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English 202C
Process Description
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Process behind a Hydrogen Bomb Explosion

Within the Marshall Islands, the first hydrogen bomb (H-bomb) was detonated on November 1, 1952. This thermonuclear weapon works with fission and fusion processes that involve isotopes (different forms of an element) of hydrogen to produce the amount of energy to explode.

OVERVIEW

Before we dive into the processes behind this explosive, we need to address the components of what goes into the H-bomb and how fusion and fission work. Figure 1 illustrates the general make-up of the H-bomb created in 1951, known as the Teller-Ulam design. The first of this reaction is the primary. It consists of a fission bomb that produces a shock wave, a movement of high pressure that initiates the secondary phase. The secondary phase is where the fusion process occurs and in lays the hydrogen.

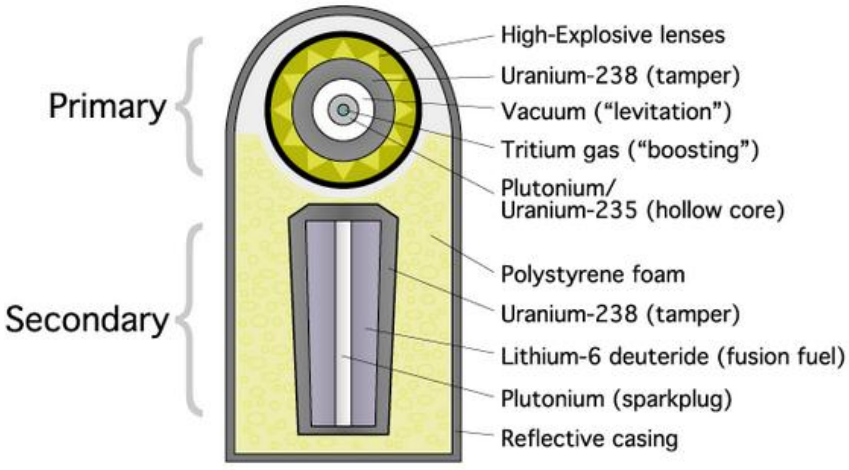

Figure 1 – Teller-Ulam Design
http://en.wikipedia.org/wiki/File:Teller-Ulam_device.png

PRIMARY – *Fission*

Fission is a nuclear reaction in which a nucleus, a central region of protons and neutrons, of an atom (a unit of matter) will split up into smaller particles. In order to start this reaction, there is an initial explosion that takes place on the outer casing that triggers the event. This event is a chain reaction of particles colliding to create temperature and pressure that translates into energy. The element commonly used in this process is uranium-235 or plutonium-239 because you need heavier nuclei to be able to break apart into smaller pieces. This energy will continue to increase until pressure is too great, causing the bomb to explode.

SECONDARY – *Fusion*

Nuclear fusion is just the opposite of fission. This is a process in which atomic-nuclei are moving at high speeds, colliding to create larger, new nuclei. Requirements of fusion are high temperatures, high pressure, and the presence of a light weight element. Here, the H-bomb uses hydrogen because it is the lightest element on the periodic table. This will allow lighter nuclei to collide and form heavier nuclei. A large amount of energy is released due to the conversion of matter to energy. In the same respect, the increase of energy will become so significant that it too generates a massive explosion. This fusion process allows the H-bomb to be one of the most effective nuclear weapons.

STAGES OF H-BOMB
(Figure 1 is referenced in every stage to explain how each items works to create this explosion.)

STAGE ONE – *Implosion of Fission Bomb*

As stated above in "Fission," the start of this process requires an outside explosive to trigger the reactions. (In Figure 1, this is occurring within the High-Explosive Lenses) This trigger causes the inner cores of uranium-238 and plutonium/uranium-235 to shrink, powering the chain reaction of colliding atoms. The tritium gas that you see in Figure 1 is simply an "enhancer" to these chain reactions. On implosion, the vacuum is broken and it releases its neutrons to provide more particle interactions to increase efficiency. In Figure 2, "Stage One" can be seen in phases A and B.

