

India's 3 Stage Nuclear Power Program

India's 3 stage Nuclear Power Program was conceived soon after Independence to meet the security and energy demands of Independent India. India's Uranium reserves constituted a very small amount, but India has a very huge amount of thorium reserves. Hence to attain independence in the energy domain it was conceived to develop a 3 stage nuclear power program utilising the abundant thorium reserves.

When was India's 3 stage Nuclear Power Program devised?

India's 3 stage Nuclear Power Program was devised in 1954.

Who devised India's 3 stage Nuclear Power Program?

Homi J Bhabha, the father of India's Nuclear program, devised India's 3 stage Nuclear Power Program.

What was the objective behind formulating the 3 stages Nuclear Power Program?

1. India has only 2% of World's Uranium reserves, on the other hand, India has 25% of the World's Thorium reserves.
2. Since India was not part of some of the International Nuclear treaties, India was prevented from taking part in international trade in the Nuclear field.
3. India has a huge population and growing economy, to meet the energy demands India had to rely heavily on imports of coal, and crude oil.
4. Hence India had to devise methodologies to be self-sufficient in meeting energy demands arising due to a burgeoning population and economy; the 3 stage Nuclear Power Program was one of the answers to it.

How do the 3 stages of the Nuclear Power Program produce energy?

India has approximately 400 thousand tonnes of thorium reserves, close to 25% of Global Thorium reserves. Thorium is not a fissile material, but it can be converted into Uranium - 233, which can then undergo fission to produce energy.

What are the 3 different stages in the Nuclear Power Program?

The nuclear reactors used in different stages are different and the byproducts of one stage will be used in succeeding stages.

Below table gives details on different stages and the process involved in those stages

Stages	Process
Stage 1	<ol style="list-style-type: none"> 1. Use natural Uranium to fuel a Pressurized Heavy Water Reactor (PHWR). 2. The byproduct, Plutonium (Pu) - 239 is used in Stage 2.
Stage 2	<ol style="list-style-type: none"> 1. Develop Fast Breeder Reactor (FBR) to produce excess, Pu-239, which will then lead to the conversion of Thorium (Th - 232) to fissile Uranium U-233.
Stage 3	<ol style="list-style-type: none"> 1. Develop Breeder Reactors, these are Thorium based Nuclear reactors.

3 stages of the Nuclear Power Program - Challenges

1. Technical challenges involved in building Fast Breeder Reactors.
2. Technical challenges involved in building Thorium based Reactors.

Location of Nuclear Reactors in India

The below table gives a list of the locations of nuclear reactors in India

State	Location
Rajasthan	Rawatbhata
Tamil Nadu	Kudankulam Kalpakkam
Gujarat	Kakrapar
Uttar Pradesh	Narora
Karnataka	Kaiga
Maharashtra	Tarapur

Is it safe to build Nuclear Power Plants in India?

It is absolutely safe to build the Nuclear Power plants, as they have a very high safety record. Barring three accidents, Three Mile Island (TMI) in the USA, Chernobyl in Russia, and Fukushima in Japan, there have been no accidents.

1. All the safety features worked in the TMI case and there was no leakage of radiation.
2. In Russia, the accident was due to human error and for not following safety protocols.
3. Moreover, Graphite was used as a moderator in the Chernobyl reactor. Graphite is a form of carbon and its combustible property led to explosion in the reactor core. Such a scenario is ruled out in Indian reactors as the core is cooled and moderated by heavy water reactors.
4. Fukushima, Japan kind of scenario is ruled out as Indian reactors are not in a Geologically high seismic zone, they are built at a height which cannot be affected by any Tsunami waves.