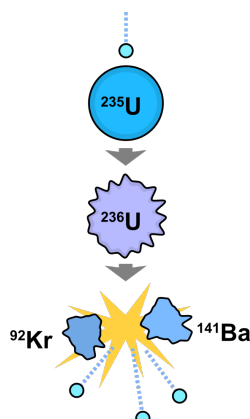


8.7 Induced fission

Nuclear fission is a term used for the process in which a large, unstable nuclei splits in two, releasing energy in the process. The energy released in the nuclear fission of uranium is the basis of electricity production in nuclear power stations.



The induced fission of uranium-235



When a uranium-235 nucleus is hit by a slow-moving neutron, it can capture the neutron to become uranium-236, which is unstable. Uranium-236 splits ('fissions') into two roughly equal pieces and 3 fast moving neutrons.

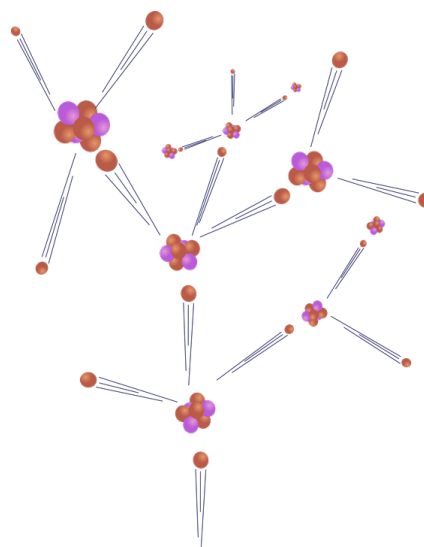
The process liberates energy which manifests itself as the kinetic energy of the products.

As discussed in section 8.6, the energy produced comes from a mass loss during the reaction.

(1) In the reaction, above, work out the mass loss in the course of the reaction and hence work out the energy released in joules. (mass of neutron = 1.00867u, mass of ^{235}U = 235.04393u, mass of ^{92}Kr = 91.92616u, mass of ^{141}Ba = 140.91441u, u is the 'unified atomic mass unit and is equivalent to an energy of 931.3MeV)

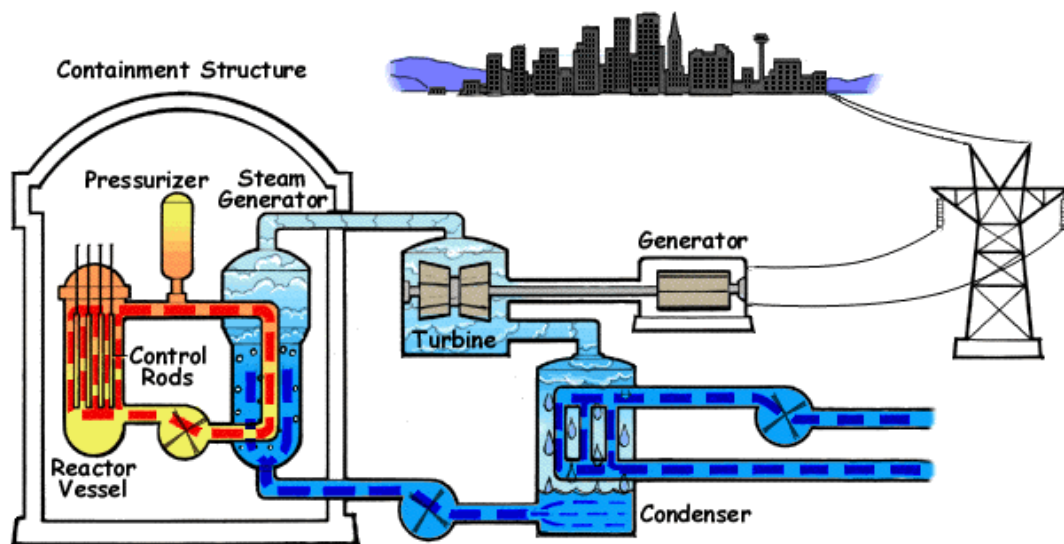
If uranium-235 nuclei are packed together in sufficient concentration, the released neutrons can (after moderation) hit other uranium atoms and cause them to fission. This is called a chain reaction. This is how an 'atomic bomb' works.

In a nuclear power station, the chain reaction is controlled using 'control rods' so that there is a steady reaction rate.



A pressurized water reactor (PWR)

Below is a diagram of a PWR. As the name indicates, it uses water under pressure as a coolant and as a moderator. The section outside the containment structure outside is the same as a conventional fuel burning power station. Steam is used to turn a generator, which in turn turns a generator. The steam is then



condensed back into water and reused.

Use information from the link to answer the following questions:

[http://energyeducation.ca/encyclopedia/Pressurized water reactor](http://energyeducation.ca/encyclopedia/Pressurized_water_reactor)

(2) What does the moderator do and why is it necessary?

(3) In the PWR, the moderator is water. Why is water a suitable moderator?

(4) The water can reach a temperature of 315°C after passing through the reactor. Why doesn't it turn to steam?

(5) What are the control rods made out of, and how do they control the reaction rate?

(6)  In what form is the uranium found in the fuel rods? What percentage of uranium-235 is needed?

(7)  What is the containment shield made from and what is its function?

(8)  Why do you think there are separate water systems for cooling and for steam generation?

(9)  Why do power stations need to be located near to a source of water (i.e. lake, river, sea)?