Nuclear Research Reactors And Their Utilization

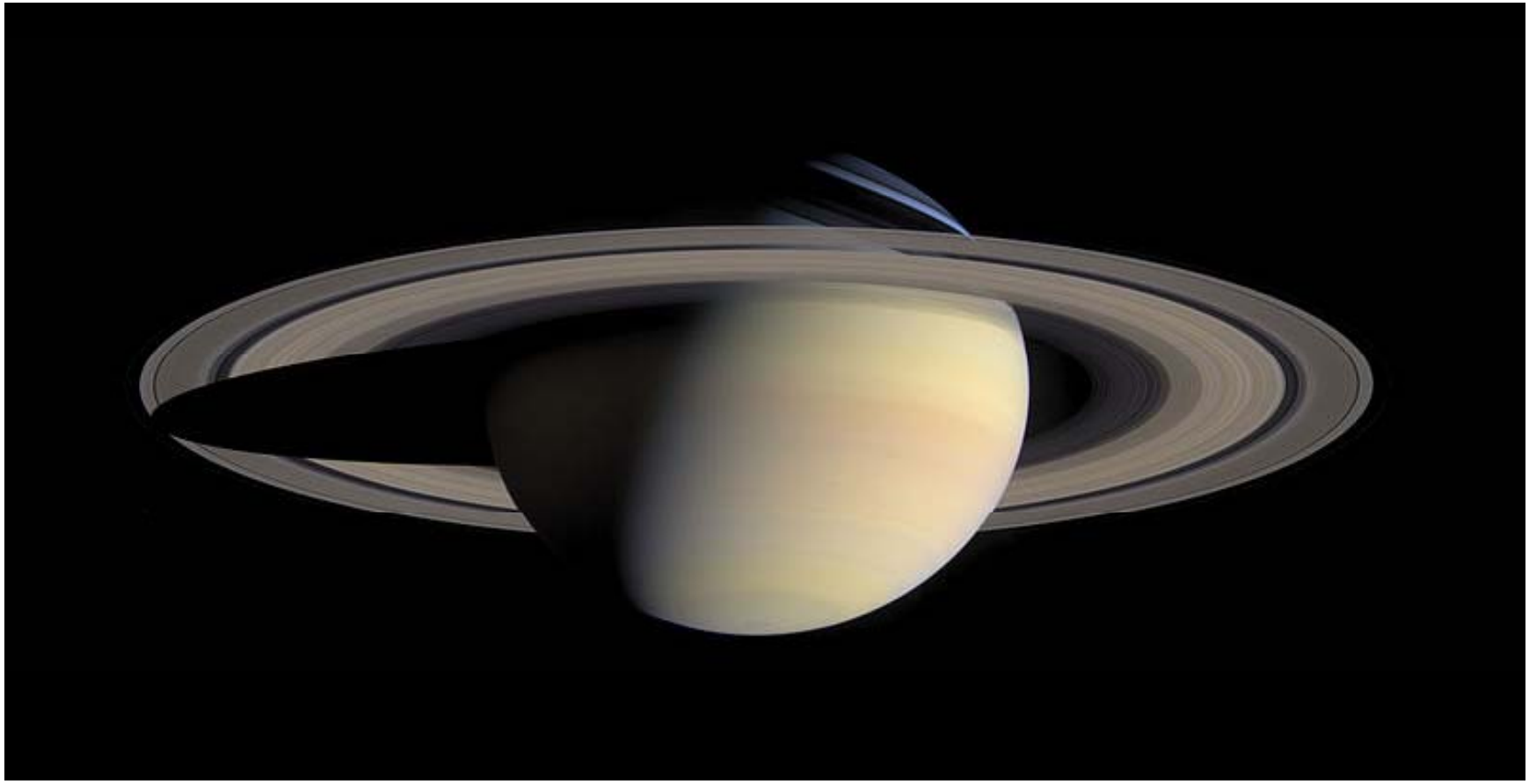
By Dr. Dilip Kumar Lahiri

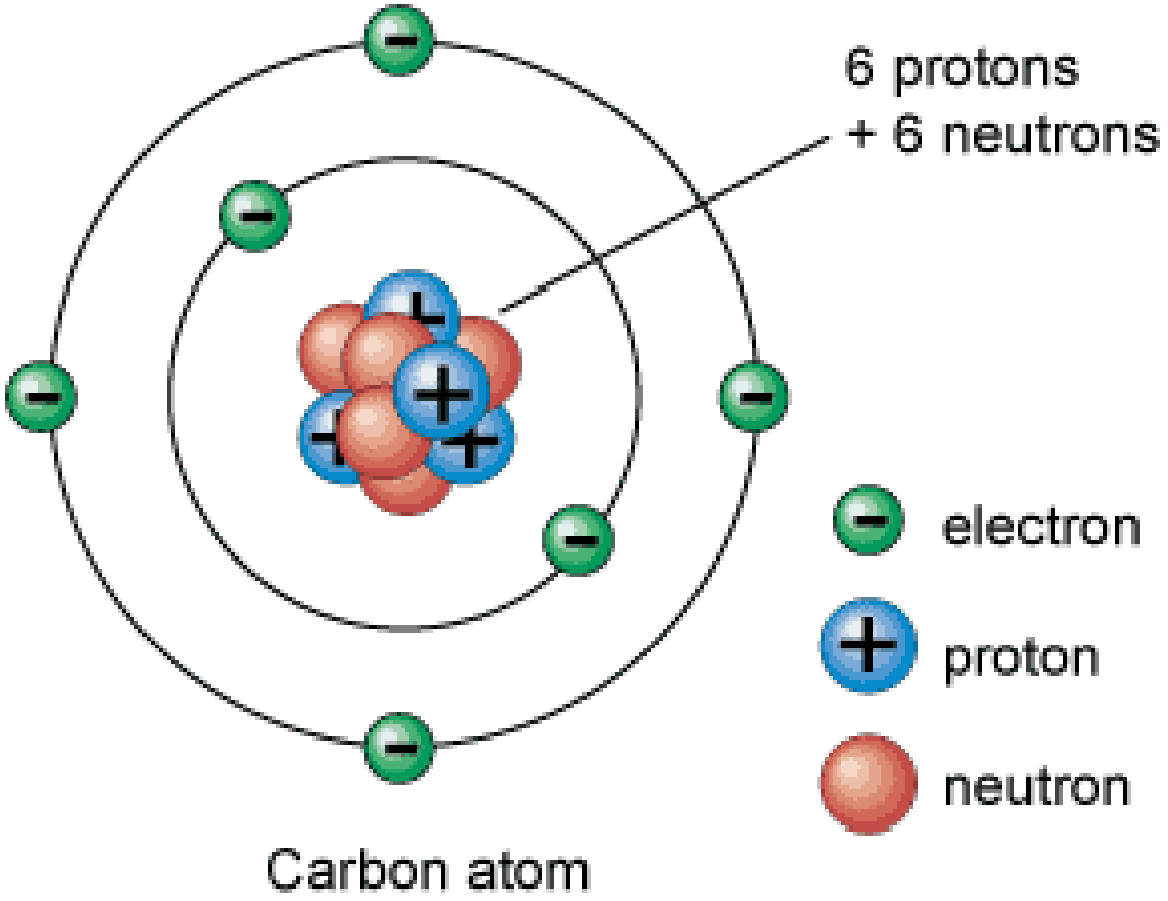
Introduction

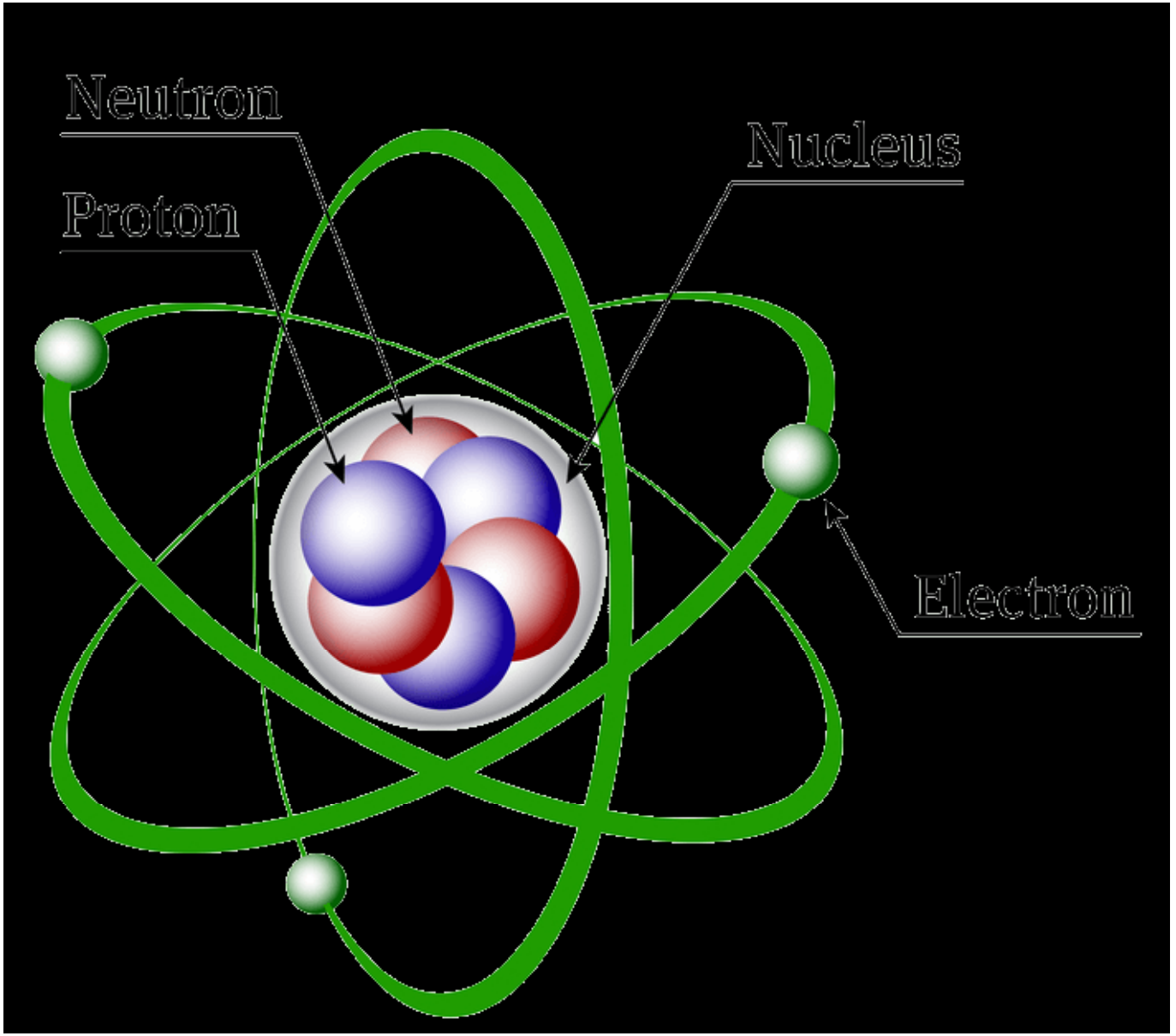
Sub Atomic Particles

a) Electrons
b) Protons
c) Neutrons

Structure of an Atom




6 protons
+ 6 neutrons
electron
proton
neutron
Carbon atom


Neutron
Proton
Nucleus
