ATOM FOR PEACE, NOT FOR WAR

Prof. Manashi Goswami

Come August, the whole world remembers two frightful days of world history, August 6th and 9th, 1945. The atomic bombings of the cities of Hiroshima and Nagasaki in Japan were conducted on these days by the United States during the final stage of World War II. These two bombings were the first and remain the only use of nuclear weapons in warfare.

By August 1945, the allied Manhattan project had successfully tested an atomic device and had produced weapons based on two alternate designs. A uranium gun type atomic bomb (Little Boy) was dropped on Hiroshima on August 6, 1945, followed by a Plutonium implosion-type bomb (Fat Man) on the city of Nagasaki on August 9. Within the first two to four months of the bombing, acute effect killed 90,000 - 166,000 people in Hiroshima and 60,000 - 80,000 in Nagasaki. During the following months large number of people died various radiation effects and injuries.

On the Day

At 2.45 am on Monday, August 6, 1945 a B -29 bomber plane, the Enola Gay took off from Tinian, a north pacific island in the Marinianas, 1500 miles south of Japan. Colonel Paul Tibbets, the pilot nick named B-29 as "Enola Gay" after his mother. Just before the take-off the plane's nick name was painted on its sides. The Enola Gay was escorted by two other bombers that carried cameras and a variety of measuring instruments. Three other planes had left earlier in order to ascertain the weather condition over the possible targets. On the hook in the ceiling of the plane hung the ten- foot atomic bomb "Little Boy". On 6th August, 1945, the first choice target Hiroshima, was having clear weather. At 8:15(am) local time, Enola Gay's door sprang open and it dropped the little boy.

The Mushroom Cloud

The bomb exploded 1,900 feet above the city. The mushroom cloud itself was a spectacular sight. A bubbling mass of purple-gray smoke with a hot red burning core estimated to have reached a height of 40,000 feet. Such was the description of dreadful devastation that took place on 6th August 1945 at Hiroshima city.

Why Hiroshima

The U.S.A. began in spring 1945 studying targets for dropping of the atomic bomb. To observe accurately the effect of atomic bombing, the potential cities required to have an urban area of at least 5 km in diameter. On July 25, 1945, an order was issued calling for

the first atomic bomb to be dropped on one of the four cities Hiroshima,Kokura,Niigata & Nagasaki. The name Hiroshima as the prime target was issued on August 2. One reason is that Hiroshima was the only city thought to have no Allied-prisoner-of-war camps. On 6th August, the sky over Hiroshima city was clear hence Hiroshima's fate was destined for destruction.

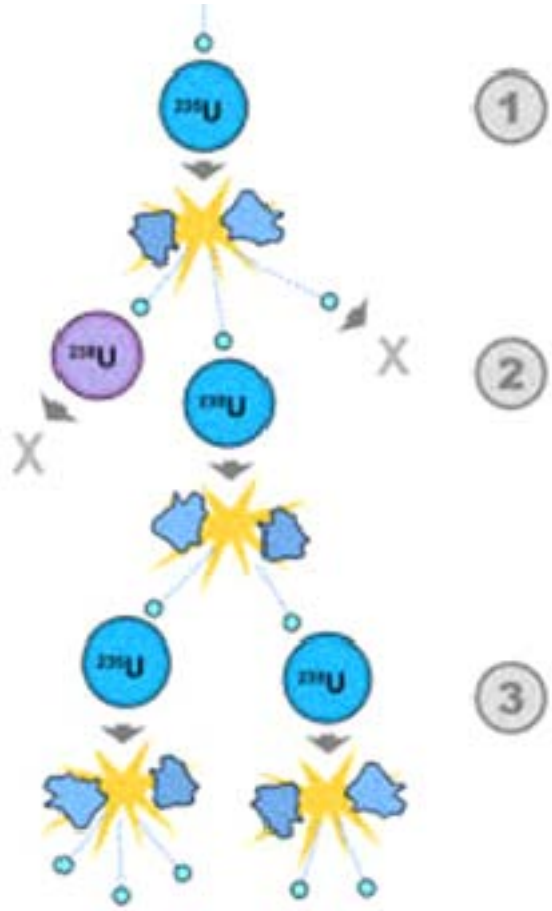
The Science Behind Atom Bomb

A nuclear explosion is an explosion that occurs as a result of the rapid release of energy from high speed nuclear fission or fusion reaction. The driving reaction may be nuclear fission, nuclear fusion or a multistage cascading combination of two.