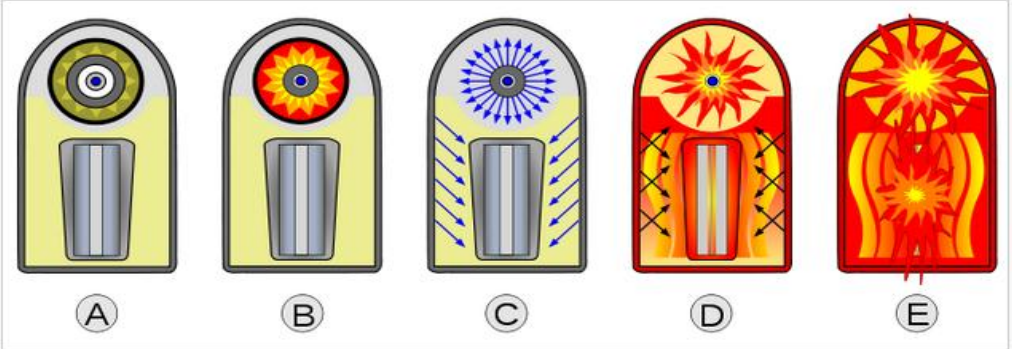

Figure 2 – Start to Finish
http://en.wikipedia.org/wiki/Th

STAGE TWO – *Primary to Secondary*

Due to fission that occurred in the primary phase of the H-bomb, a shock wave of X-ray radiation, waves of energy that has the ability to propagate through matter, and neutrons are emitted and initiates the secondary phase (this is illustrated in Figure 2, phase C). This shock wave causes the polystyrene foam to become plasma, increasing the temperature and pressure on the uranium – 238 casing. This starts its own fission process, resulting in expansion on the casing. In Figure 1, there is a plutonium rod that is in the center of the fusion fuel. As we know, plutonium is very fissionable, and due to the high temperatures and pressure caused by the uranium casing, it undergoes a fission process as well. Resulting, the inner fusion fuel of lithium-6 deuteride is compressed and combines with the shock wave of neutrons which is the catalyst to the fusion process.

STAGE THREE – *Fusion Process*

With fission occurring all around this fusion fuel, the requirements are met for the process to proceed (high temperature and pressure). As lithium-6 deuteride interacts with neutrons, it creates hydrogen, tritium (an isotope of hydrogen that is easily fusible), and helium (just a by-product that has no significance adding to the reaction). In these chemical reactions, the fusion of hydrogen can now ensue. In Figure 2, phase D shows this fusion process.

EXPLOSIVE ENERGY

The major components of energy has resulted from the uranium fission in the primary phase, fission within the plutonium rod and uranium casing in the secondary phase, and finally the hydrogen fusion within the casing. With these four sources of energy, the temperature and pressure become exceedingly high and the whole bomb explodes, breaking the Reflective Casing illustrated by phase E in Figure 2. This explosive power is represented on a unit of a megaton, which equals 1,000,000 tons of TNT. This surpasses the 1,000 ton power of an atomic bomb, which is strictly the primary phase process described in the H-bomb. This shows the catastrophic impact that the H-bomb has. The supersonic (speed greater than sound) shock wave that results from the explosion has the ability to demolish anything within several to hundreds of miles.

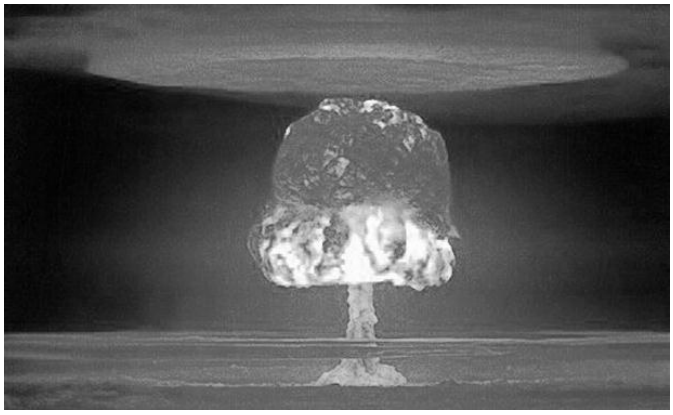

Figure 3 – Mushroom Cloud from H-bomb Explosion
http://jamnews.ir/detail/News/135945