Electron

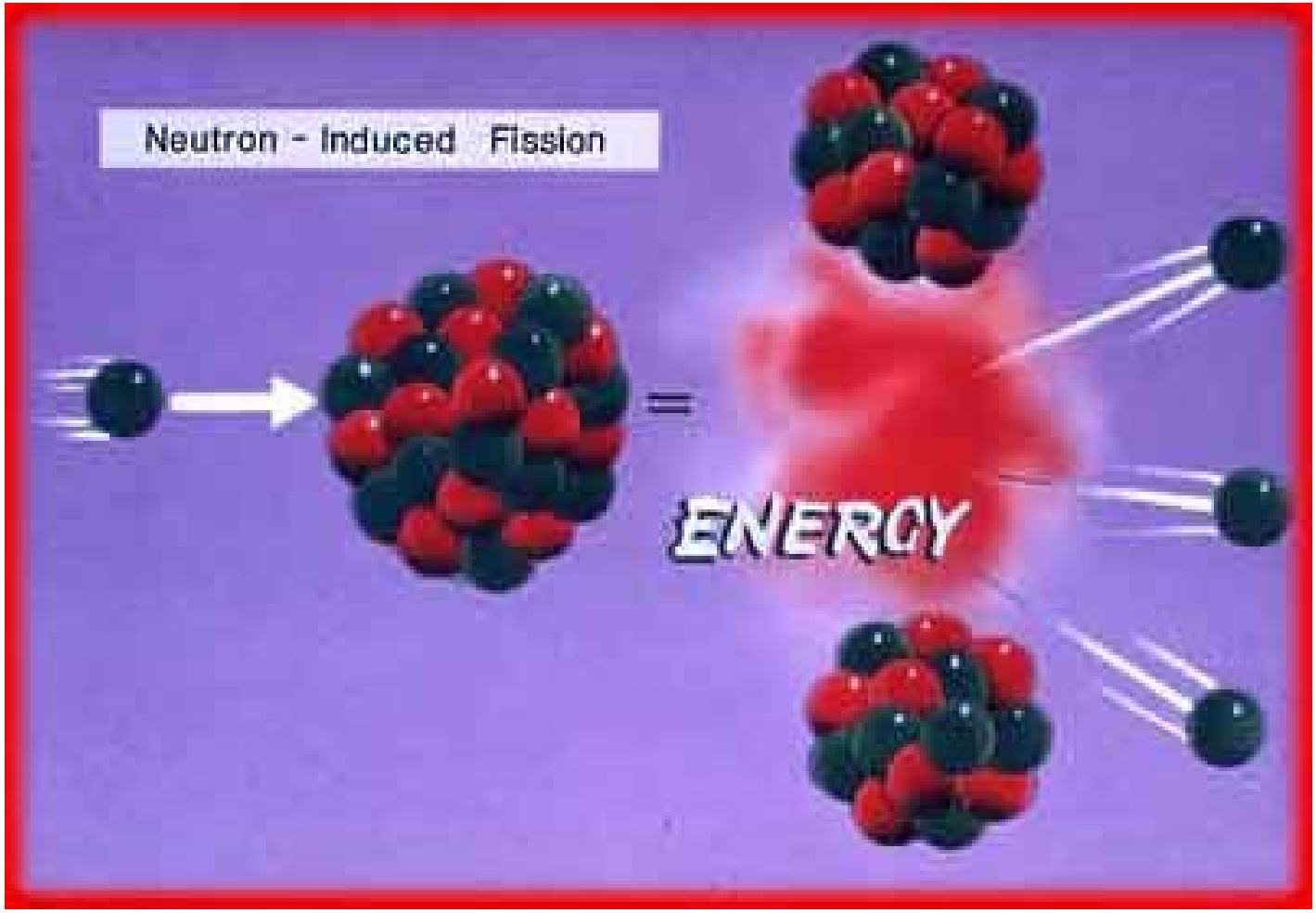
Binding Energy

It is the energy that would be

required to disassemble

the nucleus of an atom

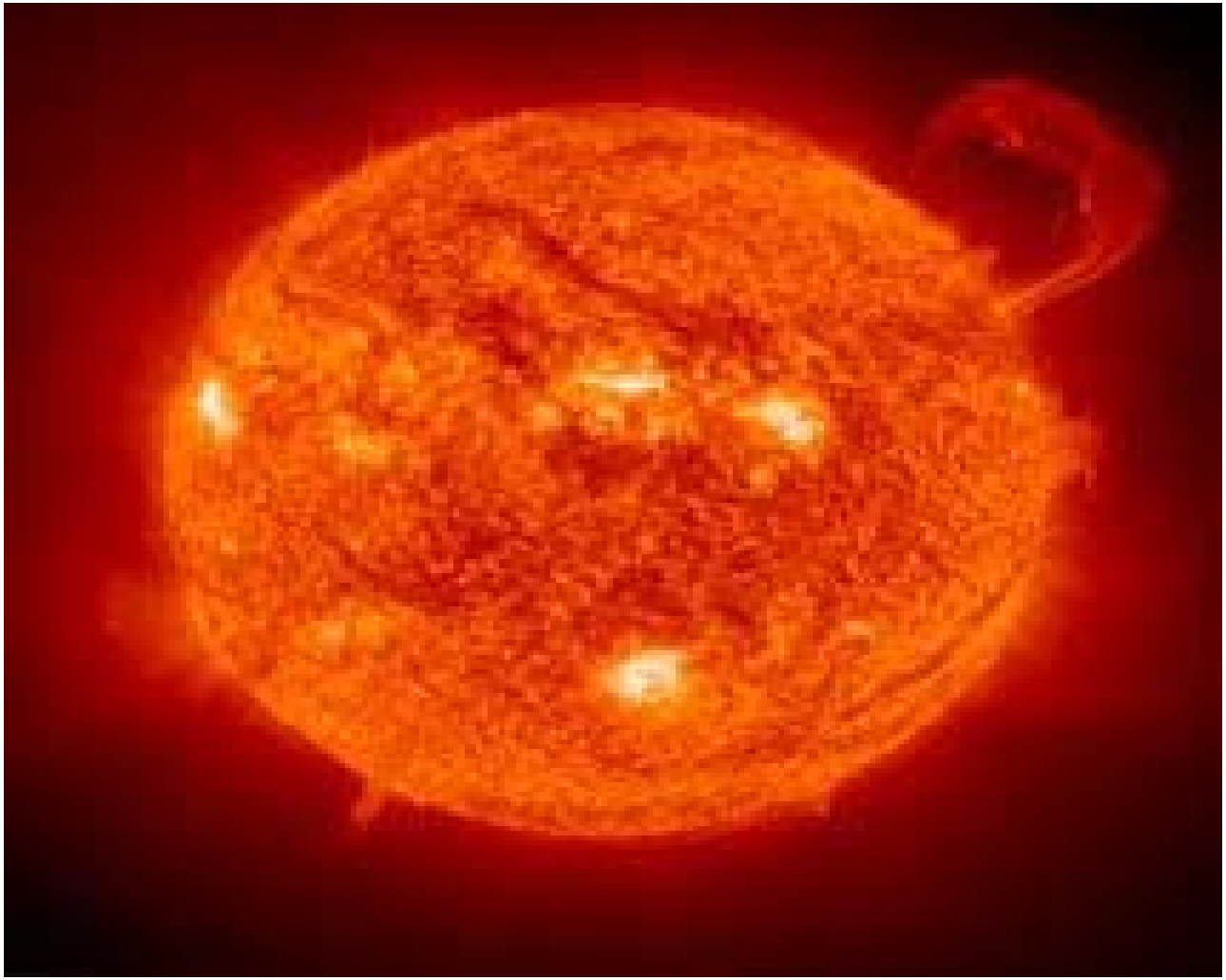
Nuclear Fission



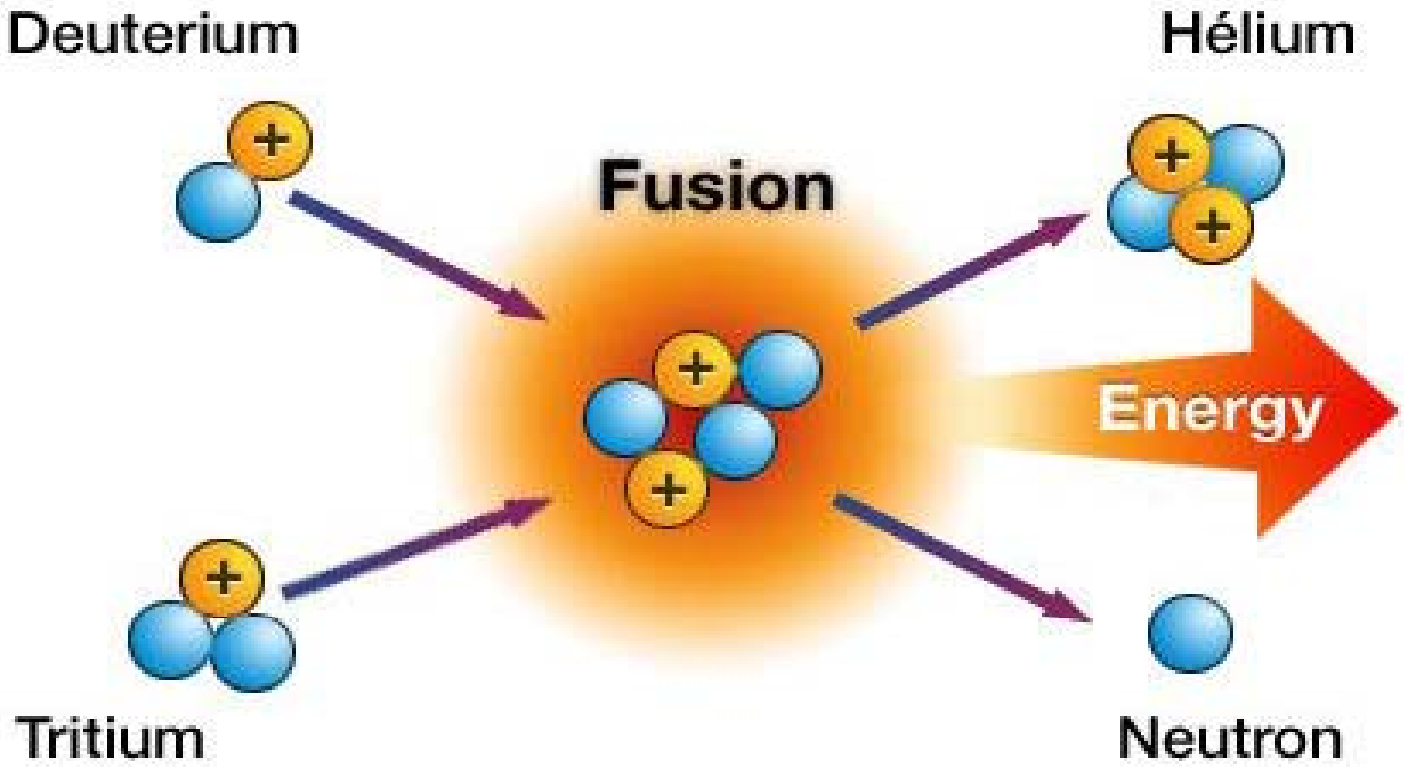
Nuclear Fusion

Fission is the division of one atom into two, and **Fusion** is the combination of two lighter atoms into a larger one

