India's 3- stage nuclear programme

India's nuclear power programme has been designed to alternately utilize the vast thorium reserve

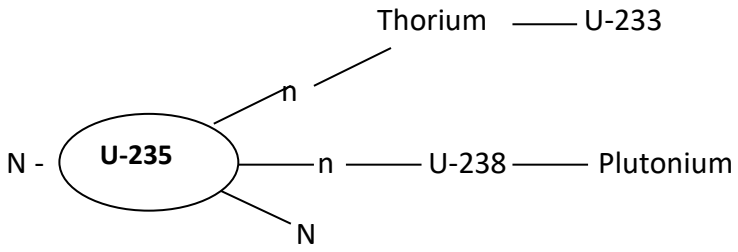
Ist stage

It comprises of Pressurized heavy water reactor (PHWR) and its associated fuel cycle. It uses natural uranium as fuel and heavy water as the moderator and coolant (to remove the heat) .

Reactor is based on be the condition design.

The first stage of nuclear programme is in commercial operation. The beginning reactors were of 220 mw each. New reactors of 540 mw and 700 mw are now being built. Recently GOI has announced setting up of 10 indigenous PHWR of 700 mw each .

The fuel consists of low enriched uranium (5 % U-235 and rest U-238)



All thermal reactors are example of converters. The spent fuel is processed to get plutonian or U-233

2nd Stage Programme

Fast Breeder Reactor (FBR): -It utilizes a mix of Plutonium and U-238 as fuel. It uses plutonium as fuel as well as produces plutonium

The essential different between a converter and a breeder is the breeder produces more fuel the it conserves for running itself

India operated a small test for breeder reactor at Kalpakam for several years. India has now built the first 500 mw prototype fast breeder reactor at Kalpakam. India set up a new company BHAWINI for building the fast breeder reactor .

3 rd Stage Nuclear Power Programme

It is based on (thorium- U-233) cycle. A small thorium based reactor (KAMINI) is being operated at kalpakkam. It is the only reactor which is using U-233 as a fuel.

Bhaba atomic research center BARC is developing AHWR-300 Advanced heavy water reactor-300. It is a 300-mw boiling light water reactor & heavy water moderated reactor .Light water is used as coolant and heavy water as moderator .

AHWR is in designing and experimentation stage. It is expected to be functional in the next one to two decade

Effect of Radiation on human Health

1. Radiation leads to stopping of cell division . Every second 10 million cells are formed which replace the dead cell .
2. It introduces defects in chromosomes. There can breakage and abnormal joining of chromosomes. It can also head to gene mutation Thus it increases the chance of cancer and other genetic disease. It radiation has impaled the sexual organs diseases can be passes on to the child.
3. It can lead to sterility in male this principle is used in making male insect sterile by exposing them to radiations the sterile malls are releases in the general population. When they copulate with the female next generation will not be formed.
4. Strong radiation can kill cell. This principle is used in the radiation therapy of cancer cells Atoms in the service of nation

Application of Nuclear technology for societal development

Nuclear energy enraged in the 20th century. The beginning application was for weapon purpose but in the coming decades multiple civilian Applications developed nuclear energy impacts wide area from agriculture to heath & from industry to environment

Major area of application:-

1. **Power Production:-**

   About 2% of total power generation in India comes from nuclear source, India has a 3-stage nuclear power programme PHWR, Fast breeder reactor and Thorium based

reactor. Second stage has become commercially operational . The third stage is at design stage .

Radioisotopes are supplied by BRIT . India has set up research reactors for supply of radioisotopes .

Agriculture:-

Radio isotope is used to induce mutation in the crop. Beneficial mutant are selected. This process is also called mutation breeding BARC has developed more than 30 varieties of crops using mutation breeding.

Sterile male technique for controlling insect population:- Integrated post management

Food Processing:-

Radiation processing of food items destroys or inactivates organism it therefore extends the shelf life of certain food products.

Low dose of radiation is used for sprout inhibition in onion, potato, ginger, garlic etc.
It is used for insect disinfestations of cereals, pulses, spices.

Radiations processing of certain fruits are the pre condition for expert to certain countries.
Radiations are used for patronization at meat product, first product, chicken products etc.

Radiation processing Equipments are available with agro- exporters

2. ## Health care:-

Iodine -131 is used for diagnosis and treatment of thyroid for diagnosis purpose

"Radio immunoassay " is an important diagnostic tool for accurate measurement of hormones vitamins & other body biological products

Cancer Radio Therapy:There are two types of radiation therapy in cancer.

a) Barchy therapy: Radioisotopes are brought in direct contact the cancer us fescues. It can be in the form of needles, tubes etc. This technical is used for treatment of oral breast uterus and prostate cancer.
b) Tele Therapy: It uses gamma says produced from cobalt – 60 radioisotope in a teletherapy machine

- ISOMED : is being used for radiation sterilization of medical products like syringes, surgical smutches, cotton dressings etc.

3. **Industrial Application:**

Gamma says scanning is an important technique for finding problems in industrials columns and & manufacturing units

- Radio isotopes are used extensively in locating leakage in oil and gas (piping) pipelines
- Radio isotopes can also check the seepage of water form dam and water bodies.
- Radio isotopes are used to study the rate of sedimentation at ports and harrowers.

4. Environmental Application:

Sludge is the solid portion filtered out form sewage . Many municipal corporation have installed sludge treatment plant based on radiation therapy principle. It kills most of the pathogenic micro-organisms and sludge can be used as manure in the agricultural fields .

Civil Nuclear Literality Act:2010 CNLA

India exacted CNLA for finely and proper compensation of the people in event of nuclear disaster. This Act defines the responsibility / liability of different players in the event of nuclear accident.

I. Operator:- The company which is operating the nuclear power plant, NPCIL and BHAVINI are two main operators

II. Suppliers:- The company which has supplied the reactor or other equipments to the operator. Eg. Areva, Westinghouse (US), G.E general electrical BHEL, (L and T) L $ T : Larsen & turbo

III. Affected People:- This act defines nuclear accident and damages

In countries like France & Russia liability of Nuclear power companies are underwritten by their respect respective government . In countries govt. will provide compensation in case of nuclear accident

But in countries like India where don't underwrite the liability of nuclear operator, such an Act will help the company in getting insurance courage. The compensation amount must be decided.

The Atomic Energy based will notify nuclear accident within 15 days of its occurrence.

- Nuclear damage has been defended as:-
    a) Loss of life or injury to person
    b) Loss or damage to the property
    c) Economic loss arising out of damage to the person or property

The liability of nuclear operator has been fixed at Rs. 1500 crore. But the total compensation will not exceed 300 million SDR. The amount above Rs. 1500 will be provided by the central govt.

Section 17 of the Act provider that the operator of the Nuclear plant after paying compensation to the people will have light of recourse against supplier (it has supplied a faulty equipment rector)

- This Act creates two authorities by notification
    a) Claims commissioner: If damage is less
    b) Nuclear damage claims commission if damage is extensive.

Due to section 17 of the Act many foreign companies were reluctant to supply reactors/ equipment to India.

India Nuclear Insurance pool was set up under GIC-RE

Rs. 750 crore was provided by GOI and Rs. 750 crore by the 4- public rector general insurance companies' oriental insurance, New India Assurance United India Insurance.

Under the pool New India assurance issues the policy and also deals with the management of cover to the operator and supplier.

- NPCIL has not got insurance from NIA (New India assurance)