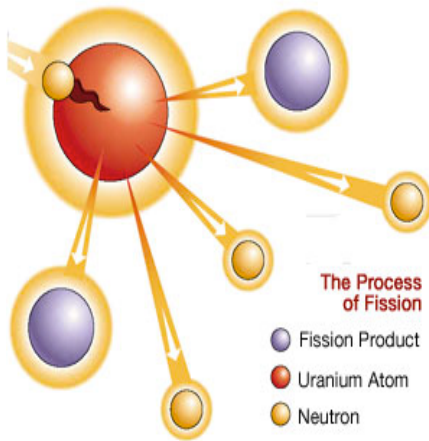


Can a Nuclear Reactor Explode Like an Atomic Bomb?



Other Possible Explosions

It's obvious now that it's impossible for a nuclear reactor to explode like an atomic bomb. However, other accidents can occur in the nuclear reactor and lead to explosions. One example is hydrogen explosion where hydrogen build-up in the reactor core causes a hydrogen explosion. To clarify more, Hydrogen is produced when the cooling water level drops down, thus leading the zirconium in fuel pins to melt and interact with water. Afterwards, it creates a hydrogen bubble, subsequently, the hydrogen explosion occurs when the hydrogen interacts with oxygen in the air. Another example is a steam explosion. Pouring a hot liquid into water makes the water reach a superheated state, which creates a violent flashing of water and causes the steam explosion.

Fission chain reaction

First, a fission chain reaction is a process where a fast moving neutron strikes a heavy nucleus atom causing it to split up. When the heavy nucleus atom absorbs a neutron, it splits up into two atoms and emits two or more neutrons. The resulted neutrons hit other atoms and produce more neutrons. As neutrons split more and more atoms, more and more neutrons are produced. Eventually, the fission chain reaction keeps operating until neutron particles strikes all atoms in the surrounding.

A fission reaction can be either controlled or uncontrolled. In the case of a controlled fission reaction, there is certain number of neutrons allowed to strike the heavy nucleus atom. Most reactors achieve a controlled fission reaction by inserting control rods that are made of neutron absorbent materials such as cobalt, hafnium, gadolinium, samarium, and boron. These control rods absorb free neutrons in the fission reaction. In addition to the control rods, there are moderators that slow down the speed of neutrons in the reactor and thus control the fission reaction. The moderators are usually heavy water (D_2O) or light water (H_2O). The principle of controlled fission reaction is used in nuclear reactors to produce power and generate electricity.

In contrast to a controlled fission, an uncontrolled fission is a process where nuclear fission reaction is allowed to proceed without any removal of neutrons. Hence, there are numerous amounts of neutrons hitting atoms in the reaction and therefore producing massive energy. As a result, atomic bombs are developed.

Neutron Life Cycle

Neutrons are considered to be very important in fission chain reactions. Hence, studying the life cycle of a neutron and learning more about it is a good idea. A neutron can survive up to about 0.001s after its formation in the reaction. Then, it will be absorbed or leaked in the reactor core. However, when neutrons are lost or not absorbed in the fission reaction, they will escape or leak out to the containment or shielding and the neutron life cycle ends.

By using uranium enrichment, the amount of uranium atoms produced from a fission chain reaction is increase. Therefore, energy is released and electricity is generated. Uranium enrichment in nuclear reactors should be about 3-5%, as NRC laws require it to be. As for atomic bombs, uranium enrichment should be at least 85% or more.