Fusion inside the Sun



Typical Fusion Reaction



Sustainable Chain Reaction

https://www.youtube.com/watch?v=0Tgtv1CAfxI

Schematic Diagram of Nuclear Reactor

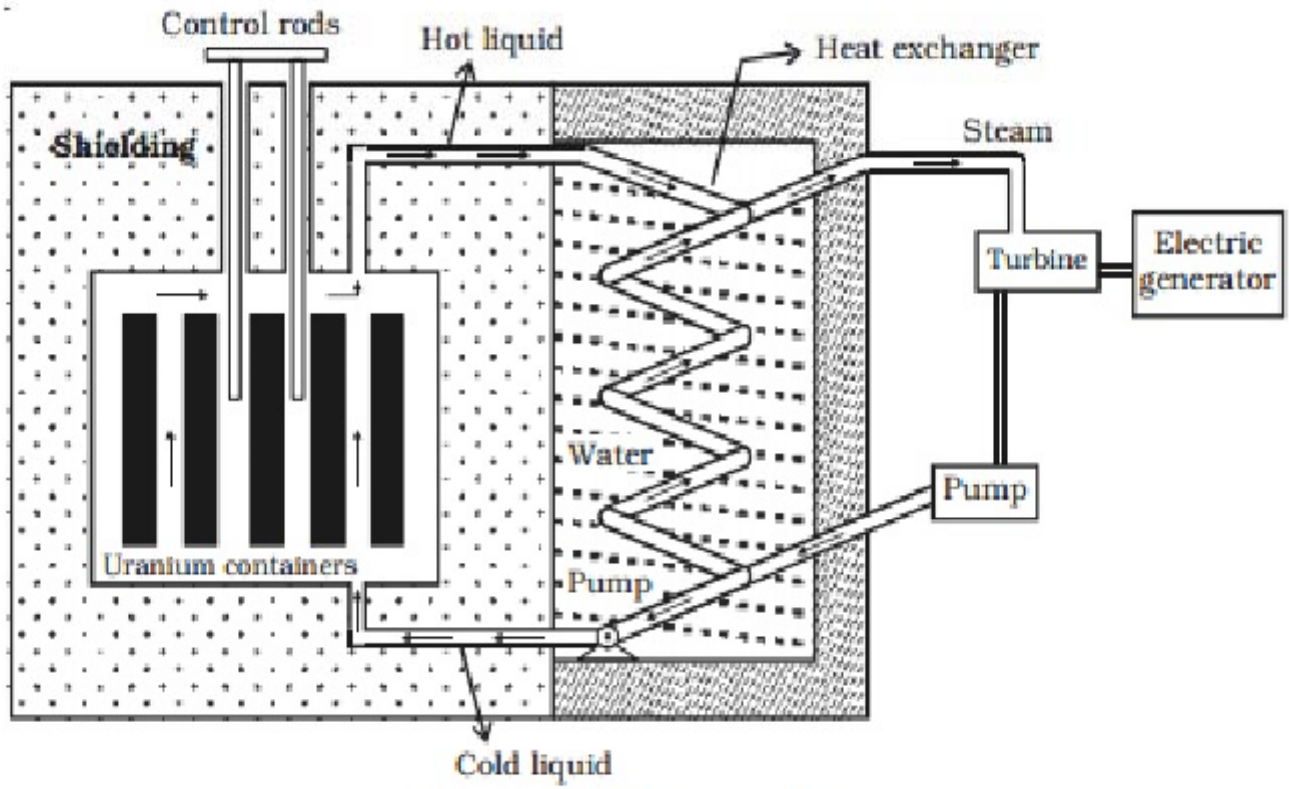


Fig Nuclear reactor

Nuclear Reactors can be broadly divided into two groups

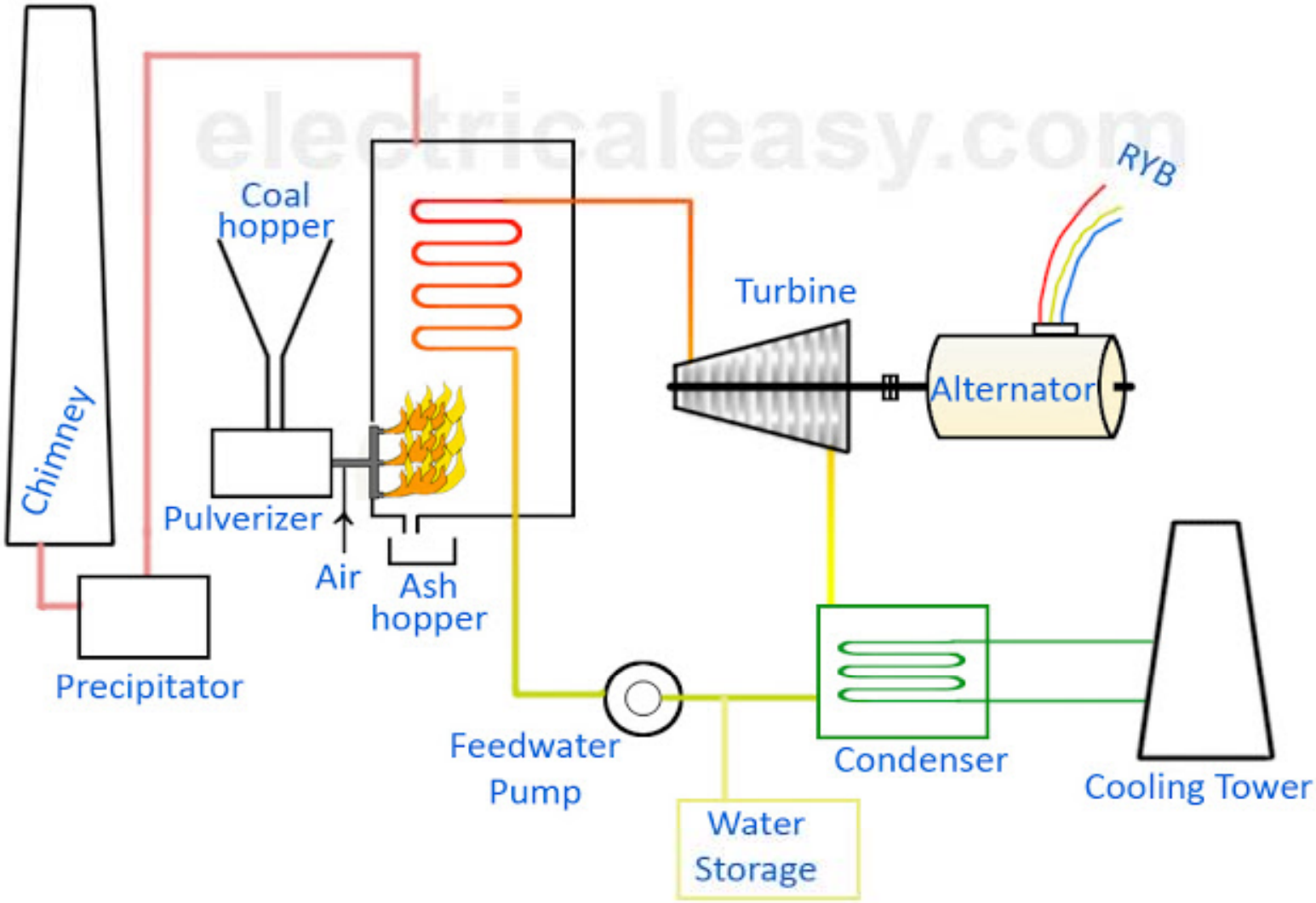
A) Power Reactors

A) Research Reactors

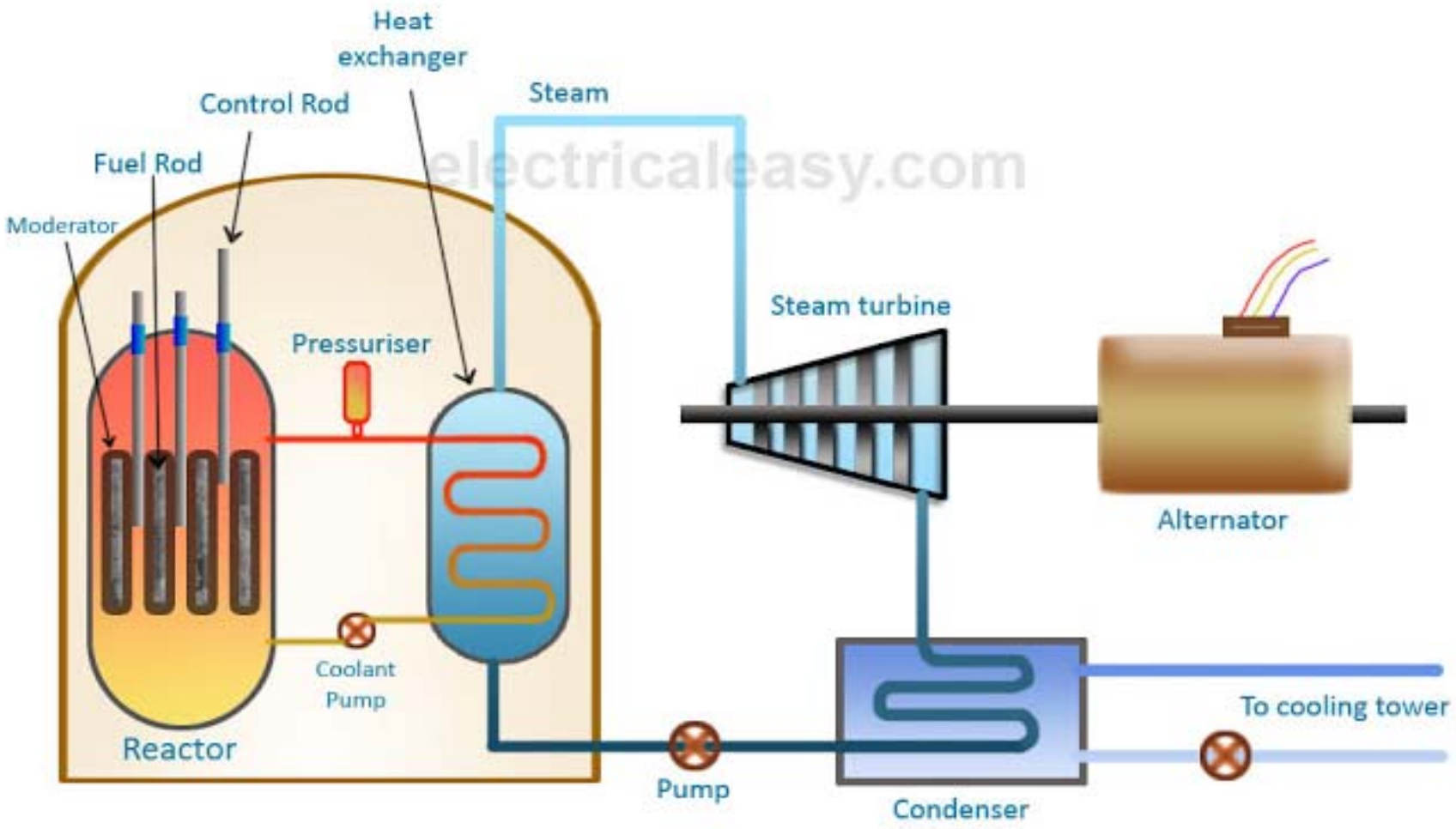
Difference between Power Reactors and Research Reactors

Research reactors are nuclear **reactors** that serve primarily as a neutron source. They are also called non-**power reactors**, in contrast to **power reactors** that are used for electricity production, heat generation, or maritime propulsion.

