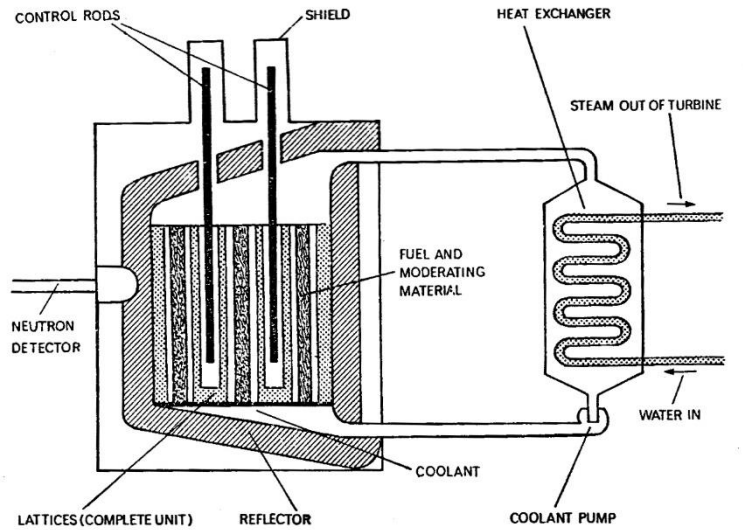
CHAIN REACTION

When fission occurs, an average of 2-5 neutrons are emitted from the nucleus. If the fission process can be so arranged that one of these liberated neutrons is captured by another U-235 nucleus to produce another fission, then the reaction will become self-sustaining.

When emitted, neutrons travel at a high velocity, and it is known that such fast neutrons have little chance of being captured by the fissile Uranium. However, if slowed down to thermal speeds, their probability of capture is greatly increased. In the normal thermal reactor, the uranium is surrounded by a large mass of moderating material. The liberated neutrons collide repeatedly with the light atoms of the moderator in such a way that they lose much of their energy and eventually become thermalised. The moderator may be either a liquid such as heavy water, or a solid such as graphite. Both these substances are of low atomic weight and have low neutron absorption cross-sections. With the graphite moderator, the uranium which is generally in the form of rods is inserted into channels cut out of the graphite. These channels are so arranged as to form a lattice structure, the object of which is to reduce neutron escape to a minimum. Provided that a sufficient mass of uranium is disposed in a number of rods through the moderator, a high enough proportion of the emitted neutrons will find their way to fissile nuclei to produce a chain reaction. The minimum quantity of uranium required to initiate the chain reaction is called the critical mass.

Once irradiated, the uranium fuel elements tend to lose strength and become wrinkled. It is therefore necessary to encase them in a can or cladding of some material such as aluminium or magnesium. These cans are designed so that they not only support the uranium inside, but also contain the highly radioactive fission products, and prevent reaction taking place between the fuel and the coolant.

A chain reaction can be initiated by inserting more and more fuel elements into the reactor core until critical mass is attained. It can be terminated by withdrawing the rods. Once started, the chain reaction must be controlled in such a way that a steady neutron flux rate, and thus a steady production of heat energy, is maintained. The simplest method of control is by inserting control rods of cadmium, or some similar material with a very high neutron absorption cross-section, into the moderator. The purpose of the control rods is to absorb the neutrons emanating from a fissioned nucleus. If therefore there is an increase in the neutron flux rate in the reactor, more control rods can be inserted until the reaction rate is stabilised again: that is, until the multiplication factor is exactly 1.



Cross-section of thermal reactor

1. Comprehension

A. Define the term 'fission'.

B. What kind of relationship is there between the velocity of neutrons and their chance of capture?

C. How do neutrons become thermalised?

D. According to the context what do you mean by 'moderation' ?

E. What is the topic of the third paragraph?

F. How can the chain reaction be controlled?

G. How are ideas organized in this text?

H. What might be the objective of writing this text?

2. Short questions

A. Prepare a note on this text.

B. What makes you feel that this is a technical passage. Talk about its presentation technique also.

3. Long/ Discussion question

What are other field in your surrounding where the term 'chain reaction' is applicable? You can interpret it in different ways.