The immense destructive power of atomic weapons is derived from a sudden release of energy produced by splitting the nuclei of the fissile elements making up the bomb's core. The U.S. developed two types of fission based atomic bombs during the second world war. The first "Little Boy" was a gun type weapon with a uranium core. The second weapon dropped on Nagasaki was called "Fat Man" and was an implosion-type device with a plutonium core.

Fission

The isotopes Uranium- 235 and Plutonium-239 readily undergo fission. Fission occurs when a thermal neutron strikes the nucleus of either isotope splitting the isotopes into fragments and releasing a tremendous amount of energy. For example splitting of one atom of uranium produces around 220 MeV of energy. The fission process becomes self-sustaining as neutrons produced by the splitting of atom strike nearby nuclei and produce more fission. This is known as chain reaction which causes nuclear explosion.



Nuclear Chain Reaction

Natural uranium contains very less amount (0.7%) of fissionable U-235 isotopes and rest is U-238 isotopes. When a uranium-235 atom absorbs a neutron and splits into two new atoms, it releases three new neutrons and the sum total of mass lost in the process appears in the form of energy according to Einstein's famous Mass-Energy equivalence

formula $E = mc^2$. Two neutrons do not continue the chain reaction because they are lost or absorbed by U-238 atom. However, on an average one neutron does collide with a neighbouring atom of U-235, which then splits and releases again neutrons and some energy. This causes a nuclear chain reaction.

Criticality

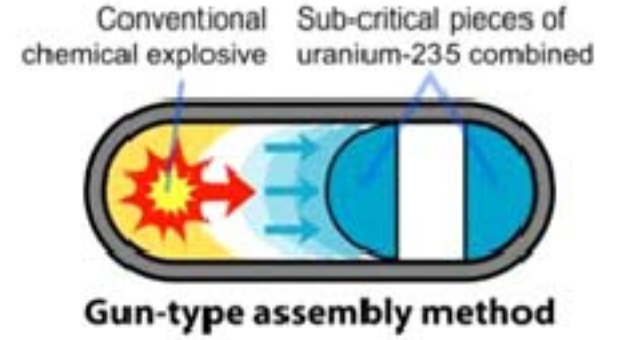
In order to detonate an atomic weapon, a critical mass of fissionable material is needed. This means enough uranium-235 or plutonium-239 is required to ensure that neutrons released by fission will strike another nucleus, thus producing a chain reaction. The more fissionable material is available the more is the chance that such an event will occur. Critical mass is defined as the amount of material at which a neutron produced by a fission process will, on an average create another fission event.

Difference between Little Boy & Fat Man

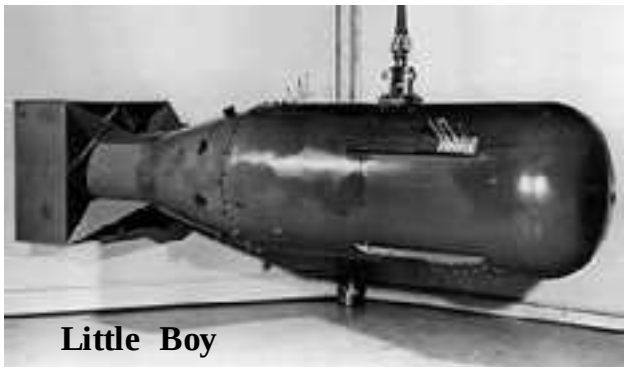
Little Boy and Fat Man utilized different elements and completely separate methods of construction in order to function as nuclear weapons. Little Boy detonated due to a fission chain reaction involving the isotope U-235 of uranium, while Fat Man used Pu-239 isotope of plutonium.

Little Boy

Little Boy was powered by the Uranium isotope U-235. Most Uranium found naturally in the world exist as U-238, leaving only 0.7% of naturally existing Uranium as the U-235 isotope. When a neutron bombards on U-238, the isotope often captures the neutron to become U-239, failing to fission, and thus failing to instigate a chain reaction that would detonate a bomb. Hence the first challenge of the project was to determine the most efficient way to separate and purify U-235 from the overly abundant U-238.