Layout of Thermal Power Plant

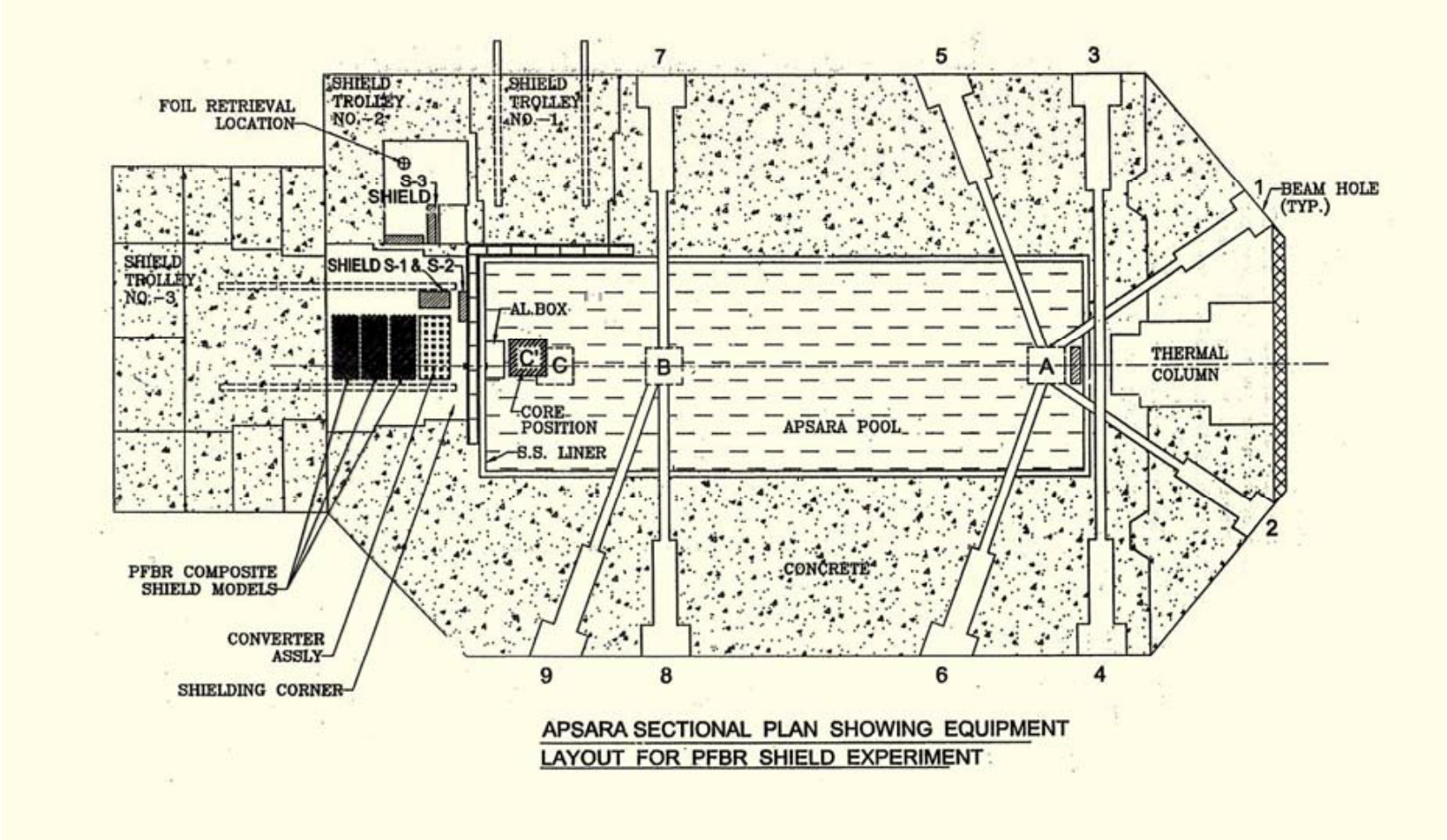


Layout of Nuclear Power Plant



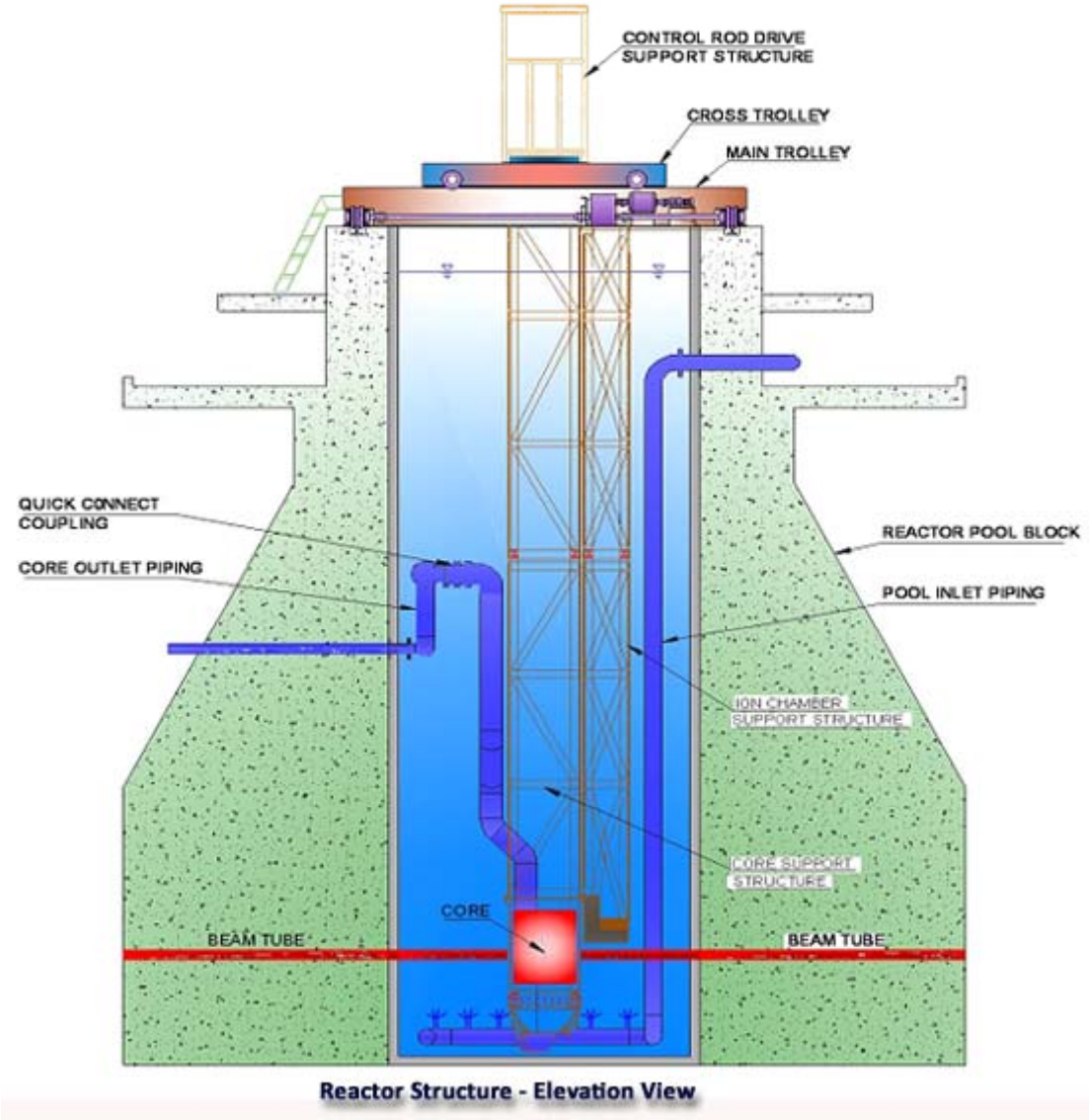
Research Reactors in India

Apsara Reactor

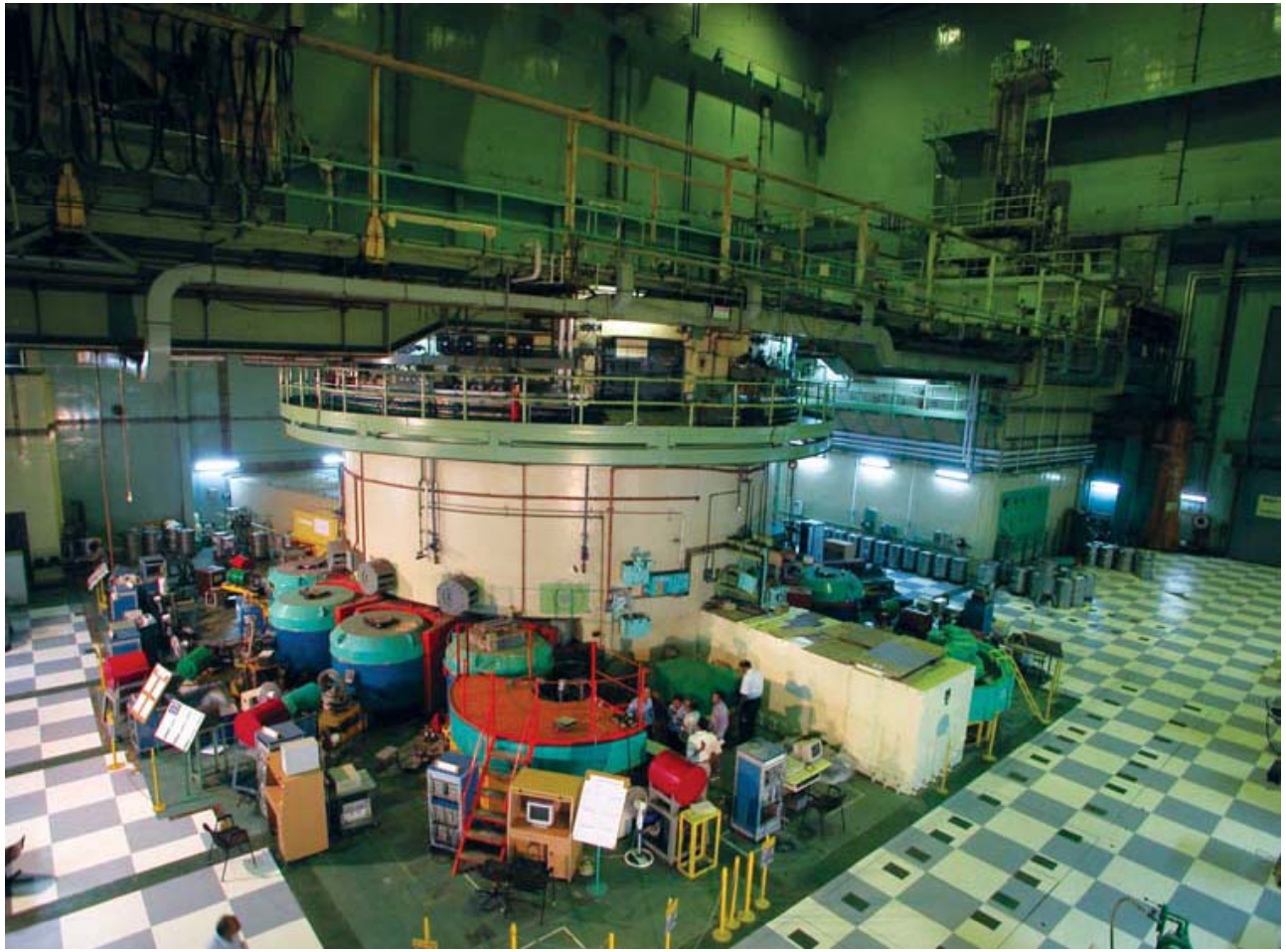


