1 kiloton) t,
- small - from 1000 to 10 000 t inclusive,
- an average of 10 000 to 100 000 tonnes inclusive,
- Large - from 100,000 to 1 mil. t including,
- at a rate of more than 1 ml. t.

The nuclear explosion is accompanied by the formation of a shining area, a source of intense light radiation. Gamma rays and neutrons emitted during the partition reaction process generate a penetrating radiation stream. From the center of the blast in all directions spreads a spherical zone of sudden compression to the air, called the shock wave. In addition, a large amount of radioactive material is created in the nuclear explosion, creating radioactive contamination of the locality and objects.

Shockwave, light radiation, penetrating radiation, and radioactive contamination are major emerging factors of the nuclear explosion.

The electromagnetic impulse that occurs at the moment of the explosion in the surrounding space is also related to the striking fac

3. Conclusions:

1. Nuclear Weapons would reach the destruction of hundreds of planets like our Earth;
2. The presence of a nuclear weapon has a more deterrent effect on opponents than it would be in real use;
3. The development of nuclear weapons must be under control and the military-industrial complexes must not be uncontrollable. The control bodies must also be public and accountable to society to reduce the amount of space for weapons;
4. The use of nuclear weapons would be detrimental to the inhabitants of the Earth and terrorist organizations should not have access to such weapons.

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