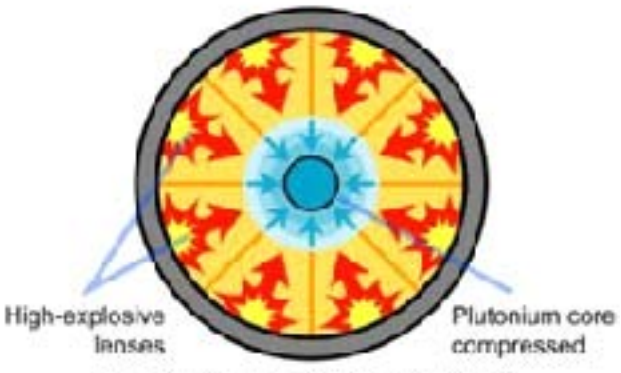
Gun-type assembly method


Little Boy

Once enough Uranium-235 was obtained to power the bomb, the bomb was assembled with a gun type design. In this special design an amount of U-235 is fired at another to combine the two masses. This combination created a critical mass that sets off a fission chain reaction to eventually detonate a bomb. The two masses of U-235 had to combine quickly to avoid the spontaneous decay of the atom which would cause the bomb to fizzle and thus fail to explode. Little Boy was carrying around 64 kg of pure U-235 of which only 0.6 kg was detonated during the explosion.

Fat Man

Powered by Plutonium, Fat Man could not use the same gun-type design that allowed Little Boy to explode effectively. The form of Plutonium collected was containing traces of Pu-240 isotope, as opposed to the desired Pu-239. Pu-240's higher decay rate would cause spontaneous decay before the gun type design could bring two masses of plutonium together. This process lowers the energy involved in the actual detonation of the bomb. Hence, a new design was constructed at Los Alamos laboratory of U.S.A. The new design used conventional explosives around a central Plutonium mass to quickly squeeze and consolidate Plutonium, increasing pressure and density of the substance. An increased density allowed the Plutonium to reach its critical mass, firing neutrons and allowing fission chain reaction to proceed. To detonate the bomb the explosives were ignited, releasing a shock wave that compressed the inner Plutonium core and led to its explosion. Fat Man was carrying 6.2kg of plutonium, of which only 20% was detonated during explosion.



Implosion assembly method


Fat Man

Atom for Peace

It was unfortunate that the atomic energy before being utilized for the benefit of mankind was used for destruction of mankind. In 1950s the attention was shifted to harnessing the power of the atom in a controlled manner to apply the steady heat yield for generating electricity through nuclear reactors. However, by 1942 the first artificial nuclear reactor, Chicago Pile -1 had been already constructed at the University of Chicago by a team led by Enrico Fermi. But the primary purpose of those reactors was the mass production of Plutonium isotopes for nuclear weapons. Besides the military use of nuclear power, there were political reasons to pursue civilian use of atomic energy. U.S.A. president Dwight Eisenhower made his famous ATOM FOR PEACE speech to the UN general assembly on December 8, 1953. This diplomacy led to the dissemination of reactor technology to all institutions worldwide including those in U.S.A.

Before 1950s, radiation from Radium was the only source for treatment of cancer. Now nuclear reactor has opened up possibilities for making other elements radioactive. These

radioactive isotopes are now used extensively in medicine, agriculture and industry. Radioactive isotopes have helped in diagnosis and prevention of many critical diseases. They are of immense use in the field of agriculture for better production of crops, high yielding variety of seeds, pest control and fertilisers. Radiation alternated vaccine has immunised sheep from lungworm diseases. In India under UNDP (United Nation Development Programme) collaboration such vaccines are going to be produced commercially in a laboratory located in Kashmir Valley. Bhabha Atomic Research Centre at Trombay is well known in the world for production of many useful radioisotopes. It produces near about 325 radioisotopes.

Bhabha Atomic Research Centre (Trombay).

Perishable food stuffs, if exposed to radiation, are found to remain fresh beyond their normal time. Hence radiation is used for canning of food and preservation. In a tropical country like India, self- life of fruits and vegetables are short. Small dose of radiation prevents sprouting of potato and onion while higher dose can delay the ripening of mango, apple, banana etc. BARC, Trombay has a semi commercial food processing plant.

At present 30 countries worldwide are operating 435 nuclear reactors providing 12.3% of the world's electricity. The use of nuclear power in domestic and commercial purpose has become a reality in France since 1976. France has been still dominating the world in nuclear power with 73.3% share of its total power consumption. After Kudankulam reactor of India being fully operational with almost

Kudankullan Reactor Centre

1000MW power output, the number of reactors in India has been raised to 21, with nuclear power capacity of 5308 MW and nuclear power share has enhanced to 3.5%. The whole world has now realised that nuclear energy is the ultimate source of energy which can reduce the greenhouse gases and save our earth from global warming, which is pushing it to a big catastrophe. So it is well justified that atom only can bring peace to the world in true sense, if immensely available energy from its core can be judiciously harnessed and utilised for the well being of the entire mankind.

■

Regional Institute of Education, Bhubaneswar-22
Mob.- 9439615558