APSARA SECTIONAL PLAN SHOWING EQUIPMENT LAYOUT FOR PFBR SHIELD EXPERIMENT

Apsara Reactor



Research Reactors



Dhruva Reactor

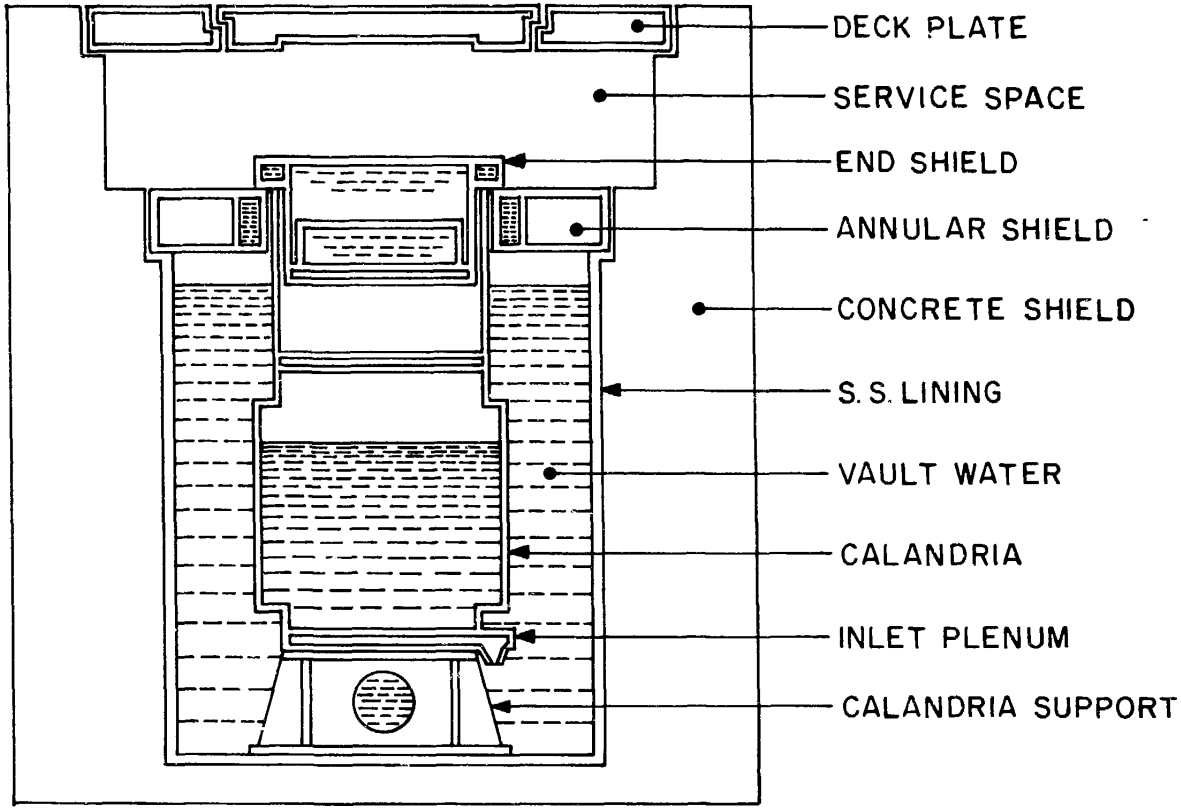
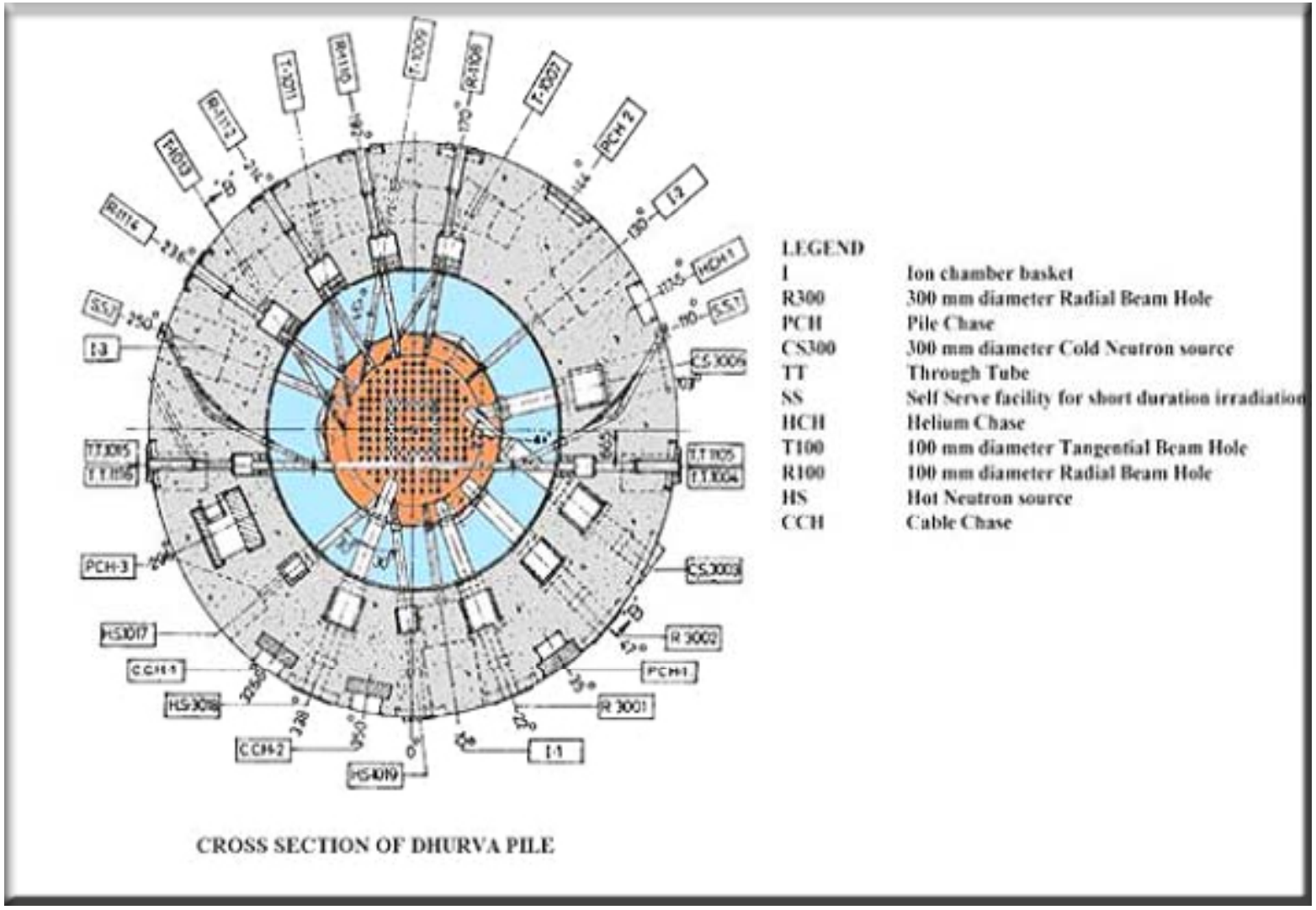


Fig. 2 PILE BLOCK SCHEMATIC

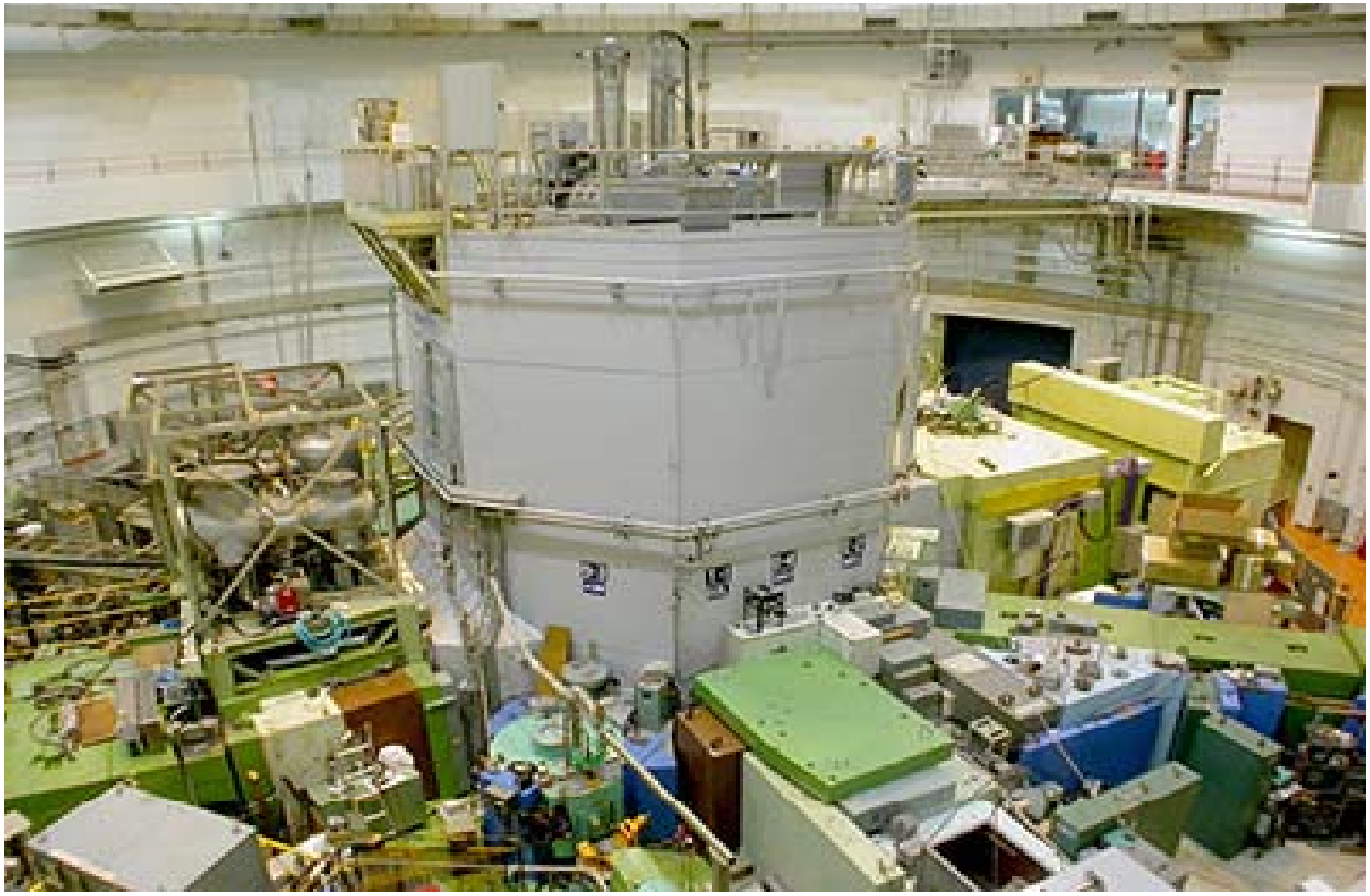
1306

Dhruva Reactor- Top View

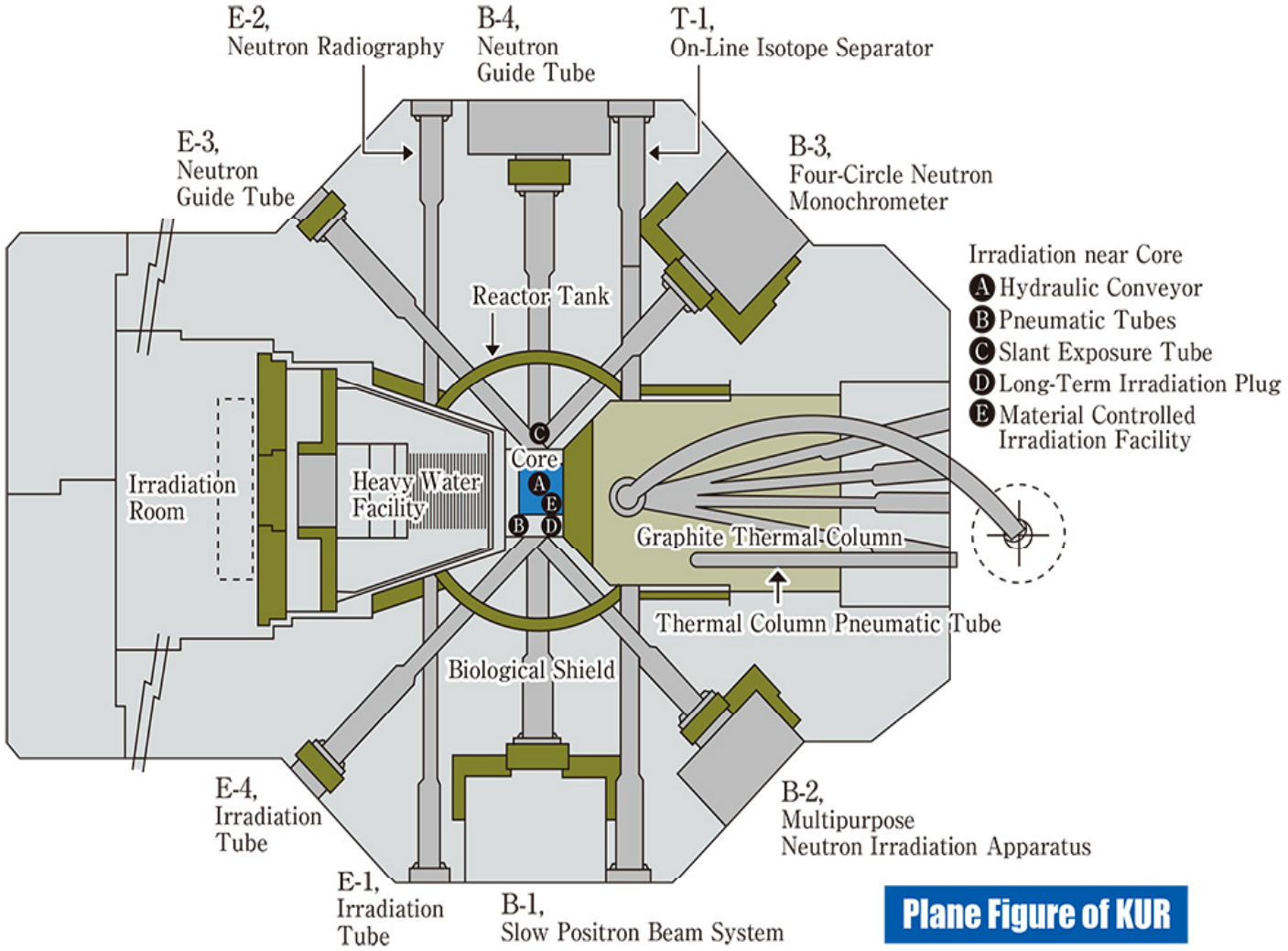


Some Research Reactors in the World

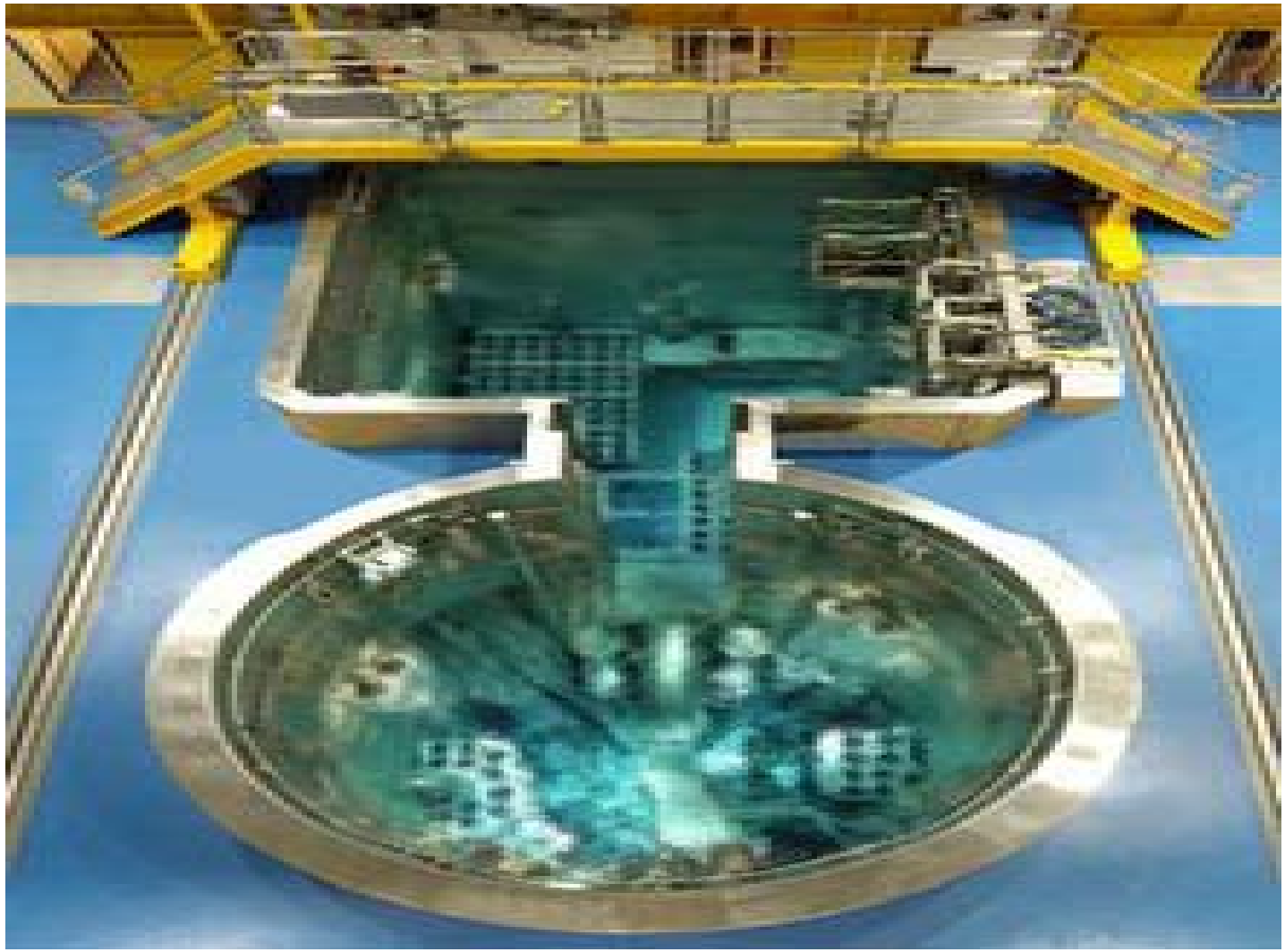
Kyoto University Research Reactor Japan



Facilities in Kyoto Reactor



Open Pool Australian Light Water Reactor



Facilities Available in Dhruva

A) Neutron Scattering Experiments

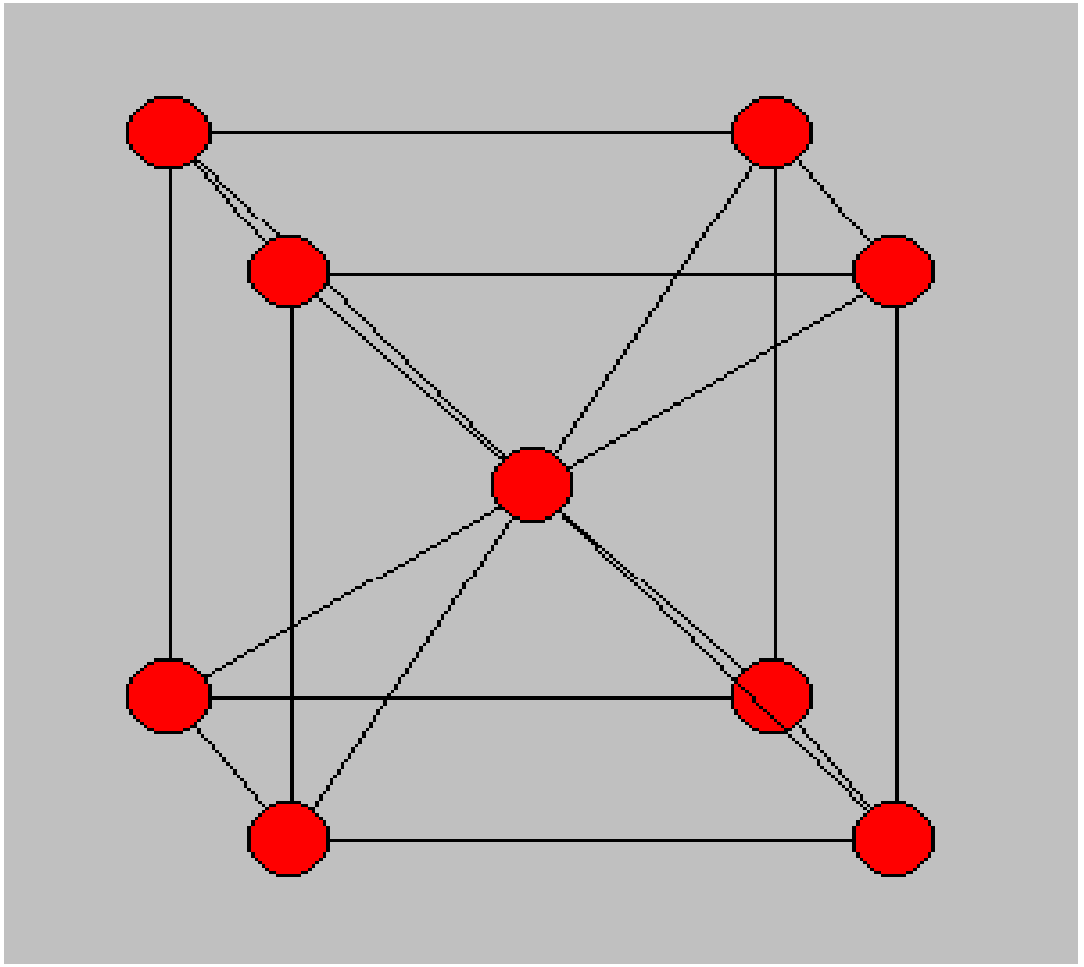
B) Isotope Production Facilities

C) In pile Irradiation Facilities

D) Neutron Activation Facilities

What is Neutron Scattering ?

Scattering is used to determine the positions and motions of atoms in condensed matter



Body Centre Cubic Structure

Neutron beam Experiments Set up inside DHRUVA

Isotope Production Facilities

In Dhruva Reactor Isotopes are produced through in Pile Irradiation Facilities

Irradiations are classified into three main types

A) Long Term Irradiations

B) Medium Term Irradiations

C) Short Term Irradiaons

Long Term Irradiations

The Samples are irradiated for several years

Examples are Cobalt and Irridium

Medium Term Irradiations

In Dhruva these are mainly produced for Medical diagnosis and Treatment and mostly irradiated for three to four days

Examples are Molybdenum based samples which have reasonably short life

Short Term Irradiation Facilities

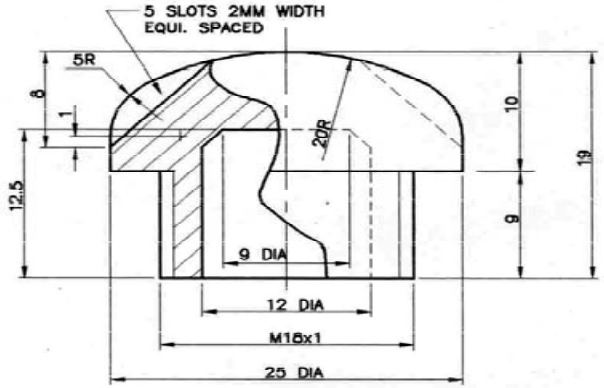
A) Self Serve Facility

B) Pneumatic Carrier Facility

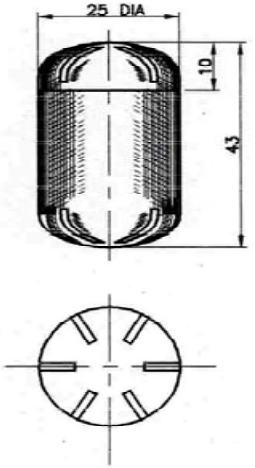
Pneumatic Carrier Facility

Small Capsules carrying Samples are conveyed Pneumatically into the Reactor from a sending station located far away from the Reactor.

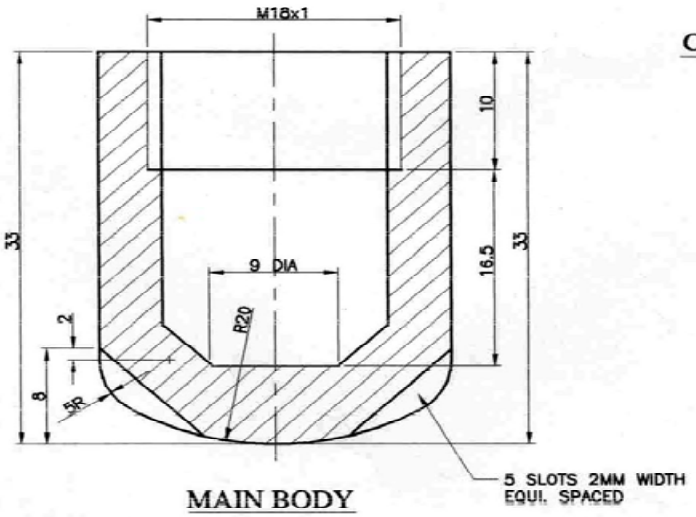
PNEUMATIC CARRIER FACILITY
CAPSULE ASSEMBLY & DETAILS



CAP

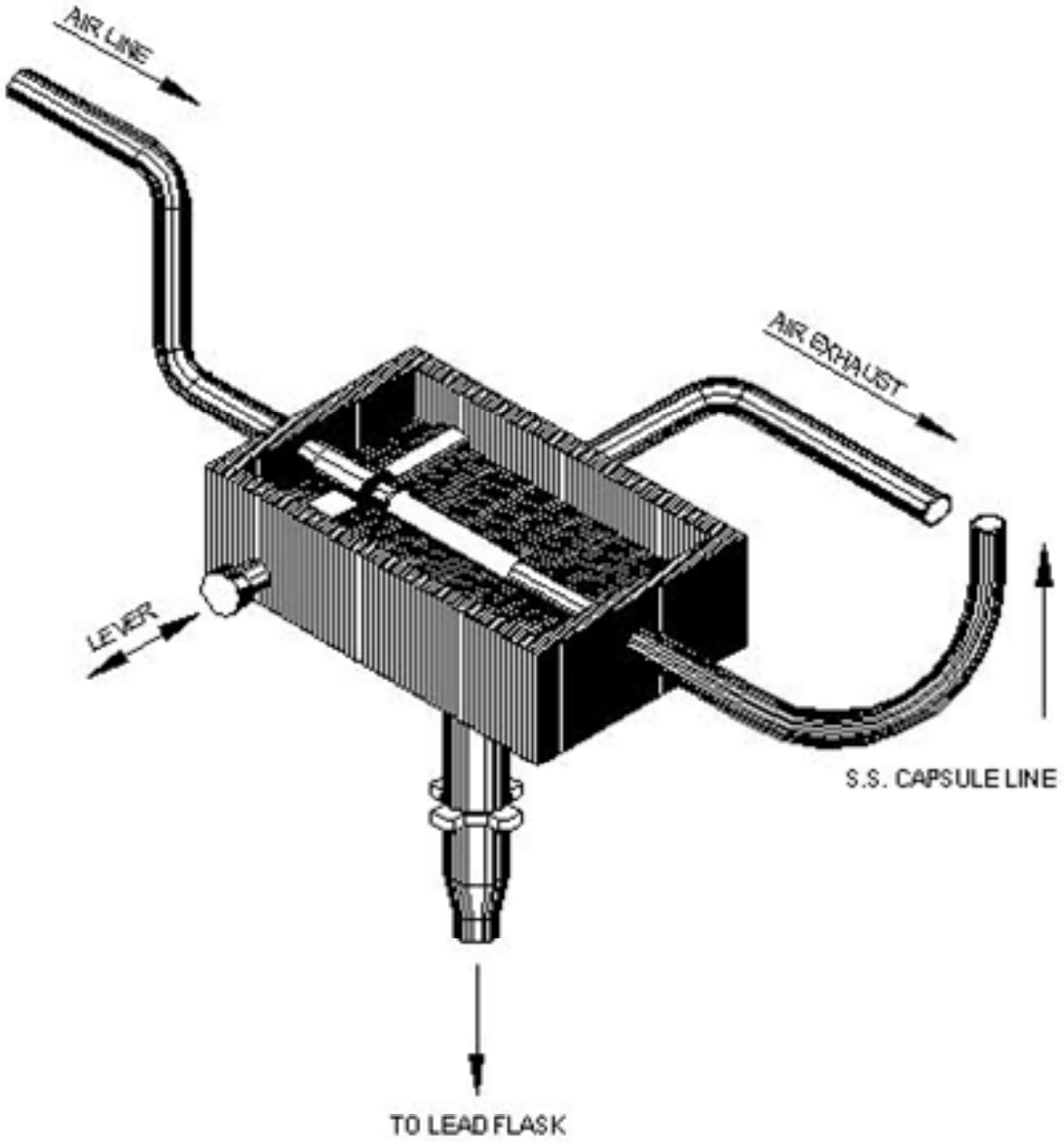


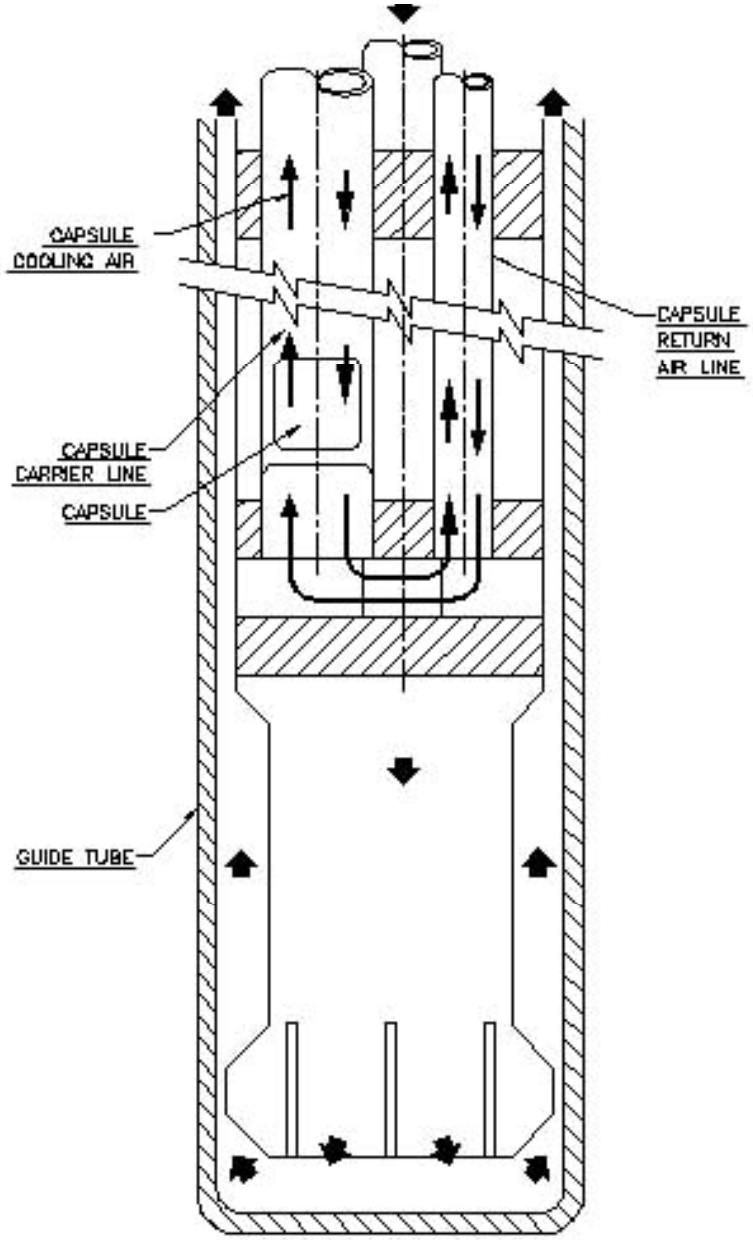
CAPSULE

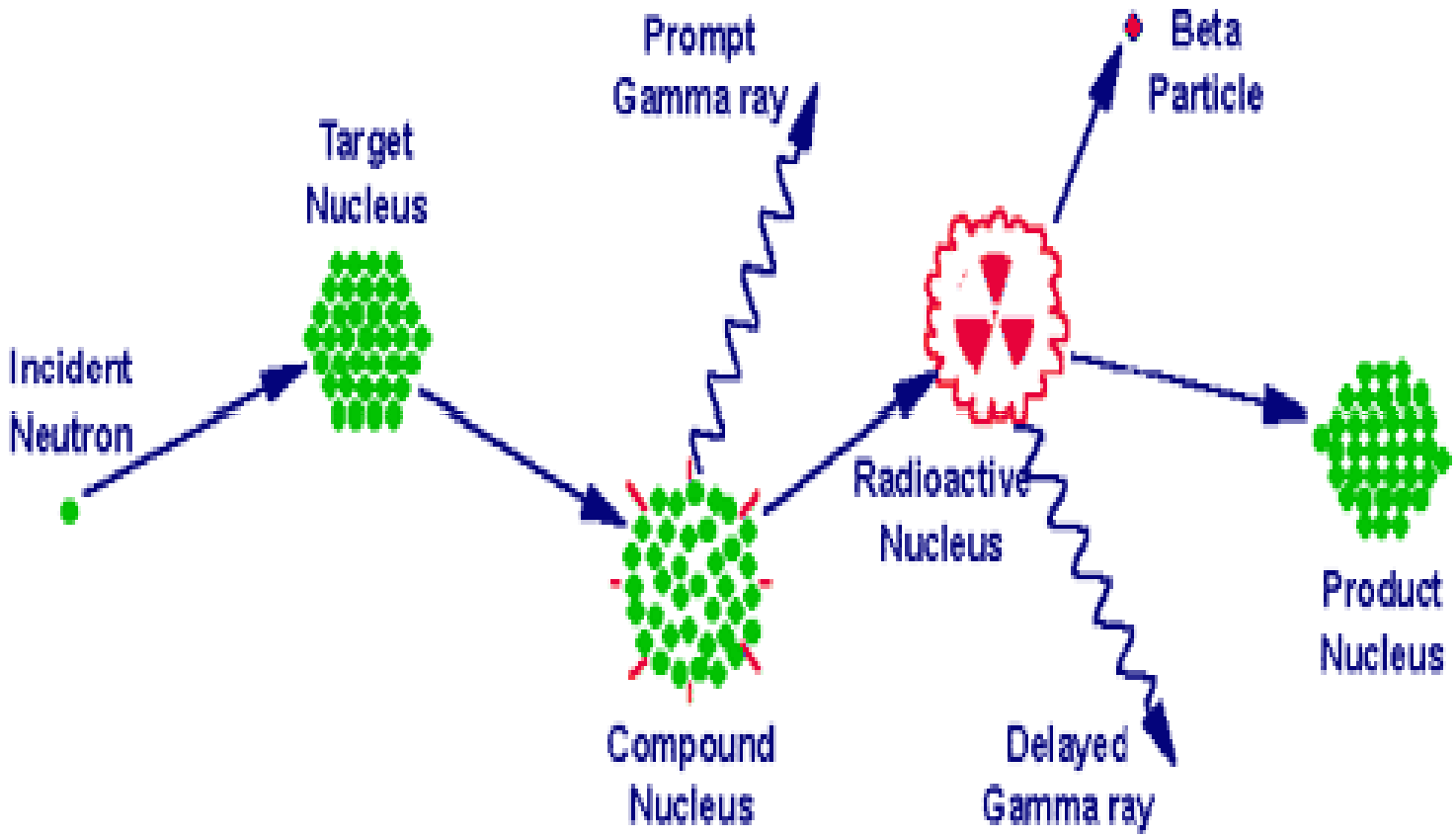


MAIN BODY

NOTE:-
ALL DIMENSIONS ARE IN MM.


AIR LINE
AIR EXHAUST
LEVER
S.S. CAPSULE LINE
TO LEAD FLASK


CAPSULE
COOLING AIR
CAPSULE
RETURN
AIR LINE
CAPSULE
CARRIER LINE
CAPSULE
GUIDE TUBE


Prompt
Gamma ray
Beta
Particle
Target
Nucleus
Incident
Neutron
Radioactive
Nucleus
Product
Nucleus
Compound
Nucleus
Delayed
Gamma ray

THANK YOU